AMENDMENT TO

METAL MINING

AND

TOURIST ERA RESOURCES

OF

BOULDER COUNTY

MULTIPLE PROPERTY LISTING

United States Department of the Interior
National Park Service

National Register of Historic Places
Multiple Property Documentation Form

This form is used for documenting multiple property groups relating to one or several historic contexts. See instructions in *How to Complete the Multiple Property Documentation Form* (National Register Bulletin 10-900-a). Use a typewriter, word processor, or computer to complete all items.

___ New Submission _XX_ Amended Submission

SECTION A: NAME OF MULTIPLE PROPERTY LISTING

Amendment to Metal Mining and Tourist Era Resources of Boulder County Multiple Property Listing

SECTION B: ASSOCIATED HISTORIC CONTEXTS

(name each associated historic context, identifying theme, geographical area, and chronological period)

Metal Mining and Tourist Era Resources of Boulder County Multiple Property Listing

SECTION C: FORM PREPARED BY

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SECTION D: CERTIFICATION

As the designated authority under the National Historic Preservation Act of 1966, I hereby certify that this documentation form meets the National Register documentation standards and sets forth requirements for listing of related properties consistent with the National Register criteria. This submission meets the procedural and professional requirements set forth in CFR Part 60 and the Secretary of the Interior's Standards and Guidelines for Archaeology and Historic Preservation.
(see continuation sheet for additional comments [ ])

State Historic Preservation Officer
Signature and title of certifying official date

State Historic Preservation Office, Colorado Historical Society
State or Federal agency and bureau

I hereby certify that this multiple property documentation form has been approved as a basis for evaluating related properties for listing in the National Register.

Signature of the Keeper date of action

Table of Contents for Written Narrative

Provide the following information on continuation sheets. Cite the letter and title before each section of the narrative. Assign page numbers according to the instructions for continuation sheet in *How to Complete the Multiple Property Documentation Form* (National Register Bulletin 16B). Fill in page numbers for each section in the space below.

Section E: Statement of Historic Contexts

E.1: INTRODUCTION

In terms of mining history, Boulder County ranks among the most important regions in the entire Rocky Mountain West. Boulder County not only possessed mineral wealth in an array of forms, but also the county was home to many important events. For example, in the spring of 1859, Gold Hill became center to the first popular gold rush west of the Rocky Mountain piedmont area. In association with this, Gold Hill pioneers established the first formal mining district, developed the earliest hardrock mine, and set up the first mechanized ore treatment mill in Colorado and probably the greater Rocky Mountain chain. One of Colorado's earliest and most important silver rushes materialized at Caribou in 1869, and it laid groundwork for silver mining and metallurgy elsewhere in the state. In 1872, prospectors working at Gold Hill discovered the first economical telluride gold deposits in the nation, which became well-known and interested some of the most prominent geologists of the era. In trying to win gold from the telluride veins, the county's mining industry laid the groundwork for a variety of important technological advancements. Boulder County was also the scene of the earliest tungsten mining in the nation and produced most of the world's supply through World War I. Because tungsten ore was relatively rare as of the 1900s and 1910s, few precedents existed for its production and treatment, and the county served as a proving ground where effective milling methods were pioneered. On a state-wide level, Boulder County rose to prominence during both world wars as an important source of fluorspar, which was in high demand as a flux for smelting steel and metal ores. As Colorado's most significant fluorspar producer, the county played a significant but quiet role in the success of Colorado Fuel & Iron's steel mill at Pueblo.

Currently, a legacy of historic resources represents Boulder County's fascinating and important placer- and hardrock mining industry. After abandonment, many of the prospects, mines, and mills fell to the pressures of residential development, scavenging, environmental projects, and especially natural decay, leaving a number of sites in various states of preservation. While some of the important mines, mills, and towns are well-known and recognized, forgotten resources are constantly being rediscovered through land use projects, historic preservation and heritage tourism efforts, environmental cleanup, and greater attention to local and Federal public lands.

For these reasons, Boulder County Parks and Open Space realized that a Multiple Property Documentation Form focused on the county's rich mining heritage was a needed and timely contribution. Little contextual work has been completed as of 2006 in regards to the county's mining history and remaining resources. The first comprehensive work was a county-wide survey of principal historic sites launched by Boulder County's Historic Preservation Advisory Board in the late 1970s. Robert D. Rosenberg began the project and in the early 1980s Manuel Weiss completed the survey, which included many mining-related sites. Rosenberg and Weiss conducted cursory archival research, examined and photographed various properties, and completed forms compiled as the *Boulder County Historic Sites Survey*.[1] Rosenberg's and Weiss' survey left several broad data gaps. First, they limited their survey primarily to sites with standing structures, leaving sites with archaeological and engineering features undocumented. Second, Rosenberg and Weiss did not delve into the subject of evaluating the significance of potentially important resources.

The second comprehensive work was published in 1989 as the *Metal Mining and Tourist Era Resources of Boulder County*. The document should be lauded as the first attempt at a Multiple Property Documentation Form in the county, but it treated the complex mining history in a cursory manner and lacked accurate Periods of Significance. In addition, the document provided guidance for recognizing and evaluating the significance of only residential and commercial architectural resources. Absent were discussions of archaeological, engineering, and architectural features at prospecting, mining, and milling resources.

In 2002, Historic Boulder commissioned the third comprehensive work regarding the county's mining resources, which was a reconnaissance survey focused exclusively on mining and milling resources. The survey report provided a comprehensive history of placer- and hardrock mining in the county and survey results by mining district. The project did not include formally registering any resources with the Office of Archeology and Historic Preservation, but it did specify evaluating the potential significance of sites with archaeological, engineering, or architectural integrity. In conjunction with this, the report became the first document to suggest arenas of significance for the county's potentially eligible mining and milling resources. The survey report contains a few errors such as several misidentified mines, incomplete discussion of important historical events, and ambiguous dates.

While the above projects were certainly important, they were not designed to provide broad guidance for the identification, interpretation, and evaluation of Boulder County's mining resources. The 2007 Placer and Hardrock Mining Multiple Property Documentation Form commissioned by Boulder County Parks and Open Space attempts to fill this need. The document contains an abundance of information that has been formatted for an understanding of the common types of mining-related resources that may be encountered in the mountainous portion of the county.

Section E provides descriptions of the county's geography, its mining districts, and the technology commonly employed for prospecting, mining, and milling in the county. This information is important for a better understanding of the county's mining history and to help interpret mining resources in the field.

Section E also details the county's mining history, which has been divided among its ten principal mining districts. The county was so divided for several reasons. First, while mining was certainly a county-wide phenomenon, the county's mining industry was far from uniform in time, place, and ore type. Each individual district had its own distinct sets of events, trends, people, organizations, and places of importance. The timeframes that were important, known as Periods of Significance, were often isolated to specific mining districts, and in many cases, the Periods of Significance for one mining district had little to do with those in another district. In

[1] Available at Boulder's Carnegie Library and at Boulder County Parks and Open Space offices.

addition, the type of ore mined in a given district greatly influenced the Periods of Significance, and many types of ore were found only within specific districts. For example, fluorspar was mined only in the Central district and it was important primarily during both world wars, which were Periods of Significance for fluorspar mining. Given this, the events, trends, people, and associations of importance to fluorspar mining cannot be applied to the county's other districts because they lacked fluorspar deposits. Further, most of the county's other districts were in decline when fluorspar mining boomed in the Central district. As another example, silver was discovered at Caribou in 1869, which incited a rush. Because prospectors only found silver in the Caribou area, the rush did not extend to the county's other districts. Thus the Period of Significance for the Caribou rush is limited to the Caribou-Grand Island district and cannot be applied to the county's other districts, which were relatively quiet at that time.

The second reason for dividing the county into its mining districts is based on the types of projects that involve historic resources. Most projects tend to focus on individual- and groups of historic resources within specific mining districts, instead of on a county-wide basis. Therefore, it is easier to assess the importance of a historic resource when perceived in the context of the events, trends, people, organizations, and Periods of Significance that were significant to the host mining district.

E 2: THE PHYSICAL ENVIRONMENT OF BOULDER COUNTY

Boulder County, located in north-central Colorado, consists of approximately 753 square miles with two very distinct landscapes. The plains, around 5,200 feet in elevation, occupy the eastern half of the county, and they abruptly give way to the Rocky Mountains, which constitutes the county's rough, western half. The mountains ascend westerly in the form of hills and elevated, geomorphic benches that are heavily dissected by permanent- and intermittent streams. Broad areas of gently sloped topography represent the benches, and they rise in an almost stairstep fashion to the west. The first bench crests between approximately 7,000 and 7,500 feet in elevation, and the second extends several miles to the west and lies between around 8,200 and 8,500 feet in elevation. The third lies at around 9,000 feet and forms a skirt abutting a series of imposing mountains known as the Indian Peaks, which are the Continental Divide. Originally known as the Snowy Range, the Indian Peaks culminate in a north-south alignment of glaciated mountains ranging from 10,500 to over 14,000 feet in elevation. The range, which also serves as Boulder County's western boundary, abruptly drops off west into Winter- and North Park basins.

Four principal waterways drain the mountainous portion of the county, and they all flow easterly. South St. Vrain Creek drains the north portion of the mountains and opens onto the plains at the town of Lyons. Left Hand Creek drains the central portion of the mountains and empties onto the plains at the settlement of Altona. Several historically important tributaries descend into Left Hand Canyon, including James Creek, Spring Gulch, and Indiana Gulch on the north side, and Lick Skillet Gulch on the south side. Boulder Creek flows through the south-central portion of the mountains and opens onto the plains at the town of Boulder. Important tributaries include Four Mile Canyon, Bummers Gulch, and North Boulder Creek on the north, and Keystone Gulch on the south. South Boulder Creek drains the county's southern portion and ascends southwest into Gilpin County, and Beaver Creek was the most important tributary on the north side. Of note, the middle and north forks of Boulder Creek and Beaver Creek all pass through the natural bench located at the toe of the Indian Peaks, where the town of Nederland lies.

Despite draining broad areas, none of the above creeks carry much water. During spring runoff, they can flow with volumes of up to around 1,500 cubic-feet-per-second, but the creeks slow to a trickle during fall and winter. A dendritic system of tributaries, governed by geology and topography, feed these creeks, and most are intermittent.

As can be surmised from the creeks' relatively low flow, the climate is dry. Fall is traditionally arid and usually offers abundant sunshine, warm days, and cool nights. During the day, the hills can see temperatures ranging from the 50s to 70s (Fahrenheit) and the high mountains are often 10 degrees cooler. At night, the temperatures are relatively moderate and drop into the 20s. During late fall the weather pattern changes as east-bound Pacific storms bring winds, hurricane-force at times, but little moisture as the storms drop their precipitation in Colorado's western mountains. As fall progresses into winter and temperatures drop, the Pacific storms carry snow into Boulder County with the greatest accumulations naturally at high altitudes. In the mountains, temperatures during the day can plummet to between 10 and 20 degrees Fahrenheit, with the hills being slightly warmer. As the storms pass and sunlight returns, snow in the hills and on the plains often melts, and the dry climate causes the moisture to evaporate rapidly. The middle of winter, January to February, usually sees a series of short, extremely cold but dry fronts that creep south. Because cold air tends to be heavy, the conditions linger longer in the low hills and on the plains than at high altitudes. Spring conditions continue to usher in occasionally powerful Pacific fronts as well as warm, wet storms from the east known as upslope fronts. While upslope fronts deliver snow, the temperatures tend to remain in the 20s and 30s and often do not penetrate the high mountains because they consist of heavy air. With spring, spanning April to May, comes snowmelt and a decrease in storms. Summer lasts from June to September, and except for thunderstorms, is usually dry.

The climate, weather, and ranges of altitude in the county created environments for four general ecosystems. The plains ecosystem rises up from the plains to around 6,000 feet in elevation and offers grasslands broken by riparian habitat. Scrublands, which feature a combination of various types of brush, grasses, and evergreen trees such as ponderosa and pinion pines, and plains juniper, form a buffer between the plains ecosystem and that of the foothills. Ranging from around 5,700 to 8,200 feet in elevation, the foothills ecosystem offers grasses, brush, pines, occasional plains junipers, and fir trees. North-facing slopes usually feature forests with some groundcover and south-facing slopes are broken by stands of brush and open meadow. The montane ecosystem, between around 8,000 and 9,500 feet, is characterized by a transition from pines to fir and spruce trees. These altitudes, combined with the Front Range's dry climate and sandy soils, provide ideal conditions for bristlecone pines, which are rare in general and can be as old as 3,000 years. In the montane ecosystem, north-facing slopes feature fir forests with little groundcover, while south- and east-facing slopes are vegetated with lodgepole pine forests interspersed with open meadow fringed by brush. The subalpine ecosystem begins around 9,200 feet elevation and thins at treeline, which is usually around 11,400 feet elevation. Pines become rare at these altitudes, and fir and spruce dominate. Aspen trees grow in both the montane and subalpine ecosystems and thrive in areas of disturbance, especially those created by logging and mining. The riparian habitat changes with altitude and consists primarily of forbes and arctic willows above 8,500 feet elevation, and features forbes, some willows, and deciduous trees such as alder and willows at lower elevations. The alpine ecosystem lies above treeline and is characterized by alpine tundra growing in areas of soil, which are patchy in Boulder County's high altitudes.

E 3: THE GEOGRAPHY OF BOULDER COUNTY'S MINING DISTRICTS

In general, prospectors across the West organized mining districts as primitive forms of frontier government primarily to govern claim activity and some behaviors of mining industry participants. A mining district was a geographic entity whose boundaries were usually drawn around concentrations of mineral claims. When prospecting and mining spilled outside of the established district, the boundaries were usually amended to take in the additional activity. In a mining district, an elected board drew up regulations that defined the types of claims, claim sizes, the requirements to maintain title, rights for infrastructure and engineering projects, and the discovery rights for placer- and hardrock deposits. The board also kept records, defined laws that governed behavior especially regarding claims, and enforced law and order. With the rise of effective county governments, records-keeping and knowledge of mining district regulations fell onto the Clerk and Recorder, while the sheriff administered to law enforcement. Mining districts, however, continued to be recognized, and Boulder County was no exception.

Between 1859 and 1864, the prospectors who searched Boulder County for gold established nine formally organized mining districts in the mountains. The original nine, discussed in detail below, are: Gold Hill, Boulder, Ward, Sugar Loaf, Gold Lake, Grand Island, Snowy Range, Utilla, and Bald Mountain. After 1864, local mining interests expanded, changed, and renamed some of these districts over time, and as a result, their current boundaries remain nebulous. When working with today's historic mining resources, it seems most effective to perceive them in terms of the adjusted boundaries, which have been estimated for the discussions below.

Archival sources recognize a few additional districts, and several were formally organized during the 1870s while the rest were by popular name only. The formally organized districts were Magnolia, Sunshine, and Allen's Park, and the rest were merely centers of mining activity actually located within the formally established districts. Three of these informal districts stand out, and they are the Caribou-Grand Island district, the Eldora-Grand Island district, and the Boulder County Tungsten district, which are discussed below. It should be noted that because the histories of some of the lesser formal mining districts were brief, they do not figure prominently in the MPDF.

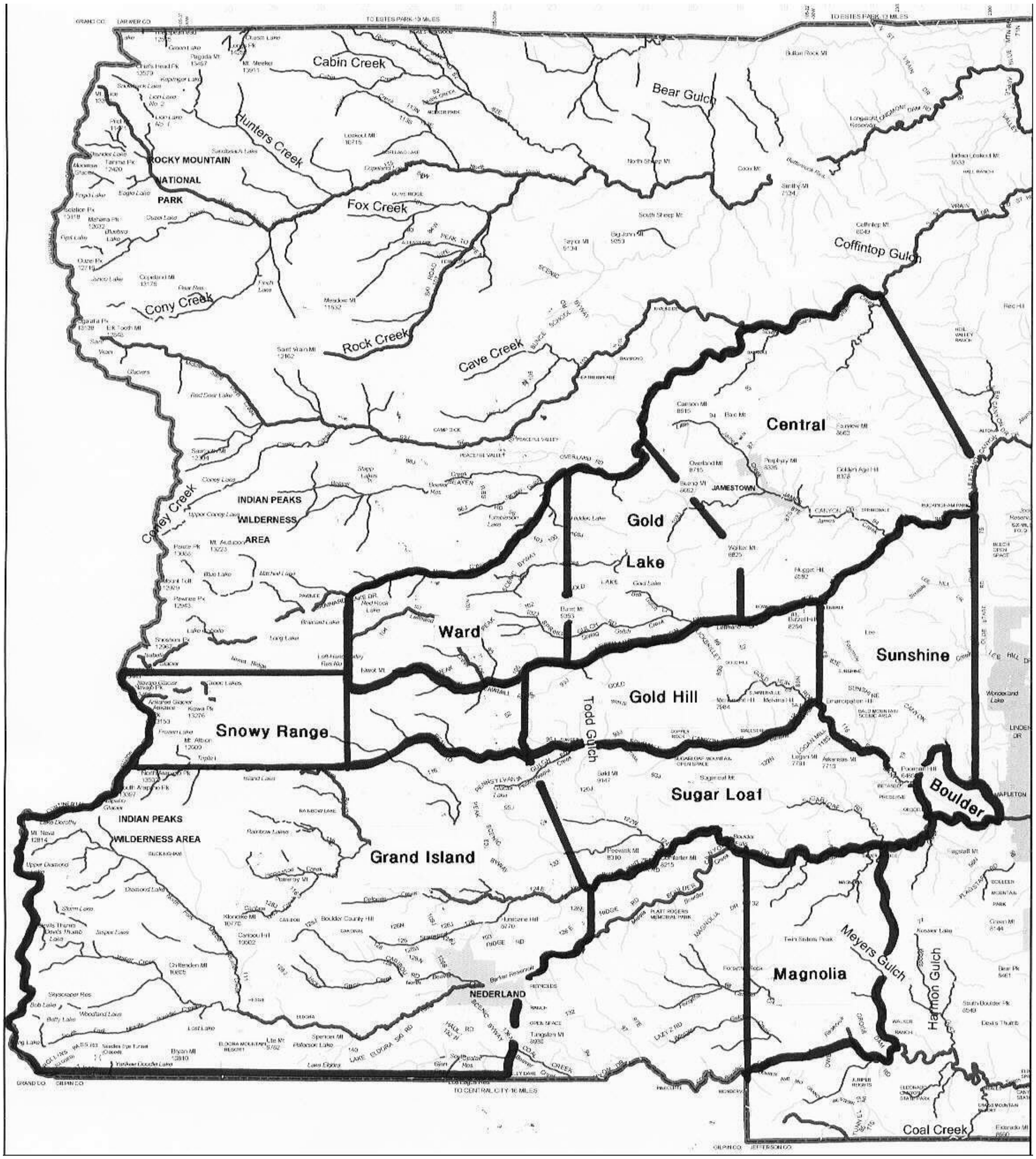

Figure E 3.1. The map illustrates Boulder County's mountainous western portion and the principal mining districts. The boundaries are approximate, and the City of Boulder is on the right edge. Base map provided by Boulder County Land Use Department.

E.3.1: Gold Hill Mining District

On March 7, 1859, prospectors organized Mountain District No.1 as Colorado's first mining district to administer to the placer gold strikes at Gold Hill. During the spring and early summer, a rush developed, and the volume of activity combined with the discovery of hardrock veins exceeded the boundaries and regulations originally established for Mountain District No.1. In response, miners met on June 23, 1859, and reorganized the entity as the Gold Hill Mining District with boundaries defined as a four mile square centered approximately on the west summit of Gold Hill.[2]

The creation of neighboring mining districts and the discovery of rich deposits to the east and west during the 1870s rendered some of the original boundaries obsolete. Over time, the district was expanded and new boundaries appear to have been popularly recognized but not necessarily formally defined. In terms of the MPDF, the popular boundaries are probably best when considering associated historic resources. Left Hand Creek served as the northern boundary, Butzel Hill marked the eastern boundary, Four Mile Creek formed the south boundary, and the ridge between Four Mile and Pennsylvania gulches was the west boundary. This ridge was located around one-half mile west of Sunset and originally lay in the Bald Mountain Mining District.

E.3.2: Boulder Mining District

On July 30, 1859, placer miners working around the confluence of Boulder and Four Mile creeks established the Boulder Mining District. Archival sources fail to clearly define the district's boundaries and instead note that the district was centered on Poorman Hill and extended around one mile south to the confluence.[3] Assuming that prospectors created the district to take in early placer workings, it seems likely that the northwest boundary lay along Dry Gulch on Poorman Hill's north side, Sunshine Canyon served as the northeast boundary, Boulder Creek was the south boundary, and Four Mile Creek acted as the west boundary. While the district was important during Boulder County's first years of placer mining, it offered relatively few hardrock deposits of significance, and as a result, the district is not discussed in detail in the county's mining history. By the 1910s, some references referred to the Boulder County Tungsten district, located to the southwest, as the Boulder Mining District.

E.3.3: Ward Mining District

Shortly after the strike at Gold Hill prospectors discovered placer gold near the headwaters of Left Hand Creek then found hardrock ore within several more months. In

[2] Fritz, 1933:21, 38.
[3] Fritz, 1933:21, 38.

response, they organized the Ward Mining District on September 12, 1860 around a growing cluster of placer claims at the confluence of Left Hand Canyon and Indiana Gulch. Originally, the district was four miles north-south and around four miles east-west, and these boundaries changed little over time. In terms of geographic names, South St. Vrain Creek approximated the north boundary, the west base of Burnt Mountain marked the east boundary, the upper reaches of Four Mile Creek was the south boundary, and the west boundary crossed Niwot Mountain's east flank.[4]

E.3.4: Sugar Loaf Mining District

When prospectors fanned out from Gold Hill in search of fresh placer deposits, they found gold in the principal drainages that radiated off Sugar Loaf Mountain, which is one of Boulder County's most prominent landmarks. On November 9, 1860, the prospectors organized the Sugar Loaf Mining District to bring order to the discoveries, and the wealth-seekers established generous boundaries. The east-west section of Four Mile Creek was the north boundary, the northwest-southeast segment of Four Mile Creek served as the east boundary, Boulder Creek acted as the south boundary, North Boulder Creek was the southwest boundary, and Bald Mountain marked the west boundary.[5]

In essence, the Sugar Loaf district was surrounded by three other districts, including Gold Hill to the north, Boulder to the east, and Bald Mountain and Grand Island districts (discussed below) to the west. Over time, the Sugar Loaf district's west boundary was adjusted westward beyond Bear Gulch, subsuming portions of the Bald Mountain and Grand Island districts.

E.3.5: Gold Lake Mining District

On February 26, 1861, prospectors organized the Gold Lake Mining District to administer to their discoveries of placer gold on the upper reaches of James Creek and in the tributaries that ascended northwest from Left Hand Creek. The district, centered on the south side of Gold Lake, was approximately four miles east-west and six-and-one-quarter miles north-south.[6]

Initially, the Gold Lake District's south portion overlapped the Gold Hill district's north portion. To avoid confusion, geographic boundaries should be considered instead for the Gold Lake district. South St. Vrain Creek was the north boundary, Bueno and Walker mountains marked the east boundary, Left Hand Creek was the south boundary, and Burnt Mountain marked the west boundary. While the district was important during Boulder County's first years of placer mining, it offered relatively few hardrock deposits of significance, and as a result, the

[4] Fritz, 1933:21, 38.
[5] Fritz, 1933:21, 39.
[6] Fritz, 1933:21, 39.

district is not discussed in detail in the county's mining history. The few actual mines and the substantial prospects in the district's east portion were most likely attributed to the Ward district.

E.3.6: Grand Island Mining District

Prospectors found just enough deposits of placer gold around the origins of Boulder Creek to justify a mining district, which they organized as Grand Island on March 16, 1861. What the Grand Island district possessed in area, possibly more than any other district in the county, it lacked in placer deposits. However, rich silver was discovered at Caribou, near the district's center, in 1869. Originally, Four Mile Creek was the north boundary, Bald Mountain (west of Sugar Loaf Mountain) marked the east edge, the south side of Middle Boulder Creek served as the south boundary, and the lofty Great Divide was the western boundary.[7]

The original boundaries were revised in response to events associated with hardrock mining. First, by the 1890s, the mining industry pushed the district's northeast portion approximately one mile to the west and attributed the mines in this area to the Sugar Loaf district. Second, the discovery of telluride gold on Spencer and Ute Mountains, which rose along the south edge of Middle Boulder Creek, gave rise to the Eldora rush. Originally, this area lay south of and outside of the Grand Island district. Mining interests then moved the south boundary to take in the new activity.

Caribou and Eldora were the principal areas of production in the Grand Island district, and their mining industries were discrete in time, ore type, and Periods of Significance. Mining industry participants recognized the mines and prospects associated with Caribou as the Caribou-Grand Island district and those around Eldora area as the Eldora-Grand Island district. The MPDF discusses these districts separately because their histories are very different.[8]

E.3.7: Snowy Range Mining District

When prospectors penetrated the high mountains west of Ward in 1861, they may have found traces of gold and certainly encountered silver ore. On June 17, 1861, the prospectors organized the Snowy Range Mining District, which was a five by five mile square centered on what was known as Smith's Peak, which was a landform near Silver Lake. While the district boundaries were never altered, the name of Albion was also recognized for the district.[9]

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[7] Fritz, 1933:21, 40.
[8] Dunn, 2003:16
[9] Dunn, 2003:23; Fritz, 1933:21, 40.

E.3.8: Central Mining District

Even though prospectors were working James Creek and some of its tributaries by 1860, they delayed a formal mining district for a year. On September 7, 1861, the prospectors organized the Utilla Mining District to take in the principal placer claims, and when the area boomed with the discoveries of hardrock gold and silver in 1866, the participants expanded the district and renamed it Central. As amended, the boundaries took in a considerable area. South St. Vrain Creek was the north boundary, the east edge lay several miles to the east of Fairview Peak, the south side of Left Hand Creek defined the south boundary, and both Bueno and Walker mountains marked the west boundary. In later years, the mining industry also recognized the district by the name of Jamestown.[10]

Following the discovery of a rich telluride ore system in Long Gulch in 1875, media began referring to the area as the Ballarat district. Technically, Ballarat was not a formally organized district, and it lay on the north edge of and within the Central Mining District.[11]

E.3.9: Bald Mountain Mining District

During the early 1860s, prospectors realized that the area between Ward and the Grand Island districts held the potential for economic minerals. On June 10, 1864, they organized the Bald Mountain Mining District to take in a region surrounded by the Ward district to the north, the Gold Hill district to the east, and the Grand Island district on the south. When the Bald Mountain district's boundaries are considered in relationship to the surrounding districts, conflict and disparity quickly become apparent. The upper reaches of Four Mile Creek define the north edge, the west base of Bald Mountain forms the east edge, the latitude of Sugar Loaf Mountain is the south edge, and the Great Divide marks the west boundary.[12]

Such boundaries translate into a district that is one mile north-south and nine miles east west, which is a highly unlikely shape. In actuality, the Bald Mountain district overlapped the surrounding districts, which is why it is not heavily recognized both in archival sources and the MPDF.

E.3.10: Sunshine Mining District

In 1873, the Gold Hill district became swept up in a rush for telluride gold and several groups of prospectors examined the as-yet undefined region to the east. There, they discovered a system of veins and apparently organized the Sunshine Mining District around the developing prospects. Uncertainty surrounds whether the Sunshine district was formally organized or

[10] Dunn, 2003:17, 19, 23; Fritz, 1933:21, 40; Hollister, 1867:264.
[11] Dunn, 2003:13.
[12] Fritz, 1933:21, 40.

merely an informal subset of the Gold Hill district, and archival sources recognize both versions.[13]

We can estimate the boundaries of the Sunshine district assuming that prospectors established it to encompass the mines and prospects surrounding the town of Sunshine. Left Hand Creek was the north boundary, the east boundary lay two miles east of Sunshine, Four Mile Creek and the Boulder Mining District formed the south boundary, and Butzel Hill marked the west boundary.

E.3.11: Magnolia Mining District

The Magnolia Mining District came about from a set of events similar to those that gave rise to the Sunshine district. After finding telluride ore, prospectors organized the Magnolia district during or shortly after 1874. Assuming that prospectors established the district to encompass the mines and prospects surrounding the town of Magnolia, we can estimate the boundaries. Boulder Creek acted as the north boundary, Hawkins and Meyers gulches formed the east boundary, South Boulder Creek was the south boundary, and the west base of Twin Sisters Peak marked the west boundary.

E.3.12: Allens Park Mining District

During the mid-1890s, the Ward Mining District saw a wave of interest in its mines as investors sought economic stability in gold during the troubled times that followed the Silver Crash of 1893. Confident that undiscovered gold veins still existed in the northwestern reaches of Boulder County, prospectors combed the mountains north of Ward and in fact found a number of ore formations. In 1896 or 1897, they organized the Allens Park Mining District, which encompassed the town of Allens Park, and then developed a number of substantial prospects in the area. As a result of both prospecting and tourism, the Postal Service granted Allens Park a post office in 1896. The district experienced a boom during the early 1900s, but because economic ore bodies were not forthcoming, the prospectors left Allens Park to the early tourists. The mining district occupied several square miles.[14]

E.3.13: Boulder County Tungsten District

Prospectors, geologists, and mining interests recognized what they referred to as the Boulder County Tungsten District relatively late in the county's history. Also known as the

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[13] Dunn, 2003:23; newspapers published during the 1870s and 1880s, and mine inspectors' reports after 1915 recognize the Sunshine district.

[14] Bauer, et al, 1990:11; *Colorado Mining Directory*, 1898:111; Dunn, 2003:13; Fritz, 1933:176-177.

Boulder Tungsten district, the region encompassed an assemblage of tungsten mines that were developed beginning around 1905. The Boulder Tungsten district was an informal recognition and actually overlapped some of the formal mining districts noted above. Because the Boulder Tungsten district featured discrete events, trends, and Periods of Significance, and its historic resources are unified by the theme of tungsten mining, the MPDF treats the district as an independent entity.

In terms of boundaries, the district can be divided into two blocks. The western-most block was a rectangle centered on Barker Reservoir. Gordon Gulch was the north edge, and a line extending south from Peewink Mountain formed the east edge. The border between Boulder and Gilpin counties acted as the south boundary, and Park Hill, west of Nederland, marked the west edge.

The Boulder Tungsten district's second block extended north along Boulder Creek from the first block. Sugar Loaf townsite marked the north edge, Bummers Gulch formed the northeast and east sides, and Boulder Creek was the south boundary.

E 4: THE HISTORY OF PLACER AND HARDROCK MINING IN BOULDER COUNTY

E 4.1: The Gold Rush, 1859 - 1868

The history of mining in Boulder County began not in the county, nor in 1859, but rather ten years earlier during the California Gold Rush. In 1850, a party of Georgians, which included a number Cherokees, trekked across the plains en route to California and camped for a time on the Front Range's piedmont area. The party consisted of prospectors who earned experience in Georgia's goldfields, and while on the piedmont, they did what was natural for prospectors and began examining the area for placer gold. They in fact struck gold-bearing gravel on Ralston Creek (near Golden) and took note of the find, but the meager discovery was no competition for the lure of California's seemingly fabulous riches. Unaware that rich gold deposits ironically lay a short distance away in the mountains, the party broke camp and continued their journey.[15]

After moderate success in the California diggings, the Cherokees returned to Georgia where William Green Russell learned of their Ralston Creek find. In 1858, Russell organized an expedition with his two brothers and other experienced Georgia prospectors and began a westward trek up the Arkansas River. Around the same time, John Beck also departed the South with a band of Cherokees possibly related to the original prospectors who made the 1850 strike, and John Easter organized a third party that also traveled up the Arkansas. The Russell and Beck parties met on their Arkansas path, joined forces, and camped at the confluence of Cherry Creek and the South Platte River. There, they panned tantalizing traces of gold and, after much effort, located a few economic deposits. Word somehow spread to the Easter party, which was at that

[15] Stone, 1918:230.

time near Pikes Peak, and the wealth seekers journeyed north to the growing prospectors' camp.[16]

The total number of prospectors assembled from the three parties quickly proved greater than the available placer deposits, and after much exhausting and fruitless effort, many soured and returned east. By this time, the Midwest, mired in an economic depression, became inflamed with gold fever and gave rise to the great Pikes Peak Gold Rush of 1858. Before the year came to an end, a small settlement named at first Auraria, then Denver, grew at the confluence of Cherry Creek and the South Platte, and hopeful individuals continued to arrive through 1859.

Captain Thomas Aikens was one of the Midwesterner farmers who readily responded to the Pikes Peak rush. At the advanced age of 50, he organized a party that began as a small assemblage of extended family members and neighbors then grew during its westward journey. Popular literature claims that the Aikens party traveled up the Arkansas River to Auraria, and disappointed at the lack of gold, continued west to the base of the mountains.[17] Accurate sources, however, relate a different and more detailed account. The Aikens party actually followed the Platte River to the safety of Fort St. Vrain, tarried briefly, and learned not only of the exhaustion of the Auraria diggings, but also of a swarm of desperate prospectors fruitlessly combing the southern piedmont area. Realizing they would waste their time at Auraria, the party members struck out westward for the St. Vrain Creek area.[18]

Once at the base of the mountains, the Aikens party undoubtedly explored and prospected, although the members had little experience with finding gold. As the party wandered south it came upon the mouth of Boulder Canyon in October and decided to establish a base camp, a choice almost certainly influenced by the Flat Irons and other scenic wonders. Depending on the source, Aikens and compatriots built 11 cabins either at the very mouth of the canyon (Settlers' Park) or to the east at the confluence of Boulder- and Sunshine creeks. Because building supply firms had yet to be established, the party constructed log cabins that were low, dimly lit, and assembled with almost no hardware.[19]

The Aikens party was not the only group drawn by the allure of Boulder Creek and the Flat Irons. The Arapahoe Indians considered the area to be a special location and often camped there, and for this reason, they were alarmed by Aikens' intrusion. Both groups, however, shared a desire for peace and developed friendly relationships, with Chief Niwot, which meant "left hand," as spokesman for the Arapahoe. As a side note, fearful White settlers banished the Arapahoe to a reservation on Sand Creek in eastern Colorado during the early 1860s. While the natives were asleep early in the morning, a militia that ironically included soldiers from Boulder County attacked and killed Niwot among others.

The beginning of winter, 1858, was mild on Boulder Creek and provided Aikens and partners with an opportunity to prospect for gold. They tried the gravels of Boulder Creek and

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[16] Abbott, et al, 1994:51; Stone, 1918:232, 234.
[17] Eberhart, 1987:78; Stone, 1918:272.
[18] Bixby, 1880:379; Pettem, 1980:3; Smith, 1981:12.
[19] Bixby, 1880:379; Pettem, 1980:3; Smith, 1981:12.

quickly found placer deposits, but only in tantalizing amounts. Discouraged by the tortuous canyon, Aikens, Charles Clouser, I.S. Bull, William Huey, W.W. Jones, and David Wooley moved north and tried another drainage where they again encountered traces of the metal. By the second week of January, 1859, the prospectors began following the placer gold up the drainage in hopes of finding a rich deposit, and their search led them to the summit of the hills above their base camp. Continuing west, the party tested gravel in one of the high gulches on January 15 and finally found what they were looking for. Through examination, they proved that the gravel offered gold in paying quantities, and the party named the drainage Gold Run.[20]

Uncertainty surrounds exactly which drainage the party of six prospectors ascended en route to Gold Run. Most archival sources claim that the party followed what is known today as Sunshine Canyon and merely crossed over the intervening terrain to Gold Run. Two problems, however, cast doubt on this. First, little gold was ever found in Sunshine Canyon, and second, to reach Gold Run, the party would have to exercise great care in finding a route without first encountering other areas that offered placer gold, such as Four Mile Canyon. Simply put, if the party ascended today's Sunshine Canyon, it would have probably discovered gold somewhere other than Gold Run.

Instead, it seems likely that the party actually ascended what is currently known as Fourmile Canyon (not to be confused with the Four Mile Canyon where Crisman, Salina, and Wallstreet are located) west through the townsite of Sunshine. In contrast to Sunshine Canyon, Fourmile Canyon was rife with placer gold furnished by the numerous telluride gold veins around Sunshine.[21] Further, Fourmile Canyon provided the most direct route toward Gold Run, and the Aikens party merely had to cross over Bighorn Mountain. Perhaps Fourmile Canyon was originally known as Sunshine Canyon, which most likely was named after the important townsite at the canyon's head.

The Aikens party was not the only group of prospectors in the Boulder Creek area to take advantage of the warm January. B.F. Langley and partners established a camp on South Boulder Creek and examined its tributaries for placer gold. Like the main Boulder, Langley found that the South Boulder's canyon was very difficult to access, and instead of giving up, he and partners climbed into the surrounding high country and followed the creek's course. In late January, Langley's small party found another rich placer deposit in what it named Deadwood Gulch (near Rollinsville), which was apparently the second found in the region. By the end of January, old man winter finally forced both the Aikens and Langley parties out of the mountains to their camps, where they impatiently awaited spring.[22]

Unable to wait for long, the Aikens party returned to Gold Run in the first week of March, 1859, despite unpredictable weather, and began staking claims. In a move that established a precedent, they organized Mountain District No.1, which was the first formal

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[20] Bixby, 1880:382; Hall, 1891:289, 290; Kelly and Goddard, 1969:7; Kemp, 1960:20; Pettem, 1980:4; Smith, 1981:12; Stone, 1918:272.
[21] The floor of Fourmile Canyon features almost two miles of historic placer workings.
[22] Fritz, 1933:9; Hollister, 1867:60; Smith, 1981:13.

mining district in Colorado and probably the greater Rocky Mountain chain. The party elected a governing board, established the district's boundaries, and recorded bylaws defining claim sizes and rules for staking and holding such.[23]

The Aikens and Langley discoveries, and the organization of Mountain District No.1, were very important events in Colorado. The Aikens party was the second to discover gold west of the piedmont and Langley was the third or fourth. For context, George Jackson is credited with the first mountain discovery near Idaho Springs on January 7, the Aikens party was next on January 15, and it remains unknown whether Langley or John Gregory was third. Gregory was the prospector who discovered the Gregory Diggings at what became Central City.

The organization of Mountain District No.1 was important because, as noted, it was Colorado's first formal mining district. In general, mining rushes have been described as scenes of confusion, mayhem, and anarchy where greed often overpowered honesty and the best of intentions. Understanding this, prospectors organized mining districts to impose order on such chaos, and without regulation, the pandemonium would have discouraged the development of anything approaching an actual industry. The governing board of a mining district defined laws that defined claims, claim sizes, rules for possession, rights for water and infrastructure, and general law and enforcement. Not until May of 1859 did prospectors in the Gregory Diggings organize the Gregory Mining District, which was Colorado's second. Both Mountain District No.1 and the Gregory district served as key examples for prospectors interested in imposing order in other centers of mining.

By the spring of 1859, word of the Aikens, Langley, Jackson, and Gregory strikes reached the overpopulated Auraria diggings, inciting a rush among those who remained. By the summer, Langley's Deadwood Diggings featured 300 miners, who found additional placer deposits in Beaver Creek and other tributaries. With the regulations established by Mountain District No.1, members of the Aikens party were well prepared for the throng of prospectors who ascended into Gold Run and claimed most of the drainage. Prospectors spilled over into Lick Skillet Gulch (originally known as Aikens Gulch) to the north, and when more arrived, they found that the soil along the sides of Gold Run offered gold and staked dry placer claims.[24]

Following a pattern typical of mining rushes, the number of prospectors greatly exceeded the profitable ground at Gold Hill, forcing late-comers to search far a field for new deposits. Some prospectors found them on Boulder Creek and in the lower reaches of Four Mile Creek, which were the areas initially rejected by Aikens. During the summer, several companies flumed Boulder Creek out of its bed to expose gravel, and miners were at work at the mouth of the canyon (near Eben G. Fine Park). To administer to the growing activity in the area, the miners gathered together and organized the Boulder Mining District on July 30, 1859, which was the second district in Boulder County and one of the earliest in Colorado.[25]

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[23] Fritz, 1933:15, 21; Kemp, 1960:21-22; Pettem, 1980:29; Smith, 1981:18.
[24] Hollister, 1867:69, 215.
[25] Bixby, 1880:380; Fritz, 1933:21; Hollister, 1867:69.

As prospectors continued to arrive, they penetrated every principal drainage north and south of Gold Hill. To the south, miners converged on Four Mile Creek, which was natural because Gold Run opened into Four Mile Canyon. They also worked shallow placers in Bummers Gulch, which ascended west up to Sugar Loaf Mountain. To the north, they struck placer deposits on Left Hand Creek and lined the lower reaches of the canyon with claims. They wandered up James Creek and found more, and late arrivals had some luck on the tributary Little James Creek. Calvin M. Ward and other prospectors continued to the upper reaches of Left Hand Canyon, where the placer deposits became inconsistent, and found profitable gravel in what they named California and Indiana gulches. Prospectors even tested South St. Vrain Creek and found through failure that it was largely void of gold. However, the southwest tributary Long Gulch offered gold to a fortunate few. In general, the prospectors who searched these two areas unwittingly and probably unwillingly demonstrated to others exactly where the northern limits of Boulder County's goldfields lay.[26]

While many of Boulder County's 59ers were inexperienced greenhorns (a term for new arrivals who knew little of mining and the frontier), the rush also attracted prospectors who were familiar not only with placer gold, but also with the concept that placer gold usually came from a hardrock source. J.D. Scott, William Blore, Matthew L. McCaslin, and David Horsfal were among these wizened prospectors, and they were in the area by early summer.

Archival sources make little mention of Scott and Horsfal, although it is known that Blore and McCaslin came to Gold Hill with experience that they gained ten years earlier during the California Gold Rush. McCaslin was born in Butler County, Pennsylvania during 1822 to a farming family, and while he was a boy, the family established a homestead in Iowa. In 1841, McCaslin left to work on river boats, and when the news of gold in California reached him in 1849, McCaslin promptly left and joined the westward migration on the overland trail. Once McCaslin arrived in California, he mined placer gold successfully for four years then reverted to his roots and tried operating a farm for two years. McCaslin returned to the East in 1855 and used his savings to buy a share of a grain mill and sawmill, which he ran until word of gold reached him again in 1858. This time, however, the gold required a journey only half as long – to the Pikes Peak country. Unlike most wealth-seekers, McCaslin responded early enough to find gold at the Auraria Diggings, and after these had been exhausted, he ascended to Gold Hill in the Spring of 1859 and enjoyed success there.[27]

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[26] Kemp, 1960:20; Hollister, 1867:69.
[27] *History of Boulder and Clear Creek Valleys*, 1880:665.

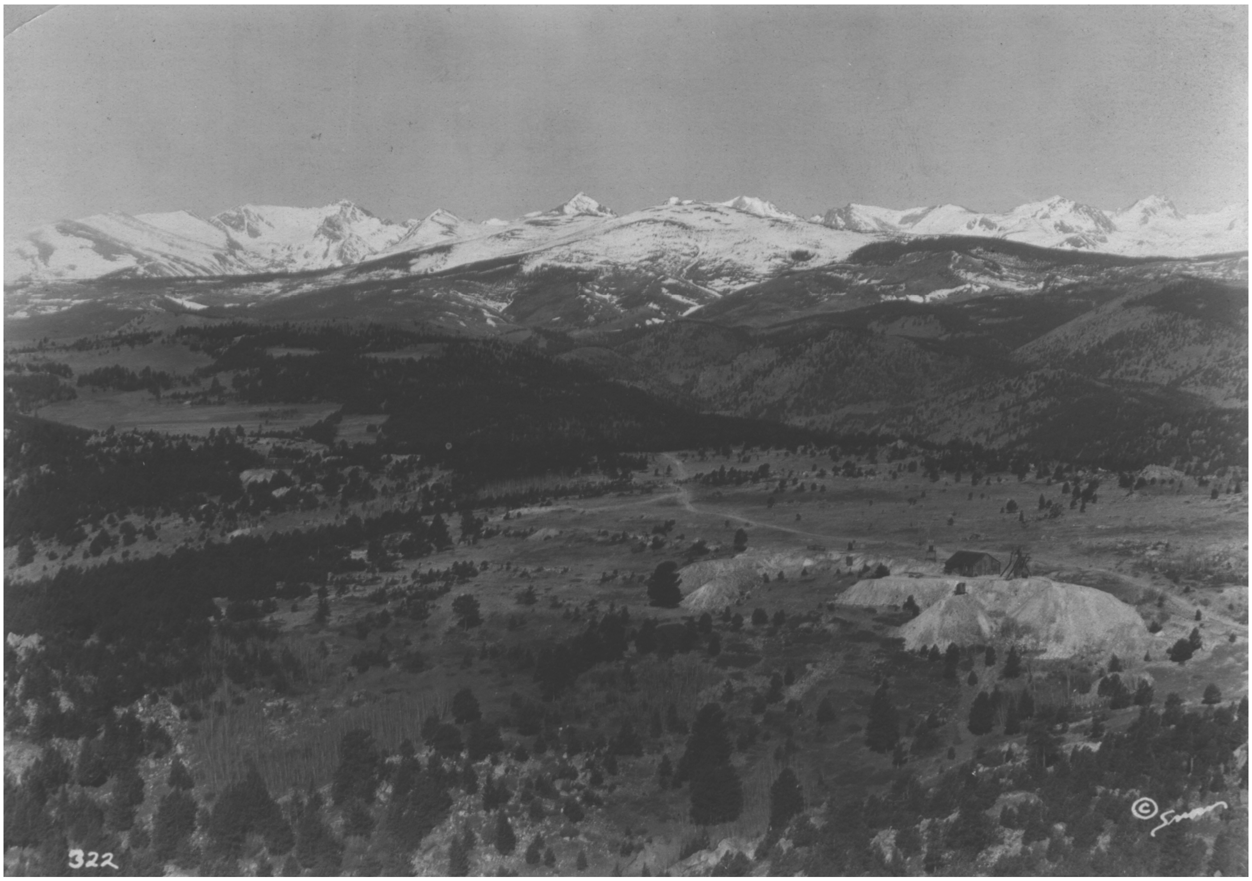

Figure E 4.1.1. The circa 1930 west view depicts the top of Gold Hill (landform), right, and the head of Gold Run, center-left. The Horsfal Mine, one of Colorado's first hardrock gold discoveries, is visible at lower right, and by 1930, the mine's surface facilities had been altered several times. The Indian Peaks and Continental Divide rise in the background. Source: Boulder Carnegie Library, 219-4-5.

Blore was born in Otsego, New York in 1833 and moved with family to a farm in Pennsylvania as a boy. The hard work required of running a farm impressed upon Blore that such life was not for him, so he joined the California Gold Rush and probably experienced some success during the early 1850s. In 1856, Blore returned east and moved to the frontier town of Sarpy, Nebraska, where he tried dealing real estate. Probably because business was poor in the climate of the 1857 depression, Blore joined the Pikes Peak Gold Rush in 1858 and was among the first to Auraria. While there, he helped organize the Auraria townsite and earned income through construction of some of the settlement's first buildings. With money saved, Blore finally took to the hills of Boulder County to prospect n 1859 and was one of the first at Gold

Run. At some point in time, Blore, McCaslin, and David Horsfal formed a prospecting partnership and worked together at Gold Hill.[28]

In a precedent-setting event, J.D. Scott became the first recorded person to see deeper than the veneer of placer gold in the soil and expose a hardrock gold vein in Colorado. It remains unknown whether Scott accidentally revealed the vein while scraping together gold-bearing gravel or intentionally sought it, but his discovery in May, 1859, confirmed the suspicions of other experienced individuals. They easily spared the time from placer mining to search for gold veins and found several more in quick succession during the summer. Blore, McCaslin, and Horsfal found a handsome vein on the east summit of the landform named Gold Hill (east of and adjacent to the town) on June 13 and named it honor of Horsfal. This was apparently the second or third vein recorded in Colorado, although miners in the Gregory Diggings were searching by this time, as well. Mostly on Gold Hill, other prospectors quickly exhumed the Twins, Alamakee, Savannah, Winona, and other veins, and brought them into production.[29]

The veins were a prospector's dream and yielded readily to the various parties at Gold Hill. The veins cropped out on ground-surface, they were clearly defined, the ore was easily removed, and the quartz fill material was friable and easily broken. All the various parties probably imitated Blore et al, who worked the Horsfal Lode downward, extracted the rich ore, crushed it with hammers, and recovered the gold in a sluice. With these archaic methods, Blore et al realized around $10,000 for their efforts, and the claimants of the other veins were successful, as well. From these tiny and shallow workings arose one of Colorado's most important hardrock mining industries.[30]

The hardrock discoveries combined with the rush for placer gold quickly overwhelmed Mountain District No.1, and the prospectors and miners met in July to discuss what to do. By the end of the month, the participants revised the regulations, added definitions applicable to hardrock mining, and reorganized the geographic entity as the Gold Hill Mining District. Ultimately, the bylaws provided definitions for types and sizes of claims that became fairly standard for the era. Gulch Placer Claims were 50 by 100 feet in area, although other mining districts defined them as 100 to 300 feet along and from bank-to-bank when in a drainage. Patch Placer Claims, usually staked around the gold-bearing soils known as blanket deposits, were 100 by 100 feet in area. Lode Claims, staked over veins such as the Horsfal, were 50 feet wide centered on the vein, and 100 feet long. Tunnel Claims, staked for rights to drive tunnels into veins, allowed 200 feet on a vein per company member, and 250 feet along each blind vein discovered while driving the tunnel. Millsites provided land with water rights to build and operate amalgamation stamp mills, and water claims allowed measured volumes of water to be removed from a stream for power and placer mining.[31]

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[28] Fritz, 1933:92; *History of Boulder and Clear Creek Valleys*, 1880:615.
[29] Bixby, 1880:382; *Colorado Mining Directory*, 1879:93, 114, 123; Fritz, 1933:19; Hall, 1891:290; *History of Boulder and Clear Creek Valleys*, 1880:615; Kelly and Goddard, 1969:7; Pettem, 1980:10; Smith, 1981:18; Stone, 1918:272; Wolle, 1991:483.
[30] *History of Boulder and Clear Creek Valleys*, 1880:615.
[31] Fritz, 1933:21, 53-59.

As the Gold Hill miners such as Scott, Blore, McCaslin, Alfred Brookfield, and others deepened their workings, they became concerned over the change in the character of the ore. The quartz was no longer as friable nor the gold easy to separate, which discouraged the use of sluices. In addition, the various partnerships hungered for greater production than several pairs of hands could manage. In the fall of 1859, Thomas J. Graham arrived with an answer to these problems.

Graham was born in Cumberland County, Pennsylvania in 1830 and spent his boyhood working the family farm when not in school. By 1856, he fell in with a group of Eastern land owners and went to Des Moines, Iowa then Leavenworth, Kansas to examine property for them. The following year, Graham ventured into the Leavenworth real estate market with a partner and did well until the fateful year of 1859, when he could no longer resist the investment potential in the Pikes Peak country. Somehow, Graham learned of the hardrock discoveries at Gold Hill and realized that the mining outfits there would need the services of an amalgamation stamp mill, just like the early hardrock miners in California almost ten years earlier.[32]

During the summer of 1859, Graham surveyed the Gold Hill area in search of a strategic millsite and apparently chose the area where Lick Skillet Gulch opened into Left Hand Canyon. In September, his wagons finally arrived at the mouth of Left Hand Canyon, which provided the most direct route to Gold Hill, then stalled. The principal obstacle was the very canyon itself, which impeded wagon access. Graham and investors E.D. Steele and William Pellthier struck upon a brilliant idea that would generate profits beyond those they hoped their mill would deliver. Specifically, Graham and partners organized the *Boulder City, Gold Hill, and Left Hand Creek Wagon Road* as a way of charging people a toll to use the road that would have to be graded to Lick Skillet Gulch. The many unlucky prospectors in need of income formed an ample labor pool that completed the road probably during September, and Graham's wagons arrived at the millsite by October. Workers erected the stamp mill within the month, and it was a tiny facility equipped with three stamps powered by a waterwheel.[33]

When the workers finished Graham's mill, most were unaware that they had just erected Colorado's first mechanical mill. And Graham's mill was not even the first ore treatment facility at Gold Hill. A number of partnerships built crude types of crushing apparatuses known as arrastras to grind the quartz gold. An arrastra consisted of a stone floor, a central capstan, and large muller stones chained to a hardness beam that rotated around the capstan. As the beam slowly moved, either pulled by a draft animal or powered by a waterwheel, it dragged the stones over the floor and ground quartz ore that workers introduced. As the stones fractured the ore, they forced the gold into contact with mercury on the floor, which then formed an amalgam. The arrastra was ideal for Gold Hill's nascent mining industry as it existed in 1859 because it required only local building materials, primitive engineering, and mercury.

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[32] *History of Boulder and Clear Creek Valleys*, 1880:641.

[33] Bixby, 1880:382; Fritz, 1933:130, 194; Hall, 1891:291; Hollister, 1867:69; Pettem, 1980:20; Smith, 1981:22; Stone, 1918:273.

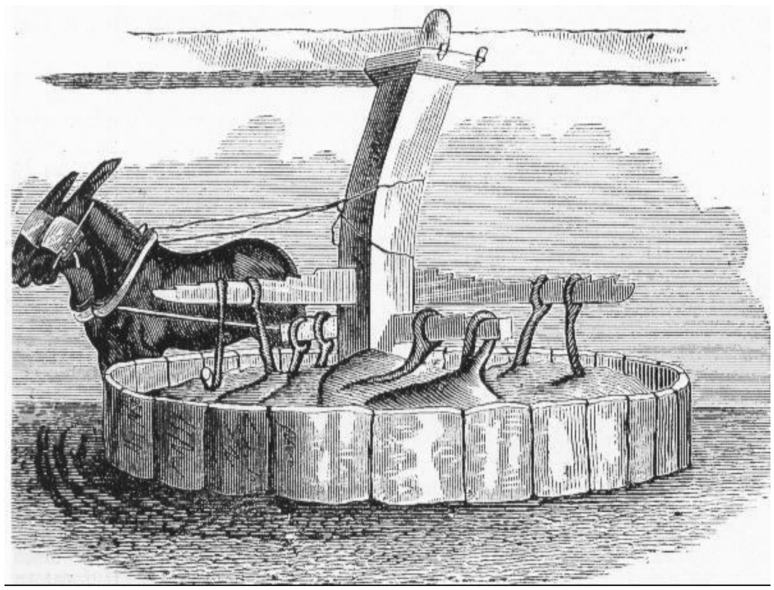

Figure E 4.1.2. Most of Boulder County's first ore treatment facilities were arrastras similar to the one in the illustration. The arrastra in all its simplicity was ideally suited for the primitive, remote nature of Boulder County during the early 1860s. Source: *Mining & Scientific Press* 5/26/83.

As soon as workers finished Graham's mill, the facility immediately received more ore than it could treat, leaving plenty of demand for additional facilities. The shortage of treatment capacity disappointed Blore and partners, who may have been using an arrastra through 1859. During the four months of 1860, Blore et al learned that Cary Culver and John Mahoney were shipping another stamp mill to the Gregory Diggings and intercepted the party while en route. Blore et al convinced Culver and Mahoney that they would make more money setting up below Gold Hill and treating their Horsfal ore than could be had in the Gregory Diggings. By spring, the Culver & Mahoney Mill's stamps began pounding away on the rich quartz gold from the Horsfal, and to formalize what was an increasingly profitable operation, Blore et al organized the Gold Hill Mining Company. When word circulated that Gold Hill had a vibrant hardrock mining and milling industry, millwrights raced each other to capture a share of the business. The confluence of Lick Skillet Gulch and Left Hand Canyon saw a wave of mill building during 1860, and by the end of the year, at least 12 amalgamation stamp mills created a din as they processed ore.[34]

[34] Bixby, 1880:382; Fritz, 1933:130; Hall, 1895:291; Hollister, 1867:69, 265; Pettem, 1980:20; Smith, 1981:22; Stone, 1918:273.

Mining and prospecting continued at a frenetic pace in Boulder County through 1860 and into 1861. Early mining historian Orvando Hollister compared the Gold Hill rush with the intense excitement at Gregory Gulch, which was one of Colorado's most celebrated placer areas. Between 1860 and 1861, excess placer miners fanned out and established Boulder County's additional mining districts. During 1860, they organized the Ward district around the placers on upper Left Hand Creek, and the Sugar Loaf district at Sugar Loaf Mountain. In 1861, the prospectors organized the Utilla district around the James Creek mines, the Gold Lake district to administer to placers in Spring Gulch and on upper James Creek, and the Grand Island and Snowy Range districts in the western hinterlands. All were important because they were among Colorado's earliest officially organized mining districts.[35]

While prospectors were turning over all the streambeds and sending them through sluices for gold, experienced miners realized that there was no reason why hardrock veins should be exclusive to Gold Hill. With this understanding, these prospectors expanded their search into all the county's principal mining districts and produced a rash of hardrock discoveries, although none came close to the density and richness of Gold Hill.

The Sugar Loaf district saw some of the earliest successful strikes outside of Gold Hill, although the exact location where the veins were located remains uncertain today. In 1860, Henry Blake was the first among his fellow prospectors to build a cabin in the district, and Daniel Whitman and an African-American known as Bowman joined him within a short time. While most individuals mined placer gold, Bowman sought hardrock ore and supposedly was the first to experience success. His Bald Prairie Lode, probably named for the open meadow around Sugar Loaf Mountain, was in inspiration to other hardrock prospectors. Porter T. Hinman then found and began developing both the Saylorville and Hinman lodes, and he helped Bowman build an arrastra to work the ore mined from his own and Bowman's claims. A few other would-be miners then constructed their own arrastras.[36]

Hinman was almost certainly one of the most experienced prospectors in the Sugar Loaf district, and his past was similar to his Gold Hill counterparts such as McCaslin. Hinman was born in Allegany County, New York, son of a merchant and judge. The family had enough money to enroll Hinman in an academy, but his parents died when he was 15 years old, throwing Hinman into a migratory life and early adulthood. Hinman worked for as a clerk for a company in Niagara, then as a clerk on a steam boat on Lake Erie, and finally as a teacher in Mansfield, Ohio. There, he married Mary Smith, and together, they established a farm in Ohio. Hinman was unable to settle down, however, and he gladly joined the California Gold Rush. After limited success, Hinman had to work as a freighter for income then returned to Ohio and tried farming again. Since the toil was too much, he worked in a land office and ran a sawmill but left in 1860 for Boulder County gold.[37]

In the Central district, George Zweck and other prospectors had a little luck, but several years would have to pass before their efforts drew serious interest. The Ward district hosted

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[35] Fritz, 1933:21; Hollister, 1867:264.
[36] Bixby, 1880:432; Eberhart, 1987:82; *Vertical Files: Sugar Loaf*; Wolle, 1995:490.
[37] *History of Boulder and Clear Creek Valleys*, 1880:644.

some of the earliest hardrock discoveries outside of Gold Hill, and within a short time, they would play a prominent role in the county's early mining history. In 1860, pioneer miner Calvin M. Ward found a vein that he named the Miser's Dream, and the following year, Cy Deardorf revealed the Columbia Vein, both of which proved quite rich. At the same time, an enigmatic prospector named Rocky Mountain Smith was at work near Silver Lake in the Snowy Range district and made a strike that was almost ten years premature. Specifically, in 1860, he discovered excellent silver ore and drew the interest of other prospectors, who then organized the Snowy Range district. But gold commanded attention and there was no market for silver, so Smith and partners staked claims then continued their search. The discovery was, however, one of the earliest silver strikes in Colorado.[38]

Over the course of several years, the population of Boulder County skyrocketed from the small Aikens party to more than 1,000 people, most of whom were young men. In keeping with the typical development pattern of mining districts, most of these individuals naturally congregated around the centers of production and prospecting, and these encampments were the seeds of Boulder County's first settlements. The mining camps of Gold Hill and Boulder grew at the same time, but Boulder can be credited as the first permanent settlement. Not only did the Aikens party build its 11 cabins there, but also Aikens, fellow prospector Alfred Brookfield, and partners organized the Boulder City Town Company to lay claim to the site in January, 1859, in anticipation of the rush that developed. The company included over 50 stockholders, secured 1,240 acres along Boulder Creek, and enticed newcomers to build cabins. To compliment this, while prospectors were beginning to arrive at Gold Hill in April, Aikens secured the first post office in the county. The above events clearly demonstrate that Aikens was visionary and probably forecasted the impact that his Gold Hill discovery would have on the area, and he prepared for that impact at an early time.[39]

While most archival sources claim that Boulder quickly assumed the role of supply center, stopping point, and union between the mountains and the plains, this was only partially true. In support of these conclusions, some of the county's earliest businesses opened their doors in Boulder in 1859. In June, Samuel Breath and William A. Davidson opened what may have been the county's first mercantile, followed by Horace Tarbox and Ed Donnelly's store. At this time, however, Boulder was also a real mining town with placer miners at work within walking distance on Boulder Creek.[40]

While it was second, Gold Hill grew as quickly as Boulder, which was natural since it was center to a growing rush. Some references suggest that the original town of Gold Hill lay on the top of the Gold Hill landform, but several factors draw this into question.[41] First, the location was one of the most exposed in the area, and second, it was around one-half mile from the closest placer mines. Third, the distance made hauling water difficult. While prospectors surely

[38] Bixby, 1880:384, 428; Eberhart, 1987:100; Southworth, 1999:55; Wolle, 1995:516.
[39] Bauer, et al, 1990:251; Smith, 1981:17; Stone, 1918:144.
[40] Bixby, 1880:402; Smith, 1981:19.
[41] Fritz, 1933:159; Southworth, 1999:54; Wolle, 1995:484.

camped on the top of the Gold Hill landform, it seems likely that the main settlement actually grew close to Gold Run where the mining was. Regardless, the town featured a hotel, at least one mercantile, and a school for the few families in the area. Gold Hill suffered its first fire in 1860, and the conflagration spread so quickly that the residents fled with the handfuls of possessions that they could carry. The destruction created great difficultly because replacement goods and provisions were costly and had to be carried up from Boulder. Archival sources claim that the town's population was as high as 2,000, although this figure probably included the surrounding mining district. While Gold Hill could certainly be defined as a settlement, the migratory population and its obsession with gold retarded the development of a true community atmosphere. This may explain why no one secured a post office until 1863, which was four years after the first prospectors pitched their tents.[42]

The Sugar Loaf and Central mining districts had several concentrations of tents and cabins, although the populations were too small to support businesses. In the Sugar Loaf district, miners camped near their placers at the head of Bummers Gulch and on Four Mile Creek at the northeast base of Sugar Loaf Mountain. This latter camp became known as Sugar Loaf (today's Wallstreet) and was center to placer mines on Four Mile Creek. In the Central district, miners camped at various points along Left Hand and James creeks, and concentrated at the confluence of James and Little James creeks (today's Jamestown), in the vicinity of George Zweck's cabin.

The Ward district had what may have been the largest settlement apart from Gold Hill. Miners and prospectors built cabins and erected tents in Indiana Gulch to be near the fabulous hardrock discoveries, the most important of which appeared to be the Deardorf's Columbia Vein. In honor of the ore body, the prospectors named their settlement Columbia City, which held the promise of becoming significant. Like Gold Hill, Columbia City burned in 1860, but the residents were quick to rebuild.[43]

Like most mining regions in infancy, Boulder County drew a population of young men who were migratory and had no intention of permanency, and so they thought little beyond their own needs. A few visionary individuals, however, were aware of a growing demand for infrastructure and saw potential profit in this. The increased movement of people and freight constituted a significant opportunity for profit in the form of toll roads, which Thomas Graham already enjoyed from his 1859 Left Hand Canyon avenue. As early as 1859, other capitalists imitated Graham when they graded a road up Sunshine Canyon (probably today's Fourmile Canyon) to Gold Hill. According to archival sources, a group of individuals organized the St. Vrain, Altona, Gold Hill & Gregory Road Company and graded a road from Altona up Left Hand Canyon to Lick Skillet Gulch. But because Left Hand Canyon was not large enough for two roads, it seems likely that this company merely purchased or improved Graham's original avenue. George Williamson, Henry C. Norton, and other investors proposed a significant project that reflected Boulder's evolution into a permanent supply node. Specifically, they planned the Bear Canyon Toll Road with the intent of using Boulder as a gateway to the mines in Gilpin

[42] Bixby, 1880:426; Bauer, et al, 1990:63; *Boulder County Post Offices*; Smith, 1981:23; Wolle, 1995:484.
[43] Bailey, 1982:39; *Vertical Files: Ward.*

County, which would place Boulder in direct competition with Golden. The road, graded during 1861, ascended Bear Canyon, which parted the Flat Irons, then traversed the high country between South Boulder Creek and Boulder Creek, and terminated in Gilpin County.[44]

Curiously, the first road graded into the county's western portion was a byproduct of the Civil War. In the early 1860s, Union interests determined that they needed a road to facilitate a rapid military movement through the county, over the Divide, and west into Middle Park, should Southern forces suddenly materialize there. The Union interests contracted with Gordon & McHenry, who graded a road up Sunshine Canyon, down Ritchie Gulch into Four Mile Canyon, southwest to Sugar Loaf Mountain, and up Gordon Gulch into the high country. As work crews neared the Indian Peaks, the project was canceled when other Union roads were completed over Rollins- and Berthoud passes. While the Union interests may have considered the project a waste, Boulder County benefited because the meandering road provided access into the remote mining districts.[45]

In addition to transportation, investors saw opportunities to profit from other forms of infrastructure. From the first years of the boom, placer miners were acutely aware of the problems that Boulder County's arid climate presented. Water for mining was scarce, meager streams flowed only through the deepest of canyons, and some drainages that were rich with gold were usually dry, with the upper reaches of Gold Run serving as an excellent example. Understanding this, in 1860, Aikens and partners used some of their mining profits to finance what was known as both the Aikens Ditch and the Gold Hill Ditch. A crew of workers excavated a ditch that delivered water from Left Hand Creek to Gold Run for miners who were willing to subscribe. While records are uncertain, it seems likely that a few other dry centers of mining received minor ditches.[46]

One of the most pressing needs for Boulder County's growing population and mining industry was lumber. Placer miners required planks for their sluices and flumes, and communities wanted to replace their low, dark log cabins with the types of frame buildings they were accustomed to. Ordinarily classified as a manufacturing industry, the lumber business was an important form of infrastructure for any mining region because it provided the materials necessary for improvement and growth.

Boulder merchants Tarbox and Donnelly understood this and built what may have been the first sawmill in the county at the mouth of Boulder Canyon in 1860. Boulder, of course, was their principal market, although numerous miners hauled lumber from the water-powered sawmill up into Boulder- and Four Mile canyons. To serve the Gold Hill, Ward, and Central mining districts, P.J.G. Lea built another water-powered sawmill in Left Hand Canyon around one mile down-gradient from Lick Skillet Gulch (near Rowena) shortly after. As the demand grew, Samuel Copeland dispensed with unreliable and seasonal waterpower and built the first steam sawmill in Four Mile Canyon in 1863. Within a year, the Pomeroy & Henry and Coffin &

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[44] Bixby, 1880:392; Fritz, 1933:195; *History of Boulder and Clear Creek Valleys*, 1880:698; Pettem, 1980:6; Smith, 1981:33.
[45] Kemp, 1960:28; Smith, 1981:33.
[46] Smith, 1981:14.

Harmony mills ran in Bear Canyon, E.J. Anderson operated a mill in Gregory Canyon, and John Davis served the Ward district.[47]

Clinton M. Tyler and James P. Maxwell, two investors already experienced in Colorado lumber, arrived in Boulder County with the intent of mining its mining industry. Maxwell was born in the early year of 1812 in Guilford, Vermont, and was forced by circumstances into early adulthood. At age 12, he enrolled in the Manual Labor Institute at Utica, New York, and became a mason's apprentice by age 14. When finished, Maxwell struck out on his own as a mason and moved to Utica, Indiana. There, he married Susan B. Clark, and together, the couple established a homestead on the Wisconsin frontier. The Maxwells were progressive, financially wise, and moved upward economically. They sold the homestead in 1847 and reinvested the money in a tract of land at Baraboo, where Maxwell built a water-powered sawmill and sheet-metal manufacturing facility. Three years later, Maxwell also built a flour mill. In 1860, he traveled to Colorado to examine the investment potential, built a house in Central City, and lost all when the town burned in 1861. He made some money selling supplies and, realizing that there more money to be made supplying the miners, he returned to Iowa and brought a herd of cattle to Colorado. Through this venture, Maxwell made the acquaintance of Clinton P. Tyler.[48]

Tyler was born in Livingston County, New York in 1834 and moved with family to Michigan as a boy. He attended public school, enrolled in a series of universities, and went to Waterloo, Wisconsin after graduating. There, Tyler found a job in Nelson K. Smith's hardware store and became a partner in the business. Both the store and Tyler's social relationships went well, and Tyler married Smith's daughter Emma. As the economy in the Midwest soured and business decreased, Smith latched onto the idea of reaping a fortune from the new placer fields in Gilpin County. Smith interested Tyler, and together the two families joined a wagon train early in 1860. It was probably Smith who secured the equipment for a six-stamp mill, which the party erected at Black Hawk and began treating gold ore. By spring, however, the party realized that more profits could be made by supplying lumber than from mining, and Smith sent Tyler back to Wisconsin for a small sawmill. Tyler and Smith ran the mill in Gilpin County with great success until 1864, when Tyler formed a partnership with Maxwell.[49]

Obviously well prepared to take advantage of the opportunities offered by new mining areas such as Boulder County, Tyler, Maxwell, and Maxwell's son James P., Jr., began assembling a small empire in 1864, which started with a sawmill on South Boulder Creek. The business, under the name of Tyler & Maxwell, did so well that the trio decided to build a second sawmill at the confluence of Boulder Creek and Four Mile Canyon. Just like Thomas Graham and his stamp mill, Tyler and the Maxwells saw an opportunity to profit from the roads that they would have to grade for the mill. But unlike Graham, Tyler and Maxwell envisioned surpassing their own needs by building a road that would serve as a regional artery and would complete with the Bear Canyon route. In 1864, Tyler and Maxwell organized the Boulder Valley & Central City Wagon Road Company and had workers push a road up Boulder Canyon past the

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[47] Bixby, 1880:394; Hall, 1891:292-293.
[48] *History of Boulder and Clear Creek Valleys*, 1880:653.
[49] *Portrait and Biographical Record*, 1898:718.

confluence of Four Mile and Boulder creeks, probably up Lost Gulch, and into the high country around Winiger Ridge and Twin Sisters Peak. From there, the workers had an easy time grading the road into Gilpin County.[50]

At the same time, C.M. Tyler & Company began building the new sawmill at the confluence of Boulder- and Four Mile creeks, and it began turning out lumber in 1865. The road served the firm as planned, allowing loggers to bring raw material to the mill and freighters to carry finished products to markets in Boulder and Gilpin counties. The sawmill also became the nucleus of a small settlement named Orodelfan, which was Latin for "place of gold." The road, of course, was an immediate success because it provided the only route possible up Boulder Canyon.[51]

In addition to aspects of infrastructure, the booming mining industry and its population required government services beyond those that the mining districts could provide. For this reason, and to ally the various interests in the Rocky Mountains with Union sympathies in light of the Civil War, the Federal Government organized Colorado Territory in 1861 and divided it into 17 counties, including Boulder, with the town of Boulder as the seat. From this point on, the county increasingly administered to land issues, although the transition was gradual.

This brought miners and prospectors great relief because, prior to 1861, the area designated as Boulder County was originally divided between the neighboring Nebraska and Kansas territories. When the Federal Government established the two territories, surveyors defined a baseline as a dividing boundary, and the Nebraska Territory lay to the north and the Kansas Territory lay to the south. The baseline was part of the great Rectangular Survey program in which surveyors established Township, Range, and dividing Sections to convey public land into private ownership. Today, Baseline Road in Boulder follows the original baseline that divided the two territories. Dividing what became Boulder County presented a raft of logistical problems in terms of taxation, land acquisition, law enforcement, and sending records for official repository, and the designation of Boulder County eliminated many of these problems.

If Tyler, Maxwell, and the rest of Boulder County's pioneer entrepreneurs had taken a close look at the trend of the mining on which they banked, they may not have been so quick to invest. Trouble for the industry began to manifest as early as 1862, even before some of the investors in infrastructure planned their ventures. The trend started when miners exhausted the gold in the small gulch placers over the course of a single season's work, and the larger deposits showed the same signs after a year or two more. The reason was that Boulder County's climate was too arid to free much placer gold from its parent veins and the topography was too steep to allow a thick accumulation of gold-bearing gravels. Simply put, the placer deposits were certainly rich but relatively thin and limited in volume.

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[50] Bixby, 1880:393; *History of Boulder and Clear Creek Valleys*, 1880:687; Smith, 1981:36.
[51] Bixby, 1880:393; *History of Boulder and Clear Creek Valleys*, 1880:654; *Vertical Files: Orodell.*

Compounding a growing problem, the hardrock mines began failing, as well, because even though the gold ore was rich, it changed in character with depth. Miners found that within approximately 100 feet of ground-surface, the free-gold ore gave way to a complex, refractory pyretic material. When near ground-surface, the pyrite oxidized and loosened its hold on the native gold, which allowed the stamp mills to easily crush and amalgamate the material. The geological environment at depth, however, prevented oxidation and maintained the integrity of the pyrite, which held the gold fast. It must have been very frustrating to possess plenty of ore that provided excellent assay returns but could not be milled at a profit.[52]

Archival sources and popular literature claim that Boulder County's bubble promptly burst in 1861 or 1862 due to the problems noted above, and also out of concern for the Civil War. For what ever combination of reasons, people supposedly then left Boulder County as quickly as they had arrived.[53] The failure, in actuality, was not sudden or catastrophic. For context, miners produced approximately $30,000 in gold per year from 1860 to 1862, which decreased only by $5,000 for 1863 and 1864, then in $5,000 increments until 1867.[54]

While the decline could be described as gradual on a county-wide level, its effects were not uniform and struck Gold Hill first. In a town that was as important as Central City for a time, the boom atmosphere was decidedly over, most of the prospectors drifted off to new pastures, and miners began trickling away as they exhausted their claims. By 1866, Gold Hill's population was so small that the Postal Service expressed its lack of confidence in the settlement by revoking the post office. Nearly all the mills in Left Hand Canyon were dismantled, some even before they were finished, then shipped to Gilpin County.[55]

Because the county's remote mining district's lagged behind Gold Hill in terms of development, they took a little longer to exhibit signs of decline. The Sugar Loaf district continued to draw interest into the mid-1860s and even saw several discoveries. In 1866, prospectors found the Little Belle lode in Bummers Gulch and brought it into production. This operation complimented the tiny mines that Hinman, Bowman, Blake, and others apparently still worked on a seasonal basis. The district had enough of a population to justify opening the post office of Sugar Loaf in 1867, probably in part to replace the closed Gold Hill office. However, the new post office was premature because the Sugar Loaf district was in decline, and when the placer gold was gone and the free gold gave way to refractory ore, most of the population left. As symptom of this trend, the Postal Service cancelled its new station in 1868.[56]

The county's other remote mining districts, which hosted only handfuls of miners and prospectors in their prime, became nearly deserted by the late 1860s. To the west, the prospectors who organized the Grand Island district, such as Samuel Conger, Nathan W. Brown, John Leahy, Ulysses and Francis Pugh, Hiram Perigo, and Nelson and Charles Wannamaker, had been scratching around the creeks with some success. They quickly exhausted the meager placer

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[52] Kelly and Goddard, 1969:20.
[53] Hall, 1895:292; Kelly and Goddard, 1969:7; Southworth, 1999:53; Wolle, 1991:483.
[54] Henderson, 1926:106.
[55] Bauer, et al, 1990:63; *Boulder County Post Offices.*
[56] Bauer, et al, 1990:137; Bixby, 1880:432.

deposits, however, and found too many obstructions such as boulder to render the gravel economical. In the Snowy Range district, prospectors continued to search with optimism during the mid-1860s, hoping to find gold associated with the silver ore already discovered there. As a reward, two parties found not gold, but instead more silver on North Boulder Creek, which they claimed as the Carmack and Comanche in 1866. With no gold forthcoming, the prospectors left the district but did not forget about the silver, which would become important in the future.[57]

Boulder County was not the only portion of Colorado to see its boom reverse into a bust. Similar trends developed throughout Gilpin, Clear Creek, Park, and Summit counties, and they ushered in a territory-wide depression. The gradual deflation of Boulder County's boom drifted down to the piedmont area and had noticeable effects by the mid-1860s, and the population fell from more than 2,000 in the Gold Hill district alone to 1,456 throughout the entire county.[58].

Portions of Williamson and Norton's Bear Creek road washed out around 1863, they rebuilt it, and when a flood damaged it again, they abandoned the venture probably at a loss. The reason was that because both Boulder and Gilpin counties were in depression, the occasional tolls that could be collected would not pay for upkeep. When high water eroded other roads, they were probably not repaired, either. The lumber industry suffered since the market in the boom camps collapsed, and in response, many of the small sawmills closed and Tyler sold his South Boulder Creek facility.[59]

The town of Boulder panged at the disintegration of infrastructure and the contraction of the building supply and service industries. The population remained a small 350 during the mid-1860s, and business owners grew deeply concerned over the sluggish growth. In addition to the failing mining industry, they also suffered the effects of real estate speculation, spiraling lot costs, and over-promotion that occurred during the boom.[60]

Ultimately, the residents of Boulder realized that the failure of the mining industry was a mixed blessing for the town. Many of the miners realized that farming and ranching provided an income that was much surer and more stabile than winning gold, and instead of leaving the region altogether, they settled around Boulder. As a result, the piedmont population increased dramatically, and Boulder assumed the role of a social, commercial, and industrial center for this sedentary culture.

Boulder's role as a mining center, however, was just beginning, in part to gathering booms in two mining districts that were miraculously spared from collapse. While the county's overall mining industry dissipated during the mid-1860s, the Ward and Central districts bucked the trend and prepared for significant development and production. Their histories are covered in detail below along with the county's other mining districts.

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[57] Boulder County Metal Miners' Association, 1910:48; *Colorado Mining Directory*, 1879:78; *Colorado Mining Directory*, 1883:49; Kemp, 1960:24.
[58] Schulz, 1977:1860-10.
[59] Bixby, 1880:392; Fritz, 1933:195; *History of Boulder and Clear Creek Valleys*, 1880:687, 698.
[60] Smith, 1981:41; Stone, 1918:144.

In 1868, the first gold rush in Boulder County was clearly over, closing out a county-wide Period of Significance. Mining resources that retain integrity today relative to this Period, spanning from 1859 to around 1868, may be important through an association with the Period's key events, trends, and themes.

Many of the historic resources such as prospects, placer- and hardrock mines, ore processing sites, prospectors' camps, settlements, sawmill sites, and aspects of infrastructure contributed to the initial exploration, development, and settlement of the county, which occurred during the Period of Significance. Such resources also participated in the development of an economy, government, infrastructure, and social geography where none previously existed. The county's agricultural industry, whose stability proved important during economic depressions, was a direct result of the initial mining industry. In sum, the gold rush served as a foundation for the county's creation and initial stages of development.

The gold rush had implications on state-wide and national levels. Gold Hill was the scene of the earliest gold discoveries to be popularized in the Rocky Mountains proper, west of the piedmont area. Only shortly after did prospectors respond to the discoveries in Gilpin and Clear Creek counties. Gold Hill was also the scene of the first hardrock gold mining in the Rocky Mountains, and in direct association, Gold Hill received the first mechanized mill. These two events helped establish a precedent and served as an example for miners elsewhere in Colorado.

Mountain District No.1, the first mining district organized in the Rocky Mountains, took in the placer- and hardrock mines around Gold Hill. This mining district pioneered the establishment of other districts elsewhere, which served as key forms of government that brought law and order to Colorado's mining frontier and paved the way for organized industries.

Boulder County's early mining industry and its additional districts, established shortly after Mountain District No.1, played several important roles. Like Mountain District No.1, the sum of the other districts along with those in Gilpin and Clear Creek counties served as examples for the miners who pushed the frontier deep into the mountains. The county's mining industry contributed heavily to the initial settlement of Colorado, its growing reputation as a mineralogical treasure trove, and its designation as a territory in 1861. The profits won from the county's mines contributed to the formation of a territorial economy and provided capital that was reinvested in infrastructure. Last, when the boom collapsed, miners and prospectors settled the plains and established a significant portion of Colorado's agricultural industry, which became a permanent institution.

E 4.2: The History of the Ward Mining District

E 4.2.1: Discovery and the Rise of Hardrock Mining, 1860 - 1868

The gradual disintegration of Boulder County's mining industry during the mid-1860s was certainly a disappointing turn of events for those residents who remained in the various towns and settlements. In contrast to the general portrayal of history, however, two mining districts gave county residents bright rays of hope and reasons for optimism, which were well founded. One was the Central district, located on James Creek, and the other was Ward, which encompassed placer mines and several very important hardrock discoveries at the confluence of Indiana Gulch and Left Hand Canyon.

As noted above, Calvin M. Ward unearthed the Miser's Dream lode in 1860 and Cy Deardorf discovered the Columbia Vein the following year. At that time, prospectors were busy in the mining districts nearest Gold Hill, which offered the richest placer- and hardrock deposits. Ward and Deardorf's discoveries certainly piqued an interest among some individuals, but the lack of development and actual production discouraged anything approaching a rush. The prospectors who did take interest congregated in Columbia City, and they staked claims and excavated test pits along the Miser's Dream and Columbia formations. Through such efforts, the prospectors revealed that while the ore assayed rich with gold and silver, the ore was complex and the veins were not of equal proportion. The Columbia proved to be massive at more than 1,000 feet long, and within weeks or months, prospectors claimed much of its known length. They did not, however, conduct much work beyond shallow examination.

One prospector, C.H. Merrill, thought that the Columbia held great promise and paid $50 for what was named Claim No.10. His partners, however, disagreed and suggested he sell, even though the claim lay on the best section of the vein. It remains unknown how Boulder merchants Samuel Breath and William A. Davidson learned of Claim No.10, but they bought it from Merrill for $15 in 1861 or 1862 with the intent of bringing it into production. Within a short time, Davidson and Breath hired a crew of miners who sank a shaft into rich ore, and they financed the construction of a six stamp mill, which began recovering gold and silver by 1862.[1]

Davidson and Breath's new Niwot Mine had a significant effect on Indiana Gulch. Their investment and reward suddenly drew the attention of prospectors who were less than successful elsewhere in the county, and they finally rushed to the area in hopes of locating additional veins. A boom was now underway. Columbia City amassed enough of a population to attract businesses and to justify a post office, which the Postal Service recognized under the name of Ward in 1863.[2]

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[1] Bixby, 1880:429; Fritz, 1933:130; Hollister, 1867:266; Smith, 1981:38.
[2] Bauer, et al, 1990:148; Southworth, 1999:55.

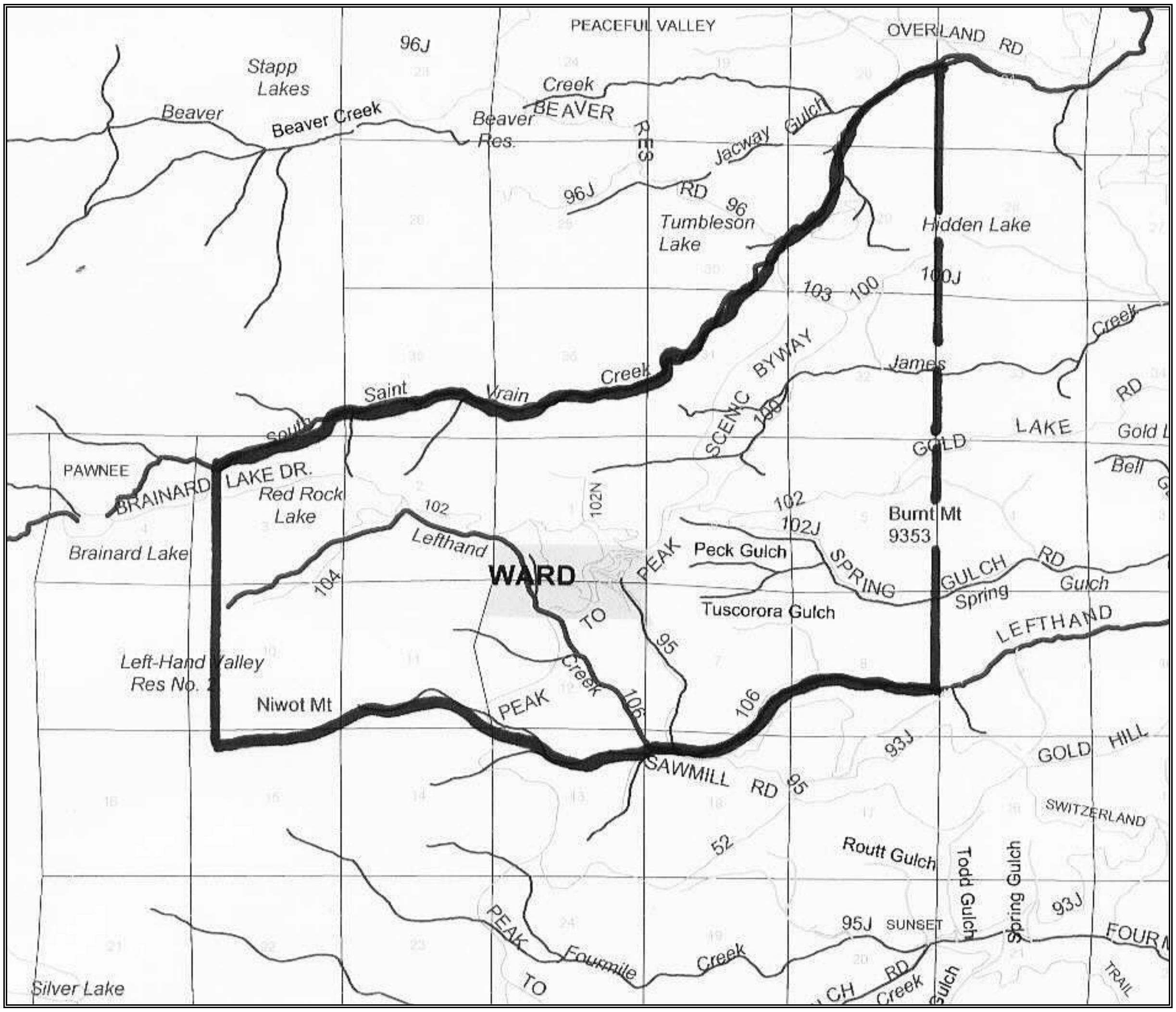

Figure E 4.2.1. The map illustrates the general geography of the Ward Mining District. The boundaries are approximate. Base map provided by Boulder County Land Use Department.

Davidson and Breath's Niwot Mine was the economic anchor for Ward and was also the only operation that enjoyed substantive production. This was possible only through the consolidation of adjoining claims, which Davidson and Breath purchased as they came up for sale. The unfortunate effect was that the partners locked up most of their money in property and left themselves with little operating capital.

By 1864, a number of partnerships and companies joined Davidson and Breath in generating ore. On the Columbia Vein, the various organizations developed the West Columbia, the Columbia, the East Columbia, the Baxter, the Nelson, the Austin, and the Idaho mines. The

Niwot, Columbia, and Nelson were neighbors and took in the best part of the vein, which crossed over the north flank of Niwot Hill. The Columbia was no longer the only ore body of interest. During 1863 and 1864, prospectors discovered the Ward, Nelson, Croesus, Banner, California, Stoughton, Norman, Rothschild, and other veins both to the north and south. While these new ore bodies lent fuel to a growing rush, the lack of capital retarded extensive exploration and development.[3]

In need of operating funds and interested in increasing the Niwot Mine's level of production, Davidson and Breath finally decided to include additional investors. In 1864 or 1865, they and Kansas Pacific Railroad directors Henry Dakin and C.S. Trowbridge organized the Niwot Mining Company, pooled resources, and spent $150,000 on an impressive surface plant. The improvements included one of Boulder County's first steam hoisting systems, as well as several buildings and an amalgamation stamp mill equipped with an impressive battery of 50 stamps. Unfortunately, the true cost of the improvements increased by around $55,000 when the mill burned within a short time of completion and had to be rebuilt.[4]

Around the same time, metallurgist and inventor J.V. Pomeroy established what became Ward's second largest mine. In 1865 or 1866, he organized the Long's Peak Gold Mining Company to acquire the Columbia, East Columbia, and West Columbia properties then built a mill that he designed. Unlike the Niwot Mine, Pomeroy only equipped the Columbia with a horse whim for hoisting, and while this apparatus was conventional at the time, its performance was painfully limited and restricted production.[5]

While the Niwot and Pomeroy mills constituted a significant ore treatment capacity, they were of little use to Ward's other nascent mines because the mills were dedicated to their parent companies. As a result, partnerships and outfits built several other amalgamation stamp mills to treat custom orders for those companies unable to afford their own facilities. One was the Cushman Mill, built at Ward in 1866, and another was the Utica Mill, erected the following year in conjunction with the Utica Mining Company. By 1868, Indiana Gulch resounded with the clatter of one water-powered and five steam-powered mills.[6]

The town of Ward was a full-fledged boom camp by around 1865 with a population of 200 to 400 young men, complimented by a few women and families. The success of the mining industry drew least 200 more people by 1867.[7] One observer noted that Ward consisted of "50 buildings, mostly frame; a post office, 6 quartz mills, two saw mills (one steam, one water power), a blacksmith shop, four hotels, three general stores, a bakery, a boot and shoe store, a meat market, a brewery, four saloons, a billiard hall, an organized school district, church services every Sabbath, a Masonic Lodge, and a Lodge of Good Templars working effectively to get rid of the saloons."[8]

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[3] *Colorado Mining Directory*, 1879:77; Hollister, 1867:20.
[4] Cobb, 1999:32; Fossett, 1879:91; Fritz, 1933:130; *History of Boulder and Clear Creek Valleys*, 1880:629; Hollister, 1867:266.
[5] Cobb, 1999:32; Hollister, 1867:269.
[6] Cobb, 1999:28, 31; *Vertical Files: Ward*; Wolle, 1995:517.
[7] Bixby, 1880:429; *Vertical Files: Ward*; Wolle, 1995:517.
[8] *Vertical Files: Ward.*

The sudden increase in freight- and passenger traffic caught the attention of both Boulder County's road-builders and local investors, who saw the potential for profits. In 1864, Davidson, Breath, and Pomeroy cooperated on a road up Left Hand Canyon from Lick Skillet Gulch, which essentially extended Thomas Graham's Gold Hill artery. Like Graham, Davidson and partners needed the road primarily to serve their mines, and they converted it into a toll way to pay for the construction costs. To capture more traffic, Davidson et al pushed a second route south into Gilpin County, which became known as the Niwot & Black Hawk Road. Around 1866, James P. Maxwell and Clinton M. Tyler added to their growing empire by grading a road to Ward from their sawmill at Orodelfan. The road became an important conduit for traffic directly from Boulder.[9]

With two highly profitable mines, a number of lesser operations, six stamp mills, a sawmill, and a booming town, prosperity seemed assured for the Ward district's 600 residents. Then the first sign of trouble materialized in 1867 when the Niwot Mining Company shut its mill down. Within a short time, some of the other mills fell silent, most of the small mines closed, then companies began to lay off their miners. Repeating the events that led to the collapse of mining elsewhere in the county, Ward's companies exhausted the free-gold and passed into a zone of pyretic, refractory material at depths between 100 and 200 feet. Assays indicated that the pyretic ore was rich, but the mineralization interfered with amalgamation. As a result, the costly stamp mills were now useless. Experienced metallurgist Pomeroy at once went to work to puzzle out the problem, but while he was tinkering with new processing methods, Ward's mining industry collapsed.

In 1868, the Ward Mining District's first Period of Significance came to an end. During the Period, which began in 1860, prospectors discovered some of Boulder County's highest and western-most placer deposits, organized a district, and began mining. Prospectors also established Columbia City, which was the predecessor to the town of Ward, and made some of Colorado's earliest hardrock ore discoveries. Ward grew into a significant town that hosted one of Boulder County's most important mining industries. Activity reached a peak between around 1864 and 1868, which coincided with the collapse of mining in the rest of the county. This overlap was important because Ward's industry softened what would have otherwise been a severe depression.

The Ward district's first Period of Significance was important for technological and economic reasons. The Ward district received some of the most advanced mining and milling equipment at the time in Boulder County and probably greater Colorado. Examples include steam hoists and large stamp mills. Further, J.V. Pomeroy may have been the first metallurgist in Boulder County to study the pyretic, refractory ore and experiment with treatment methods. Ward's gold and silver, and the business generated by the rush, stimulated local investment and the development of a transportation infrastructure, and contributed wealth to the county. The profits realized from Ward also strengthened local investors such as William Davidson, Samuel Breath, and J.V. Pomeroy, and provided them with funds to reinvest in the county.

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[9] Bixby, 1880:393; Kemp, 1960:28; Smith, 1981:36.

E 4.2.1: Time of Quiet, 1869 - 1876

At the same time that Ward saw its mining industry implode, noted metallurgist Nathaniel P. Hill was arranging the finishing touches on the solution to the refractory ore problem. Ward's mining companies were not alone when they exhausted the free-gold, and they faced the frustration of encountering untreatable but rich gold ore. Most of the outfits in Gilpin and Clear Creek counties were in a similar state, and collectively, they constituted a major ore treatment market for that individual who was fortunate enough to provide an effective solution. Nathaniel Hill was that person, and after studying state-of-the-art smelting and roasting facilities in England and Germany, he defined a process sure to work. In 1868, Hill finished his Black Hawk Smelter, successfully ran test batches of the troublesome ore, and was immediately overwhelmed with business from Gilpin County mining companies. Several years passed before Hill began accepting custom orders from the outside, and when he finally did, his smelter resuscitated portions of Colorado's mining industry.

The impact of the Black Hawk Smelter, however, decreased in intensity with distance from Black Hawk. The reason, as many mining companies realized, was that the value of their ore had to be at least $100 per ton to cover freighting costs, smelting fees of around $35, and 10 percent of the metals content lost to inefficiency. To meet such expenses and to pay for extraction at the mine, companies were limited to high-grade ore, which was uncommon. The situation improved through the 1870s when competition drove Nathaniel Hill's high fees down. Specifically, investors built the Golden Smelting Works in 1872, the Denver Smelting Company built a facility north of Denver in 1873, James H. Boyd began a smelter at the mouth of Boulder Canyon in 1874, and the Colorado Dressing & Smelting Company built another smelter at Golden in 1876. Threatened by all this new competition, Hill opened the Boulder Sampling & Crushing Works near Boyd's smelter in 1876. Hill's facility was intended to sort and physically reduce ore for shipment to Black Hawk instead of providing complete treatment.[10]

Not only did smelting costs fall, but also metallurgists such as J.V. Pomeroy figured out how to make the lower grades of ore profitable to ship. Specifically, they devised chemical and mechanical processes for crushing and separating out as much waste, known as gangue, as possible, in essence concentrating the ore's metal content. This was no easy task since the complexity of many types of ore, and especially those in Ward, resisted concentration. The result, however, was a wave of mill construction during the mid-1870s, many of which were no more than costly failures.

Those mining companies and investors who still had interests in the Ward district by around 1870 responded slowly to the above trends. Davidson and Breath's Niwot Mine was idle, and J.V. Pomeroy sold most of the Long's Peak Gold Mining Company assets to the new Ward Mining Company. Around this time, Ward featured a withered population of around 12 families and a few additional prospectors who actually made several potentially rich strikes. The

[10] Bixby, 1880:417; Boulder County Metal Miners' Association, 1910:6; Cobb, 1999:142; *Colorado Mining Directory*, 1879:125; Cox, 1989:26; Fossett, 1876:392, 409-410.

Milwaukee was one of these, and prospectors found it near the head of California Gulch in 1871.[11]

Enos K. Baxter and other investors organized the Ward Mining Company to purchase Columbia Vein claims in preparation for the moment when the ore would be profitable to ship. Baxter was born in Francestown, New Hampshire in the early year of 1805, and when old enough to leave home, he went to Boston and began a career in business. In 1849, Baxter joined the California Gold Rush and during the event, he both learned how to mine and realized a little gold. Baxter's experience, however, was not one of unbridled success, so he returned to New Hampshire in 1852 and probably engaged in business. The Pikes Peak Gold Rush drew Baxter to the Gregory Diggings in 1859, and unlike his California experience, Baxter finally struck it rich. He was among the first, fortunate prospectors to stake claims on the fabulous Bates Lode, which was one of the richest in Gilpin County. Baxter mined the vein for four years and realized a handsome profit for his effort, then sold an interest in 1864. Afterward, he invested in other mines, including the Baxter-Crispin above Central City and the Columbia at Ward, and based on his experience, the Ward Mining Company employed Baxter as the on-site manager beginning around 1872.[12]

The completion of the smelters in Golden and Denver by 1873 finally rendered Ward's ore profitable to ship, and several companies including Baxter's responded by producing batches of high-grade material. Investors attempted to concentrate the low-grade ore into something profitable, but with limited results. Pomeroy experimented with concentrating apparatuses and apparently sold his mill to Boston capitalists, who then employed him to remodel the facility. In general, mining at Ward was fitful and inconsistent during the first half of the 1870s, then gathered momentum as smelting fees continued to drop and concentration methods improved.

E 4.2.3: Hardrock Mining Boom, 1876 - 1893

Finally, the long-term property owners, investors, and residents were rewarded for their patience and confidence when boom times returned to the Ward district during the mid-1870s. The historic producers, which still possessed plenty of complex ore, led the revival. Around 1876, Davidson and Breath brought their Niwot Mine back into full production and drove extensive development workings on the Columbia Vein. By 1877, the main shaft was around 450 feet deep and was probably served by an improved hoisting system. To enhance ore concentration, the company, possibly under the guidance of J.V. Pomeroy, installed equipment for chlorination, which was a revolutionary chemical process for gold ore. Some archival sources claim that the Niwot Mine hosted the first application of chlorination in Boulder County. J.V. Pomeroy operated the Columbia Mine and successfully concentrated ore in the Pomeroy Mill. Enos Baxter's Ward Mining Company, located in Ward, developed what was now known

[11] Cobb, 1999:30; *Colorado Mining Directory*, 1879:103; *Vertical Files: Ward.*
[12] Fossett, 1876:234; *History of Clear Creek and Boulder Valleys*, 1880:436; Hollister, 1867:205.

as the Baxter Mine, and sank the shaft to a depth of 500 feet. Like the other principal operations, the Niwot company treated its ore in a mill.[13]

When the above companies demonstrated that Ward's ore veins were profitable despite Ward's distance from smelters, investors felt confident enough to risk their capital in a number of new operations. The Sunnyside Mining Company purchased the Milwaukee and sank the main shaft to a depth of 235 feet by the late 1870s. In 1876, Oliver P. Hamilton, E.W. Pierce, George W. Stone, and Peter Winne organized the Celestial Mining Company to develop the Celestial Mine in Spring Gulch to the east of Ward. Hamilton was a prominent investor and founding member of Salina (in Four Mile Canyon), Pierce financed mining ventures in the Gold Hill district, and Winne was a minor capitalist from Denver. Collectively, these three individuals typified the types of investors that were the most common throughout Boulder County.[14]

Wesley Brainard was another investor, and he also had characteristics of being visionary. Brainard was born at Rome, New York, during 1832, son of a civil engineer and railroad builder. The family sent Brainard to Rome Academy for an education, and when he graduated, Brainard began his career as a mechanical engineer on one of his father's railroad projects. In 1850, Brainard became an apprentice at the Norris Locomotive Company and, after four years, was promoted to position of on-site locomotive builder for the company. Brainard accepted the position as master mechanic for a railroad in Georgia in 1858 and returned to New York when the Civil War erupted. Within a year, Brainard assembled a volunteer company of engineers that built bridges and other contrivances for the Union Army while in battle. When the war ended, Brainard established the lumber firm of Soper, Brainard & Company in Chicago, which was successful for years. In 1873, Brainard invested in the Brighton Smelting Works and was appointed manager, and in this capacity, he learned a great deal about ore treatment.[15]

Brainard apparently came to the Ward district to examine several promising veins that he somehow learned of. Brainard convinced a small group of investors that these properties would pay handsomely given enough capital, the proper technology, and a sufficient workforce. In 1876, Frank J. Weist, Mancel Talcott, William G. Shedd, Nelson Morris, and Brainard organized the Chicago & Colorado Mining Company to begin development. Well in advance of actual ore production, Brainard laid out the townsite of Camp Talcott in Left Hand Canyon near the mouth of Tuscarora Gulch, where Weist built a concentration mill. From this location, miners went to work on several of the company's claims and at its Weist Mine, which was actually a deep haulageway driven westerly underneath Utica Hill. Brainard convinced his investors that the tunnel would undercut numerous veins a depth, and his ambitions ultimately outlasted their interests.[16]

The most significant new operation to come of the late 1870s boom was Edward J. Binford and John J. Ellingham's Humboldt Mine, located north of Ward (near today's Millsite

[13] *Colorado Mining Directory*, 1879:79; Eberhart, 1987:101; Fossett, 1879:64, 91; Hollister, 1867:268; Wolle, 1995:518.
[14] *Colorado Mining Directory*, 1879:78; Pettem, 1980:35; Smith, 1981:56.
[15] *Portrait and Biographical Record*, 1898:305.
[16] *Colorado Mining Directory*, 1879:79, 122; Eberhart, 1987:99; Southworth, 1999:64; Wolle, 1991:513.

Inn). Binford and Ellingham formed a complimentary partnership because Binford was a Denver businessman with experience in mining investment, as well as access to capitalists, and Ellingham knew the practical side of the industry.

Figure E 4.2.2. The Niwot Mine was one of Ward's oldest and most important operations during the late 1870s boom. The shaft house, center, may be the original structure constructed in 1865 or 1866, and the mill, right, was crucial for the mine's success. By the late 1890s, when Rocky Mountain Joe Sturtevant took this photograph, the mill was idle and its furnace chimney in decay. Source: Boulder Carnegie Library, 219-6-24d.

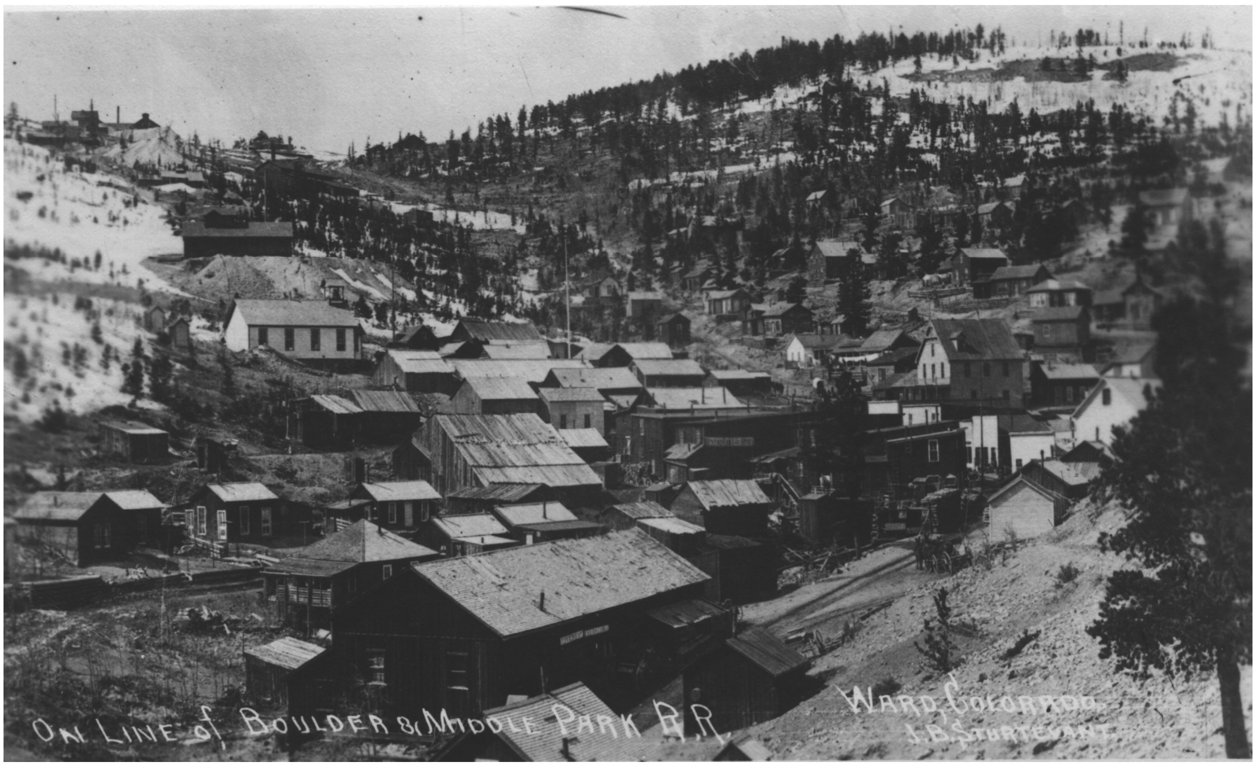

Figure E 4.2.3. By the late 1870s, Ward was center to a major industry, which allowed the town to become one of the county's most important economic contributors. The Columbia and Niwot mines, located on the Columbia Vein, are at upper left. The late 1890s western view captures the business district, which changed little from the late 1870s. Source: Boulder Carnegie Library, 213-4-24.

Ellingham was born in Cook County, Illinois in 1842 and worked the family farm as a boy. He joined the Pikes Peak Gold Rush at the late date of 1860 and, in need of income, worked a ranch in Jefferson County for a short time. After around a year, Ellingham finally went into the mountains to see the mining industry for himself. He worked as a miner and in mills in Gilpin County, and learned the basics of producing and treating hardrock and placer gold. With basic mining knowledge, Ellingham joined the rush to Virginia City, Montana in 1863 and tried his luck for a year but was back in Colorado in 1865 no richer. He worked as a freighter hauling supplies across the plains between Denver and the Missouri River, which was difficult and dangerous, until he finally got his break in the mining industry at Ward. Based on experience, it was probably William A. Davidson who offered Ellingham the position of foreman at the Niwot Mine in 1866. Two years later, however, the mine ran into trouble, and Ellingham left for an unsettled and rootless period in his life. He wandered California mining districts for several years, probably working as a miner, he traded cattle in Texas in 1871, and returned to the mountains of Boulder County in 1872. Ellingham supplied cordwood to the mines at Caribou then accepted the position of superintendent at several important Caribou mines in 1874. During this time, he saved enough money to begin investing on his own account, and in 1876 or 1877, Ellingham and Binford bought the Cushman Mill and Humboldt Mine at Ward under the firm of Ellingham, Binford & Company.[17]

The Cushman Mill allowed workers to process small lots of high-grade ore that miners removed from the old Humboldt workings while Ellingham and Binford improved the property. Originally, the Humboldt was one of Ward's early producers and was shut down while the workings were shallow. Ellingham realized that the Humboldt Vein would have to be developed properly and a mill capable of concentrating the complex ore constructed if the operation was to pay. Instead of remodeling the Cushman Mill, now known as the Binford, Ellingham personally designed the Humboldt Mill to serve the mine. Ellingham and Binford kept the Cushman Mill and ran it as a custom facility for those companies without their own mills.[18]

Ellingham proudly displayed his mineralogical acumen through the Humboldt Mill design, which exemplified what many companies desired for Ward's complex ore. The mill's success lay in its dual role as both an amalgamation facility and as a concentration works. Amalgamation equipment recovered any free-gold that was present in the ore, and a concentration process treated the rest of the material that would not amalgamate. The principal difference between the Humboldt and other mills was the use of a Bruckner roasting cylinder, which was a large revolving tube that workers charged with crude ore. Intense heat roasted the cylinder's contents, which drove off some of the sulphur and oxidized the ore, thereby increasing the amount of free-gold that could be amalgamated on-site. A battery of ten stamps crushed the crude ore into sand and gravel, which passed through grinding pans and other amalgamating equipment that extracted the available free-gold. Afterward, the sand and slurry went on to vibrating vanners that concentrated the metalliferous content that escaped amalgamation. Of note, some of the concentration appliances were special vibrating tables that J.V. Pomeroy developed specifically for Ward's ore. The Humboldt Mill did not function without problems because the processes required adaptation to the constantly changing character of the ore, but the combination of amalgamation and concentration demonstrated how other companies could maximize their metals recovery.[19]

As the late 1870s progressed into the early 1880s, mines in addition to the Humboldt rose to prominence. In 1880, Davidson and Breath sold their Niwot Mine to the Resumption Mining Company, backed by investors from New York City. They also purchased the adjacent Nelson Mine and treated ore in the Niwot Mill, which had been enlarged to a massive 125 stamp facility. Moderate-sized mines such as the Celestial and others enjoyed production at this time, but activity slowed and became intermittent in the district by the mid-1880s, possibly because companies exhausted most of the high-grade ore.[20]

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[17] Cobb, 1999:31; *History of Boulder and Clear Creek Valleys*, 1880:635-636.
[18] Bixby, 1880:429; Cobb, 1999:31, 43; Fossett, 1879:92; *History of Boulder and Clear Creek Valleys*, 1880:636.
[19] Cobb, 1999:43; Fossett, 1879:92.
[20] *Colorado Mining Directory*, 1883:73.

Regardless, Ward's principal operations continued to draw prominent investors. Around 1888, Robert H. Kline convinced fellow Philadelphia businessmen to organize the Utica Gold & Silver Mining & Milling Company and purchase the Utica Mine. While this venerable property was one of Ward's early producers, being initially developed by Cy Deardorf, it held great potential on the condition that the ore body was developed systematically. In 1889, Kline personally visited Ward, examined the Utica, and bought it. He also purchased the Binford Mill as a treatment facility and renamed it the Spaulding. The new company may have retained Deardorf as manager, and within a short time, Kline at al were rewarded for their venture when miners made a rich strike.[21]

One of the most well-known investors to sink money into Ward during the late 1880s was Horace A.W. Tabor, of Leadville fame. His Tabor Investment Company bought the Niwot Mine from the Resumption company on the premise that plenty of ore still existed. Tabor's interest created a stir among Ward's residents, who were both pleased at Tabor's confidence in their mines and hoped that his investment would inspire other powerful capitalists.[22]

High times at Ward continued into the early 1890s. The Baxter, Boston and Utica mines were the principal operations in town in part because they had been developed relatively late and offered plenty of ore. Some of the older properties, however, decreased in importance because their richest ore neared exhaustion after more than twenty years of production. For this reason, mines such as the Humboldt, Columbia, Niwot, and Madeline employed relatively small crews of miners. Despite this negative trend, the overall mining industry expanded as companies developed properties in the gulches to the north and south of Ward. The Morning Star Mine in Spring Gulch was the most significant operation to the north, and the Dew Drop was a member of a growing assemblage of new mines in California Gulch to the south. During the early 1890s, the Ward district hosted around eight substantial mines, twenty small operations, and a handful of prospects.[23]

As a town, Ward may have been larger and more energetic during the early 1890s than any other time. In 1890, the town boasted a population of 424 adults, which included families, and an additional 110 individuals lived among the mines and mills elsewhere in the district. The residents supported a wide variety of businesses such as the Jester & Thompson general mercantile, the Rachofsky & Jacobs dry goods store, Hemler's cigars and books, Bartholomew's cigars and candy, the S.M. Mathews butcher shop, David Kuntz's shoe repair, and G.R. Felton's barber shop. Miners and visiting guests found temporary accommodations and meals in one of five hotels including the Albany Hotel, the Columbia House, the Cottage House, the Sergeant House, and the Niwot House. T.J. Sipple provided assays for prospectors and independent miners, and a blacksmith maintained their tools and manufactured hardware. Ward, which was now a working-class town, featured the types of social institutions typical of gentrified, industrial mining settlements. Miners and workers mingled with each other in Ward's seven saloons and

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[21] Bailey, 1982:39; *Boulder County Herald* 9/18/89; *Boulder County Herald* 5/15/89; Wolle, 1995:518.
[22] Hall, 1891:307.
[23] *Boulder County Herald* 9/23/91; *Boulder News* 12/21/93; the number of operating mines was determined from a survey of archival records.

brotherhood organizations such as the Knights of Pythias and Odd Fellows, while women maintained social circles and attended Mrs. Hibbert's dance school. Community members regularly organized public events around holidays and held dances accompanied by brass- and string bands.[24]

The physical environment of Ward was typical of mature mining camps and offered a number of sensory offenses that the residents equated with prosperity. The thunder of at least five stamp mills, the chuff of steam engines at the mines, and the rumble of wagon traffic created a constant background din, and the smoke from boilers, blacksmith shops, and roasters at the mills generated a noxious cloud of smog. In 1894, however, Ward's residents grew increasingly alarmed when the noise decreased and their air quality improved, heralding a return of troubled times.

In 1893, the Ward district's second Period of Significance came to an end. The Period began around 1876 when a decrease in smelting fees, improvements in ore concentration processes, and greater investment fostered a revival that lasted for 17 years. The Period had at least one hiccup during the mid-1880s, and while most of the individual mines operated intermittently, they collectively formed a relatively stable industry. During the Period, capitalists of means acquired and consolidated the most important groups of claims, engineers developed ore bodies at greater depths than before, all the principal operations were mechanized, and mills provided fairly effective concentration. This allowed mining companies to extract lower grades of ore than before while maintaining profitability. The Period also saw an expansion of mining into the gulches to the south and north of Ward, which gave rise to small, unincorporated settlements that many miners called home. As a town, Ward moved farther along the pathway toward being a gentrified, calm, industrial center populated by families and individuals with an interest in the community.

The Ward district is associated with number of trends that were important on a local level during the second Period. One of the most prominent was a set of contributions that the mining industry offered to the county's economy. First, the profits realized from mining and milling made their way into the county, and second, the mining industry drew investment that was also distributed into the county's economy. A significant portion of these investments came from distant capitalists, and their money made its way into the county through various operating expenses. Third, the profits earned from some of the mines enriched local capitalists, who then reinvested some of their funds into various ventures within the county.

Another trend was that of the social geography of the western portion of the county. The mining industry expanded in the Ward district during the second Period, which reinforced Ward's role as a commercial and social center and created the seeds for the development of satellite settlements.

Technological progress was a third trend. During the second Period, metallurgists devised effective methods to concentrate the area's troublesome ore, which allowed the material to be mined at a profit. At the same time, engineers used planning and advanced machinery to

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[24] *Boulder County Herald* 9/23/91; Schulz, 1977:1890-2; *Vertical Files: Ward*.

extract ore from greater depths than before. The improvements in mining and milling were then applied with success elsewhere.

E 4.2.4: The Great Silver Crash, 1893 - 1897

During the last months of 1893, a conspiracy of factors caused the value of silver to tumble from around $.88 to $.63 per ounce, which had a major impact not only on the Ward district, but also on Boulder County and greater Colorado. At $.88 per ounce, most grades of silver ore were barely profitable to mine, and when the price fell, they became uneconomical. Mines across the West suspended operations, thousands of workers suddenly found themselves jobless, and a financial panic known as the Silver Crash of 1893 first swept the West then rippled out to the rest of the nation, ushering in a depression that lasted through much of the 1890s. Colorado, which relied to a great degree on silver, was devastated, and the effects trickled down to Ward where they resulted in two important trends. (For a full explanation of the Silver Crash of 1893, see Caribou Mining District history).[25]

The first and most immediate trend was that most of Ward's mining companies curtailed production or stopped operations altogether. One reason was that the dominant ore around Ward offered a blend of gold and silver, and it was only profitable to mine when the gold content was high enough to offset the silver. The other principal reason was that, given the dismal economic climate, investors were unwilling or simply unable to spend their money on anything other than the production of the highest grades of payrock, most of which had been exhausted years ago. Without funds flowing into Ward's mines, ore was unable to flow out. To make matters worse for Ward, a fire consumed much of the business district in 1894, which forced many out-of-work people and troubled businesses to leave.[26]

The second trend to come of the Silver Crash began to take form after 1895 and gave those Ward residents who persevered a reason for hope and kept the town from collapsing. In general, most capitalists saw their various investments evaporate after the Silver Crash, but a few financially adept individuals sought economic solace in gold because its value remained a constant $20.70 per ounce. After the worst of the depression passed by 1895, these capitalists fomented a limited but noticeable wave of interest in gold's source – the mines.[27]

Under this climate, California Gulch, located south of Ward, finally came to the fore. As early as 1890, Robert Duncan clearly demonstrated that the area held great potential when he discovered the Puzzler Vein in Puzzler Gulch, which was a southern tributary to California Gulch. Around the same time, the Dew Drop, located at the head of California Gulch, was in production, although the date of its initial development remains uncertain. In 1892, Ward's gold ore attracted investors William P. Daniels and N.C. Merrill, who began a campaign to acquire a number of potential producers, both new and old. The Dew Drop was among the properties, and,

[25] *Report of the Director of the Mint*, 1894:20; Saxon, 1959:7, 8, 14, 16.
[26] Bailey, 1982:39.
[27] Saxon, 1959:78, 14, 16.

according to a promotional publication, they organized the Orphan Boy Extension Mining & Milling Company in 1892 to acquire and work the property. In 1894, Daniels and Merrill purchased adjoining claims and reorganized the Orphan Boy company as the Dew Drop Mining Company, and they probably built the Dew Drop Mill at this time under the Dew Drop Milling Company. Within a year, Daniels and Merrill organized the Adit Mining Company to drive a lengthy haulageway underneath the Dew Drop and additional claims that the partners acquired. When Ward's mine owners decided to sell their properties and recoup their losses, the partners also purchased sections of the Columbia Vein and leased them to small parties.[28]

Unwilling to commute several miles from Ward to the Dew Drop, workers naturally established a cluster of residences at the head of California Gulch. As early as 1895, the informal settlement was named Dew Drop and featured a population as large as 200 residents. The settlement lacked a post office but may have included several small businesses.[29]

By 1896, Daniels and Merrill's gold mines constituted the most significant operation in the Ward area, although other notable investment outfits began work elsewhere. The Mutual Leasing & Mining Company may have been the most powerful, and in keeping with an emphasis on gold, the firm held properties in Cripple Creek. Robert H. Buck, who had extensive mining investment experience in Park and Lake counties, served as president, and Lucien Jones, a Denver businessman, acted as secretary. The company leased the White Chief Mine at Ward and began minor production. At the same time, the Gold Crystal Mining Company developed the Crystal Mine and invested in a new surface plant, and the Colorado Gold Mining & Milling Company conducted extensive exploration.[30]

While the search for gold, and actual production in the case of the Dew Drop consortium, kept Ward from completely dissipating, the entire mining district remained mired in depression. During this time, the number of active mines fell from eight to two substantial operations and from twenty to four small producers, and only several mills functioned. A reprieve for Ward, however, was around the corner.[31]

E 4.2.5: The Late 1890s Mining Revival, 1897 - 1905

As the decade of the 1890s waned, a variety of factors came together to spell a revival of mining throughout Boulder County and greater Colorado. First, the economy finally rebounded, investors were again willing to risk capital, financing could be found for businesses, and goods and services were readily available. Second, mine owners were more than willing to extend themselves to bring their idle properties back into production or sell them to investors to avoid sustained financial losses. Last, advances in mining technology and engineering decreased the

[28] *The Big Five*, 1901:3, 5; Colorado Mine Inspectors' Reports: Dew Drop; *Colorado Mining Directory*, 1896:217, 218; *Colorado Mining Directory*, 1898:118-121; Crossen, 1992:324, 329; *Portrait and Biographical Record*, 1898:178.
[29] Crossen, 1992:329; Wolle, 1995:514.
[30] *Colorado Mining Directory*, 1896:88, 217, 218.
[31] The number of active mines was determined from a survey of archival sources.

costs of mineral production, and improvements in milling methods permitted ores of greater complexity and lower grades to be profitably concentrated than before.

As a result of these factors, the Ward district exploded with activity and enjoyed what was probably its most important period of development and production. Nearly all the important historic properties surrounding the town of Ward were back in action and employed large crews of miners. Smoke belched from the stacks of the Columbia, Nelson, Humboldt, Kansas, Utica, and B. & M. mines, and some of their associated mills thundered away again. To the north around Peck and Spring gulches, Henry Tanton worked the Texas and New Market mines, and the Giles Gold Mining & Milling Company installed a large steam hoist and two straight-line compressors on its property. J.W. Pazzak and Paul Miller, who mined in Ward since the 1870s, operated the Calambia Mine and Mill, and the Morning Star Mine and Mill were back in production.[32]

Investors even became interested in new and speculative properties in the northern reaches of the Ward district. In 1898, the San Blas Gold Mining & Milling Company began the 700 foot long San Blas Tunnel and built a 10 stamp mill, and another outfit developed Struggler Mine and built another mill. Even though profitable ore had not yet been proven, these mills were constructed anyway, reflecting the eagerness and confidence among investors in Ward's gold.[33]

In the southern portion of the Ward district, Daniels and Merrill's Dew Drop consortium continued its dominant role. Some references indicate that Robert Duncan, who owned the Puzzler Mine, was now a partner with Daniels and Merrill, and he may have joined in exchange for improvement capital. During the year, these directors moved to consolidate Daniels and Merrill's five Ward companies into the ponderous the Big Five Mining Company, which became the foundation for one of the Ward area's most ambitious projects ever.

Archival sources differ as to the exact companies involved in the consolidation and the timeframe when it was formalized. According to a 1901 promotional publication, the companies were the Dew Drop Mining Company, the Adit Mining Company, the Niwot Mining Company, the Timberline Mining Company, and the Columbia Mines Company. During the late 1890s, Daniels and Merrill organized the Niwot and Columbia Mines companies to acquire the original Columbia group of claims on the Columbia Vein. The 1901 publication claims that the consolidation was completed in 1900, and that additional mines in Clear Creek County were also included.[34]

Most archival sources, however, indicate that Daniels and Merrill organized the Big Five company in 1897 around the Dew Drop Mining Company, the Dew Drop Milling Company, the Adit Mining Company, the Adit Tunnel Company, and the Niwot Mining Company. The

[32] Cobb, 1999:36; *Colorado Mining Directory*, 1898:119.
[33] Cobb, 1999:42; *Colorado Mining Directory*, 1902:26.
[34] *The Big Five*, 1901:2, 5.

agreement of most archival sources combined with mentions of the Big Five consolidation prior to 1900 indicates that Daniels and Merrill at least began the consolidation in 1897.[35]

What made the project highly ambitious was that an army of miners under the umbrella of the Big Five company would connect the disjointed Dew Drop workings, work them as one, and drive a deep haulageway north to undercut the Columbia Vein at great depth. The Big Five company would then enjoy production from the untapped depths of the Dew Drop, Columbia, and lesser veins, and concentrate the ore in the Dew Drop Mill located in California Gulch.

After the consolidation, Daniels, Merrill, and Duncan applied additional capital to build one of the Ward area's most advanced surface plants at the mouth of the Adit Tunnel. The original Dew Drop Mill was rebuilt as a three-story steel structure that housed an air compressor, an electrical generator, boilers, and milling equipment. The rest of the surface plant included a shop, a stable, an office, and a stone masonry explosives magazine. From this point, miners drove the Adit Tunnel toward the distant Columbia Vein and used it to bring ore from the Dew Drop system to daylight.[36]

The crew of 50 to 60 workers and their families continued to live at the settlement above the mine, which the company renamed Frances in 1898. The Postal Service formally recognized the town with a post office, and a few businesses moved in. At the same time, the Colorado & Northwestern Railroad finished its serpentine line to Ward and installed a small station directly above Frances. The railroad was lured to Ward in part by Daniels and partners, who pledged a significant tonnage of Big Five ore for the new Culbertson Mill near Boulder. The railroad directors built the mill in hopes that the combined service offered by the railroad and mill would capture most of Boulder County's mining business, and the product of the Big Five figured prominently into their plans.[37]

Between 1898 and 1902, the Big Five company realized its goals of undercutting the Columbia Vein and sent thousands of tons of ore out from the Dew Drop workings. By 1902, miners drove a total of around 11,000 feet of workings and lengthened the Adit Tunnel to 1,400 feet. At first, the railroad carried most of the ore down to the Culbertson Mill and the mining company concentrated the rest in its Big Five Mill. Over time, however, the company treated more of its ore on-site, which contributed to the demise of the Culbertson Mill.[38] The activity and facilities at the Big Five were so impressive that the regional mine inspector observed: "In extent of work, mill capacity, and number of men employed, the mines of the Big Five combination located at Frances in the Ward district, is the largest gold mining operation in Boulder County."[39]

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[35] Colorado Mine Inspectors' Reports: Dew Drop; Crossen, 1992:66; Holder, 1981:8; Wolle, 1991:517; Worcester, 1920:62-63.
[36] Colorado Mine Inspectors' Reports: Adit Tunnel, Big Five.
[37] Bauer, et al, 1990:58; Crossen, 1992:81, 82; Fritz, 1933:198; Holder, 1981:8; Wolle, 1995:514.
[38] Colorado Mine Inspectors' Reports: Big Five.
[39] Colorado Mine Inspectors' Reports: Big Five.

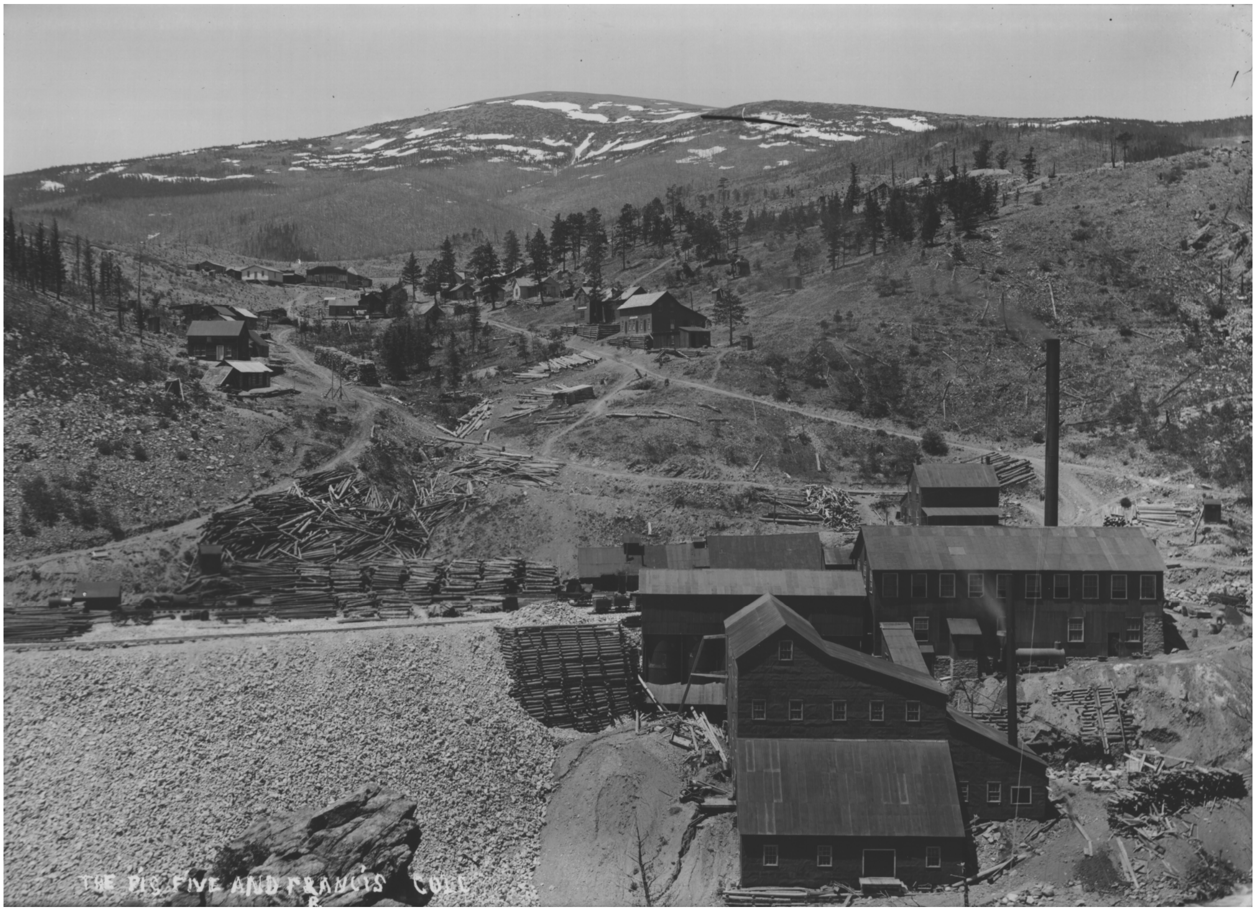
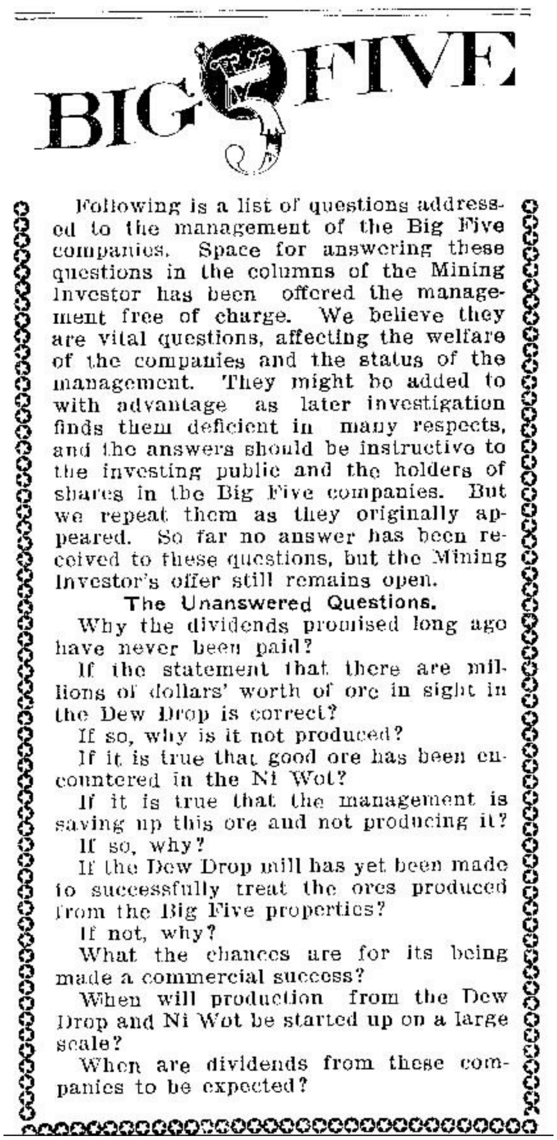


Figure E 4.2.4. The Big Five Mine, formerly the Dew Drop, was the most important operation in the Ward Mining District during the late 1890s. The Big Five Mill is at lower right, a powerhouse stands immediately above, and the stacks of cordwood stand adjacent to the Adit Tunnel. Miners employed at the Big Five and surrounding operations lived in Camp Frances, a portion of which is visible at upper left. A spur track for the Colorado & Northwestern Railroad extends right. Source: Boulder Carnegie Library, 219-3-5.

This trend did not last, however. By 1902, it was apparent that the mill was not recovering enough of the ore's metal content, and without effective treatment, the Big Five company scaled back operations. As built, the mill relied on stamps for primary crushing, sets of Cornish rolls for secondary pulverization, and water-filled jigs and vibrating tables to carry out concentration. While the equipment was effective for some gold and silver ores, it was not adjusted properly for that from the Columbia and probably the Dew Drop veins. In hopes of remedying the problem, the company contracted with metallurgist Henry E. Wood of Denver to revise the process. While Wood was at work, the company maintained a modest crew of miners who continued to develop the veins for future production.[40]

[40] Colorado Mine Inspectors' Reports: Big Five.



BIG FIVE

Following is a list of questions addressed to the management of the Big Five companies. Space for answering these questions in the columns of the Mining Investor has been offered the management free of charge. We believe they are vital questions, affecting the welfare of the companies and the status of the management. They might be added to with advantage as later investigation finds them deficient in many respects, and the answers should be instructive to the investing public and the holders of shares in the Big Five companies. But we repeat them as they originally appeared. So far no answer has been received to these questions, but the Mining Investor's offer still remains open.

The Unanswered Questions.

Why the dividends promised long ago have never been paid?

If the statement that there are millions of dollars' worth of ore in sight in the Dew Drop is correct?

If so, why is it not produced?

If it is true that good ore has been encountered in the Ni Wot?

If it is true that the management is saving up this ore and not producing it?

If so, why?

If the Dew Drop mill has yet been made to successfully treat the ores produced from the Big Five properties?

If not, why?

What the chances are for its being made a commercial success?

When will production from the Dew Drop and Ni Wot be started up on a large scale?

When are dividends from these companies to be expected?

Figure E 4.2.5. All through 1901, the conservative Denver mining industry journal *Mining Investor* published this advertisement questioning the legitimacy of the Big Five operation. One of the journal's missions was debunking investment fraud, which staff may have assumed the Big Five to be.

Wesley Brainard's Chicago & Colorado Mining & Milling Company pushed forward with the Ward district's second-most ambitious project. During the 1880s, the disillusionment of Brainard's investors stalled his grand plan of driving a deep haulageway underneath Utica Hill, but he was able to find new capital during the late 1890s revival. Brainard installed one of Boulder County's most advanced facilities at Camp Talcott, at great cost. As a visionary engineer, Brainard saw the potential efficiency of generating electricity at a central plant and wiring current to his disparate mining operations, and he completed the project by 1898. A pipeline carried water from South St. Vrain Creek to a battery of four turbines, which turned several dynamos enclosed in a stone masonry powerhouse. Wiring then sent current to electric hoists at the Left Hand and Coy shafts, and other machines at the Polar Star Mine. The advanced equipment expedited deep exploration for ore, which was the one important aspect that Brainard's grand plan lacked. To promote the as-yet barren operation, Brainard had the 1898 *Colorado Mining Directory* print: "When the full capacity of the power is utilized and the various mines are being operated by electricity, Camp Talcott will be the busiest little camp in the West, and its output may be no insignificant factor in the traffic of the railroad from Boulder to Ward."[41]

While miners were at work deep in the Adit Tunnel during the early 1900s, the mines to the north around Ward roared. In addition to the principal operations, various companies began developing a number of relatively new properties, such as the Ogden, Insbruck, the Success, the Ruby, the Celestial Extension, and others. The excitement over the Big Five operation drew interest to a number of poorly developed properties around California Gulch, including the Atlantic, Pennsylvania, Black Diamond, and Milwaukee mines. As a result, the role of Frances, which had been tantamount to a company town, expanded to that of a small center for independent miners and prospectors.[42]

Despite the boom, the first several years of the twentieth century were trying for the town of Ward. In January, 1900, the business district and many residences were lost to fire, and the devastation was so widespread that dozens of families were homeless. In response, the Boulder County Commission dispatched aid via the railroad, but without shelter, the winter forced many families to move into the outlying settlements. It remains unknown exactly how many people the late 1890s revival brought to Ward, but it can be assumed that the population was significantly more than the 424 people counted in 1890, when the mines were less active. After the fire, only 300 people remained. By contrast, the population of the entire district increased from 535 in 1890 to a busy 832 in 1900, which probably reflects, in part, the migration from Ward to the outlying settlements.[43]

After six years of intense development and production, many of Ward's historic producers and relatively new mines finally showed signs of exhaustion. The year 1905 saw a wave of mine closures, the most prominent of which was the Big Five operation. This monumental and costly failure ushered in a general feeling that Ward's best days were finally over, bringing the Ward district's third Period of Significance to an end.

The third Period of Significance began with a major revival in 1897 and lasted until around 1905, when mining companies finally exhausted the district's principal ore bodies. This timeframe can be noted as the Ward district's most important period of activity that not only involved significant mining activity, but also extensive prospecting. Between 1897 and around 1900, partnerships and small outfits were at work on at least forty deep prospects, which was more than at any other time. Between around 1900 and 1905, the number of deep prospects

[41] *Colorado Mining Directory*, 1898:118.
[42] Cobb, 1988:37; *Colorado Mining Directory*, 1902:3, 16, 20, 21, 25, 27
[43] Bailey, 1982:39; Schulz, 1977:1890-2; Schulz, 1977:1900-4; Southworth, 1999:56; *Vertical Files: Ward*; Wolle, 1995:520.

decreased to approximately fifteen, which is close to the initial boom of the late 1860s. This trend illustrates that the Ward district still offered the potential for new ore bodies, even after almost forty years of activity.[44]

Between around 1897 and 1905, at least ten significant mines were in production, and between 1897 and 1900, approximately fifteen small mines were active. By around 1904, the number of small mines increased to more than twenty. This coincides with a decrease in deep prospects, some of which were probably brought into production as small mines.[45]

In general, the Ward district experienced several important trends during the third Period of Significance. First, in terms of industry, the Ward district saw its greatest levels of investment, ore production, promotion, physical expansion, and overall development. During the Period, Ward's mines contributed heavily to local and county-wide economies, and the mining companies consumed more machinery and supplies than any other time. The vibrant mining industry also drew the railroad, which specifically targeted the Ward district's mines as an important source of freight income. This strengthened the Ward district's involvement with commerce, banking, finance, and communication. In terms of society and culture, the Ward district's population reached its peak, and while most of the people lived in the town of Ward, they also established a number of outlying settlements. The large population fostered cultural institutions, communication systems, civic improvements, and commerce for non-industrial goods and services. Further, by consuming fresh foods, the population contributed to the growth of Boulder County's agricultural industry.

E 4.2.6: Irrecoverable Decline, 1905 - 1933

Concerned by a gathering quiet, the residents of the Ward district were naturally troubled by the decline of their industry and looked to what had been the richest mines and the most promising operations for hope. They would not find it in the district's northern reaches. At the San Blas Mine, the Myrtle Mining Company lost the costly mill to fire in 1906 then abandoned work. At the aptly named Struggler Mine, the owners gave up around 1908 after being unable to make the ore body pay. The district residents found little evidence for hope immediately around the town of Ward. The usual producers such as the Columbia, Utica, B. & M., Modoc, and others were active, but their waning ore reserves were able to support only small groups of lessees instead of the full-scale company operations of several years ago. For context, where $200,000 flowed out of the Ward district's mines in 1899, the small parties of lessees generated a mere $41,000 in 1910.[46]

For hope, the Ward district's residents had to look south to California Gulch, whose mines once again produced the most ore. The Big Five company naturally fell into this category because it had been not only one of the district's largest employers, but also the underground

[44] The number of prospects was estimated from surveys of *Colorado Mining Directories* and other archival sources.
[45] The number of active mines was estimated from surveys of *Colorado Mining Directories*.
[46] *Mineral Resources of the United States*, 1906:209; Worcester, 1920:56.

workings penetrated multiple veins where miners thought that ore could still exist at depth. After the Big Five company declared bankruptcy in 1904 and the county sheriff seized the property, Daniels and partners pooled their resources, organized the Big Five Tunnel, Ore Reduction & Transportation Company, and bought the property back. Possibly because they lacked the capital necessary to pay for operating costs, Daniels and partners were unable to resume production until 1907. When they did, the mine became Ward's largest employer both through company operations and blocks of ground that the company leased to independent parties. Through 1910, both the company and the lessees focused on high-grade ore, and since most of this material had been exhausted years ago, they had to produce a majority of low-grade ore, which they concentrated with limited success in the mill. By the end of the year, both the lessees and the company suspended operations, leaving the Big Five complex idle.[47]

As quickly as the Big Five collapsed, California Gulch saw another significant operation begin production. Between 1890 and 1909, various individuals had taken a tepid interest in the White Raven Lode, located on the gulch's north side. While the White Raven offered rich ore, it bore mostly silver and lead, which garnered limited attention following the Silver Crash of 1893. During this timeframe, Claude Loder and Greg Duval did the most with the property in conjunction with their Ward Pyretic Smelter, which the partners built at the mouth of California Gulch in 1898. They built the smelter as a treatment facility for various mines that they either purchased or leased in the county, and Duval and Loder were interested in the White Raven's lead ore as a flux material. The partners began driving the St. Louis Tunnel north from the gulch floor to undercut the vein and completed at least several hundred feet before their entire scheme collapsed.[48]

The White Raven saw no further activity until 1910, when L.A. Ewing and Cassius M. Webb took an interest in the untapped vein and planned to bring it into production. Instead of spending their own money on development, Webb and Ewing leased the property to Ralph M. and Frank W. Davis, who invested in a mechanized surface plant. Specifically, the brothers installed a steam compressor, a boiler, and a shop, and hired a crew of miners to resume driving the tunnel toward the vein and sinking a shaft down to a union point. Within one or two years, the miners undercut the vein and began production.[49]

Impressed by the progress, Ewing approached the Davis brothers and proposed a joint operation, which they accepted in 1913. With Ewing's capital, the new organization of L.A. Ewing & Company invested a considerable sum in a new surface plant to accommodate increased production. Workers upgraded the existing compressed air system with electric Ingersoll-Rand and Bury compressors, which miners used to power as many as ten rockdrills underground. They also installed an electric hoist over a winze on the vein, and constructed a mechanized shop at the tunnel portal. To power the assortment of electrical equipment, the company designed a system that generated power from a hydro dynamo and distributed the

[47] Colorado Mine Inspectors' Reports: Big Five; Crossen, 1992:151; *Mineral Resources of the United States*, 1906:209; *Ward Mines and Mining, Clippings.*
[48] Cobb, 1999:145; Gustavson Associates/Pettem:2.
[49] Gustavson Associates/Pettem:5; *Mineral Survey Records.*

electricity to transformers at the buildings. This may have been the costliest surface plant erected in the Ward district since the late 1890s.[50]

Only a year after L.A. Ewing & Company prepared for production, political unrest in Europe promised a sound return on the investment. When World War I began in 1914, manufacturing industries at first in Europe and then in the United States mobilized to meet a heavy wartime demand, and as the war progressed and devastated Europe's economy, governments there sought stability in silver. In addition, the value of industrial metals, including lead, slowly rose during the first years of the war then shot upward as the war dragged on. The value of silver ascended slowly from an abysmal $.54 per ounce to $.73 by 1916, then rose to $1.04, and lead doubled from $.04 to $.08 per pound.[51]

In this positive climate, L.A. Ewing & Company brought the White Raven Mine into full production. A crew of 18 miners developed the vein at the tunnel level and deepened the existing shaft to undercut the vein at depth. Metals prices were so high that William Daniels even investigated reopening the Big Five Mine. In 1917, he hired a workforce of seven workers who remodeled the mill and rehabilitated critical areas underground. Unfortunately, Daniels was no closer to figuring out how to render the Big Five low-grade ore profitable, but the White Raven produced more payrock than ever.[52]

To the north, the situation continued to decay in the rest of the Ward district. One by one, the usual producers fell silent and their owners sold these venerable mines to local interests who tried reopening them. Such was the case with the Humboldt Mine and Mill, in which Lucius Hallet and G.A. Kline employed only five miners between around 1914 and 1922. The Modoc Mine and Mill ran on a similar scale, and small parties of miners scratched out ore in the Utica and Columbia mines.[53]

In 1918, catastrophe visited California Gulch in the form of an unusually wet spring. One rainstorm dumped inches of water on already saturated soil, filling a dam on Left Hand Creek above Frances to an overflowing level. As the storm continued, the dam burst and released a flashflood that destroyed a significant portion of the White Raven Mine's handsome surface plant. Naturally, production was interrupted, but the company kept eight workers busy reconstructing the damaged facilities and developing segments of the vein.[54]

The company used the event as an opportunity for an expansion in the form of a mill to concentrate low-grade ore that was previously uneconomical to ship. Finished in 1919, the mill greatly contributed to the profitability and local importance of L.A. Ewing & Company because it was the only operational concentration facility in the mining district, all the others having closed down. In addition to treating L.A. Ewing ore, the White Raven Mill may have treated custom orders for outfits with compatible payrock. As designed, the mill featured a jaw crusher for primary crushing, a crushing rolls for secondary grinding, classifying screens to segregate

[50] Colorado Mine Inspectors' Reports: White Raven; Gustavson Associates/Pettem:6; Worcester, 1920:60.
[51] Henderson, 1926:216; King, 1977:183; Saxon, 1959:7-17.
[52] Colorado Mine Inspectors' Reports: Big Five, White Raven.
[53] Cobb, 1999:47; Colorado Mine Inspectors' Reports: Humboldt, Utica; Worcester, 1920:63.
[54] Colorado Mine Inspectors' Reports: White Raven; Gustavson Associates/Pettem:20.

particles, a Wilfley vibrating table for primary concentration, and a Card vibrating table for secondary concentration. Pumps provided water, several motors powered the machinery, and a small boiler generated heat for workers and for drying concentrates. Unlike the ill-fated Big Five facility, the White Raven Mill recovered metals as planned and was kept in operation by a crew of four workers.[55]

In high production, the White Raven remained the Ward area's single most important operation until the fateful year of 1922, when two events clouded the mine's future. The first developed when the values of silver and industrial metals collapsed following Europe's recovery from World War I. What had been bonanza-quality ore became worth half its former value, and the low-grade material treated in the mill was no longer profitable to mine. The second was the death of L.A. Ewing, who had been the driving force behind the operation. In 1922, L.A. Ewing & Company apparently dissolved and sold the White Raven to H.O. Andrew, who leased the mine to Graham & Company. Over the course of the year, a meager crew of two miners finished stoping out the high-grade ore then closed the White Raven. Afterward, the mill was dismantled.[56]

The Ward district remained quiet through the 1920s and into the Great Depression, which began in 1929. As a clear indicator of the mining industry's decline, the number of significant producers dwindled from around ten between 1900 and 1904 to three between 1915 and 1920, and down to one by 1925. In parallel, the numbers of small mines and deep prospects both contracted from around fifteen to six. Ore production decreased from thousands of tons per year during the late 1890s revival to around 1,000 tons per year afterward, with the White Raven contributing to several peaks of over 2,000 tons in 1914 and 1921. For context, the reader should keep in mind that on average, one miner was capable of producing one ton of ore per day. After 1923, when there was any production at all, miners generated less than 100 tons per year. Without a viable mining industry, most people left the Ward district, and the population plummeted from 832 in 1900 to 222 in 1910 and continued to fall to 80 by 1930. Similarly, 300 people lived in the town of Ward in 1900, even after the January fire, but by 1930, only 10 percent of the residents remained.[57]

E 4.2.7: The Depression-Era Mining Revival, 1933 - 1942

In 1929, the nation's economy collapsed and ushered in the Great Depression, which shaped the United States as we currently know it. At that time, thousands of people were thrown out of work, capital necessary for industry evaporated, and many goods and services were curtailed or became no longer available. In 1932, Franklin Delano Roosevelt was elected

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[55] Cobb, 1988:27; Colorado Mine Inspectors' Reports: White Raven; Shea, 1988:4; Worcester, 1920:69.
[56] Colorado Mine Inspectors' Reports: White Raven; Shea, 1988:4.
[57] Schulz, 1977:1900-4; Schulz, 1977:1910-9; Schulz, 1977:1920-6; Schulz, 1977:1930-7; the number of active mines was determined from a survey of Colorado Mine Inspectors' Reports, and production figures came from a survey of *Mineral Resources of the United States*.

president and immediately began developing a variety of programs to revive the dismal economy, including a plan intended to simultaneously devalue the dollar while stimulating metals mining on a broad scale. As part of the plan, the dollar was taken off the gold standard and the Federal Reserve bought gold at inflated prices. The plan worked well and stimulated gold mining as expected, proven by an increase in the volume of gold that flowed into the treasury. In 1934, satisfied with the test, Roosevelt signed into law the Gold Reserve and Silver Purchase acts in hopes that they would resuscitate mining. The Gold Reserve Act raised the minimum price of gold from around $20.67 to $35 per ounce and the Silver Purchase Act raised the value of silver from around $.40 to $.70 per ounce.[58]

Roosevelt's plan combined with widespread destitution, lack of employment, and initiation of a raft of government programs spelled a Depression-era revival of mining across the West. In general, with mineral resources offering some semblance of income, experienced miners returned to properties that they thought may still possess ore, and inexperienced laborers formed a workforce necessary for their mining operations. Adding to the growing interest in the return to mining, advances in milling technologies rendered previously uneconomical ores profitable to produce. Overall, the revival was minor compared to mining operations of decades past, but Boulder County, including the Ward district, witnessed a return to the old mines on a scale not seen since the 1900s.

In this climate, most of Ward's historic mines again attracted interest, which fostered a low-level but noticeable change in the area. The town's population increased to around 125 and that of the greater district was as much as around 185, roughly double from the 1920s. Further, much to the delight of the town's residents, enough people lived in the district to support several businesses, including a few small hotels and a school.[59]

One of the principal demographic groups that moved back to town was miners, who may have been employed by one of the several leasing outfits. In 1935, F.A. Nagle leased the B. & M. Mine to a small party that invested sweat-equity in the property, then enjoyed minor production. In 1934, G.C. Gibson leased the Celestial from owner R.E. Arnett, the partners James and Joe Walters leased the Golden Queen Mine, and various lessees worked sections of the Celestial Mine. Charles Strong and the Ward United Mines Company were the two most significant operators in the Ward district during the Depression-era revival. Strong worked in Ward's mines since the 1910s and possibly earlier, and by the late 1930s, he held enough capital, as limited as it was, to lease entire properties and employ small crews. In 1937, Charles and brother Robert organized the Boston Mining Company and leased the Boston Mine until 1939 then turned the property over to the Ward United Mines Company. Under Charles, the Boston was one of Ward's best producers during the 1930s, which is why Ward United retained him. Ward United also leased the Utica and operated both properties in tandem.[60]

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[58] McElvaine, 1993:164; Saxon, 1959:7, 8, 12, 14, 16.
[59] Schulz, 1977:1940-9; *Vertical Files: Ward.*
[60] Colorado Mine Inspectors' Reports: B&M, Boston, East Boston; *Minerals Yearbook*, 1939:288; *Minerals Yearbook*, 1941:300.

After being closed for more than a decade, the North American Mining Company acquired the Big Five and J.C. Gates of Indiana bought the White Raven, and in 1933 both parties brought their respective properties back into limited production. Stanley M. Walker and Associates leased the Big Five and cautiously began with a substantial crew of 14, most of whom sorted the waste rock dump at the Adit Tunnel for low-grade ore cast off in the past as uneconomical. At the White Raven, W.G. Paulding kept several miners busy removing ore left in the form of support pillars in the old stopes. Both mines saw increased operations in 1934 and 1935. At the White Raven, a surface crew imitated that at the Big Five and began sorting through the waste rock dump in search of low-grade ore, while a handful of miners continued the practice of blasting down the old support pillars in the stopes. In 1935, R.W. Graham, who now leased the property, installed a mechanical screening system on the foundations of the White Raven Mill to enhance the sorting effort. The Big Five Mining Company, which now leased the Big Five, invested in new mill equipment, mules to pull trains of ore cars through the Adit Tunnel, and air compressors to power rockdrills underground. By 1934, the company successfully treated low-grade ore brought out of the mine and shipped the product to the Golden Cycle Smelter in Colorado Springs.[61]

Figure E 4.2.6. In 1935, R.W. Graham built a screening station at the White Raven Mine to process waste rock. Today, only the skeleton remains. Source: Author.

[61] Colorado Mine Inspectors' Reports: Big Five, White Raven.

The year 1935 saw the last production of significance from both the White Raven and the Big Five properties. The diminishing value of the ore, the exhaustion of known reserves, and a lack of new discoveries forced the lessees to close both mines. The Black Jack Mine, however, was just beginning production. The mine's early history remains uncertain, although it appears that someone found a second ore system adjacent and similar in content to the White Raven. By 1936, W.D. Owen and George Gerrish leased the property, located between the White Raven and the Big Five, and realized small volumes of ore for their efforts. But the operation was short-lived and California Gulch grew quiet again.[62]

Charles Strong operated the Ward district's only mill that regularly provided custom concentration. Originally built around 1912 as the Conqueror Mill, Strong bought the facility during the first years of the Great Depression and refitted it for custom work. Between 1933 and 1936, the Strong Mill treated ore from the Big Five and the White Raven mines, and from the Boston and B. & M. afterward. In addition to the Strong Mill, the Boston and Utica facilities treated ore from their respective mines on an irregular basis, as well.[63]

In terms of technology and the nature of ore production, miners in the Ward district regressed during the Depression-era revival. Whereas some mining outfits elsewhere in Colorado employed modern equipment and had the funds for underground exploration, the companies in the Ward district barely eked out an existence. G.C. Gibson's operation at the Celestial exemplifies the state that most of district's mines were in. Instead of new and efficient electric equipment, Gibson still relied on the mine's original steam hoist and boiler, which were quite serviceable but at least thirty years old. W.G. Paulding's White Raven operation was even more primitive because it lacked power equipment, which required his miners to bore blast-holes by hand. Both Paulding and Gibson focused their efforts on sorting waste rock and gleaning ore that the original miners missed in the old stopes.[64]

In 1941, the nation's entry into World War II set in motion a series of events that deeply impacted what little mining continued in the Ward district. Under President Roosevelt, the Federal Government initiated a series of programs to organize and administer to economic, material, and labor resources as part of the war mobilization effort. With domestic mineral and metal resources suddenly of supreme importance, the government naturally passed several pieces of legislation that emphasized mining. War Production Board Ruling L-208 was among the legislation and, much to the dismay of Depression-era miners throughout Boulder County and across Colorado, it mandated the immediate suspension of gold mining by the end of 1942 on the grounds that gold was not of strategic importance.

Reliant primarily on gold ore, nearly all the mines in the Ward district had to close, which brought to an end the fourth Period of Significance. During this period, the Ward district enjoyed its last revival, and while production was limited and people were glad merely to hold

[62] Colorado Mine Inspectors' Reports: Big Five, Black Jack, White Raven.
[63] Cobb, 1988:25; Colorado Mine Inspectors' Reports: Big Five Tunnel, B&M, White Raven; *Mountaineer-Mineral Age* April, 1936:11.
[64] Colorado Mine Inspectors' Reports: Celestial, White Raven.

jobs, the mining industry may have been better off than any other time following 1905. The reason was that the Federal Government raised the values of both gold and silver, which stimulated an increase in the number of small mines from around seven at the beginning of the Great Depression to around fifteen after the price increases were formalized in 1934. Due to the lack of capital for property rehabilitation and improvements, only one large mine returned to being a significant producer. The rest of the operations were little more than capital-poor lessees. In parallel with the above, ore production increased from the equivalent of one miner's worth per year to 4,300 tons per year by 1934. The level decreased as miners finally exhausted even the small bodies of low-grade ore in most properties, then peaked in 1939 at an impressive 7,600 tons, which represents the development of the Boston and B. & M. mines. Production almost disappeared after the War Production Board passed L-208 in 1942.[65]

Historic resources with integrity relative to the fourth Period of Significance may have participated in several important trends. The first is that the Ward district saw its most significant period of production since the late 1890s revival. This was particularly timely because without mining, Ward's residents probably would have abandoned the district since no other source of income existed. In addition, Ward's mines contributed greatly to the economy of Boulder County at a time when money was dear, they maintained a workforce and aspects of the original cultural geography in the mountains, and helped some investors amass capital that they reinvested in other ventures. Overall, the Ward district's industry was an important and contributing element of a Depression-era revival that swept Boulder County and greater Colorado.

E 4.2.8: An End to Mining, 1942-1980

When the War Production Board passed L-208 in 1942, it ensured an end to the Ward district's mining industry. From 1943 to present, no company in the district generated more than the tonnage of one miner per year. By 1950, only ten people called Ward home and another thirty lived elsewhere in the district, and by 1960, most of these individuals left.

Interestingly, at a time when mining in Boulder County passed largely into memory, California Gulch sheltered one of the county's last operations of note. Specifically, Fred E. and Thelma E. Tracy, and Janet E. Dunkel were optimistic that the Black Jack Mine still offered enough ore to sustain production, in part because the mine was a relatively late addition to Ward's industry. In 1965 or 1966, the three partners organized the Black Jack Mining & Milling Company and at first leased the mine and mill from owner Fred C. Davis, and when production began, they purchased an interest. By 1970, Davis decided to part with his remaining shares, and it seems likely that the Traceys turned to Richard C. Coltrane and Robert N. Coakley for capital.

[65] The number of active mines was determined from a survey of Colorado Mine Inspectors' Reports, and production figures came from a survey of *Mineral Resources of the United States*.

After five years of limited production and some milling, the Black Jack company suspended operations and passed the property on to a new group headed by Coakley.[66]

Between 1972 and 1973, the Arcy Corporation explored the vein for new ore deposits and after it proved successful, Coakley interested investors in a formal mining venture. In 1974, he and Thomas and Robert W. Sander organized the Captain Jack Mining & Milling Company to resume where the Black Jack firm left off. Between 1975 and 1978, they experienced limited success and produced payrock on a sporadic basis, some years averaging only $5,000 worth of ore. In 1978, the Captain Jack outfit suspended operations, even though the results of exploratory drilling suggested that ore still lay in the ground.[67]

Paul and John Danio were convinced that they could do what the Captain Jack outfit could not, which was to make the Black Jack Mine pay. In 1981, they organized Captain Jack, Limited to resume exploration and to produce the ore that still remained. Instead of focusing exclusively on the Black Jack, the Danios turned to another likely source of ore, which was the maze of workings in the original Big Five Mine. In 1982, the Captain Jack outfit cleaned out the heavily silted Adit Tunnel and rehabilitated critical areas underground, then conducted an exploration and drilling campaign in the Big Five and the Black Jack workings.[68]

It remains unknown whether the Danios encountered ore in either mine, and if they did, the quality and quantity were insufficient to interest investors in significant development. The Danios apparently then tried using the Black Jack Mill, now known as the Captain Jack, as a facility to concentrate tungsten ore, then suspended operations by 1983. The Danios did not give up entirely on the operation and tried operating the mill on ore probably mined from either the Black Jack or Big Five workings in 1992. Unfortunately, the Danios discharged the mill tailings into Left Hand Creek, which roused the ire of local residents. Complaints about the operation drew inspectors from the Division of Minerals and Geology who shut down the operation for non-compliance and brought an end to the last mining operation in the Ward district.

[66] Colorado Mine Inspectors' Reports: Black Jack.
[67] Colorado Mine Inspectors' Reports: Black Jack.
[68] Cobb, 1999:27; Colorado Mine Inspectors' Reports: Black Jack, Misc. D.

E 4.3: The History of the Caribou-Grand Island Mining District

E 4.3.1: Discovery and Development, 1869 - 1875

During the late 1860s, Boulder County's mining industry was poised on the brink of extinction. Miners long since exhausted the gold at Gold Hill and in the surrounding mining districts, the booms at Ward and Jamestown ended for the time being, and the handful of prospectors who continued to peruse the county found little of significance. Then, in an unlikely place, prospectors from Gilpin County struck silver ore so rich that the event launched one of the greatest rushes to sweep Colorado's Front Range.

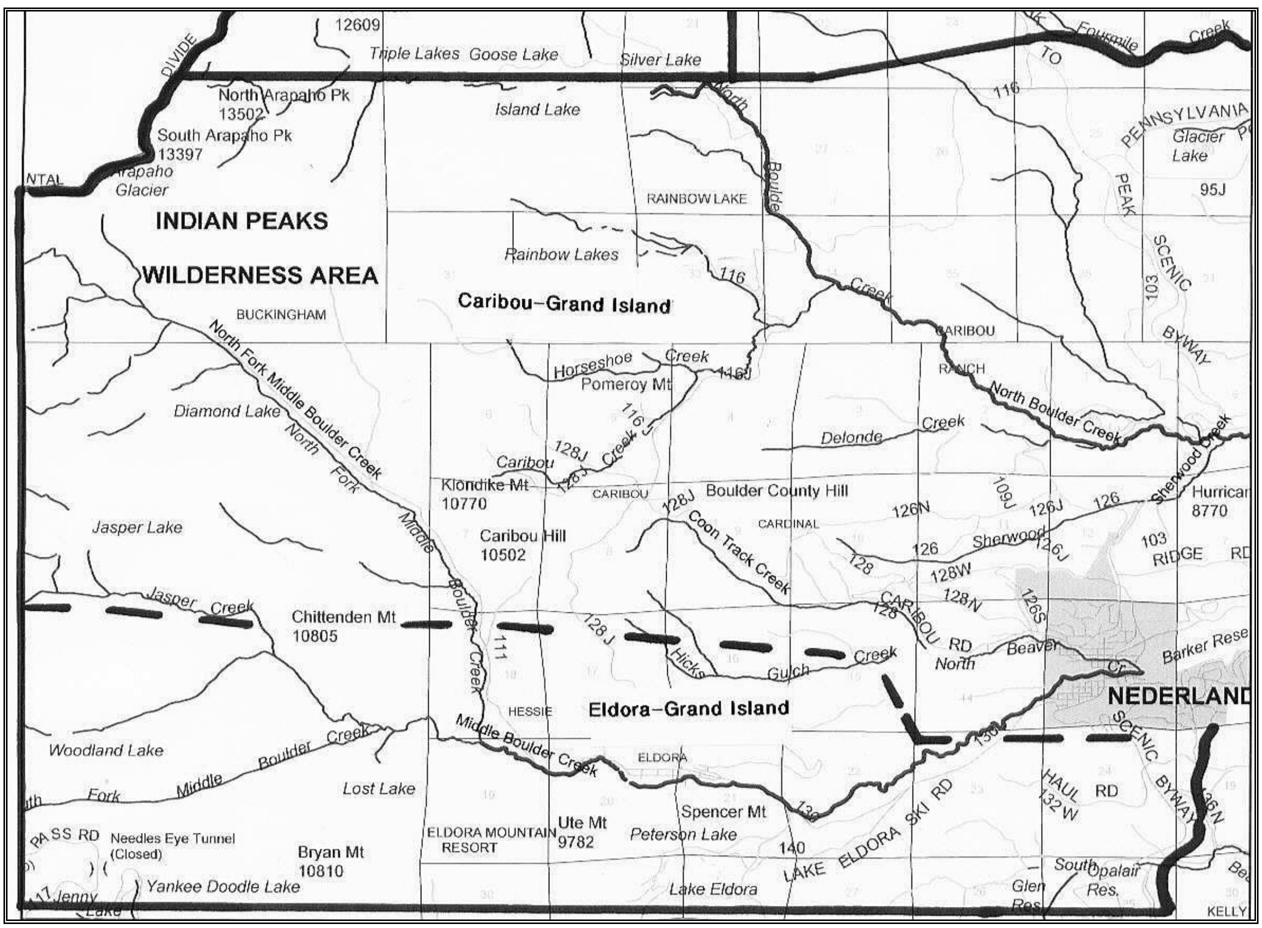

Figure E 4.3.1. The map illustrates the Caribou-Grand Island Mining District. The south boundary originally followed Middle Boulder Creek and was amended in the 1890s to take in Eldora, and the boundaries shown are approximate. The town of Caribou was near center. Base map provided by Boulder County Land use Department.

Archival sources recite at least three versions of exactly how the silver ore was discovered, but all agree that one man, Samuel Conger, was responsible. Conger was born at Marietta, Ohio in 1833, and entered the mining industry at the youthful age of 17 as a prospector who searched for lead in Wisconsin. He joined the California Gold Rush and used his experience to find gold, then tried to repeat his success in Gregory Gulch in 1859. Conger prospected for a year with meager results and, in need of income, hunted game in Gilpin and Boulder counties to sell to butchers. Through his expeditions, Conger supposedly became the first White prospector to thoroughly explore the Arapaho Peak area in Boulder County. Since the proceeds from hunting met only some of Conger's needs, he found work at Samuel Mishler's sawmill and ranch north of Black Hawk. Mishler also employed William J. Martin, and was assisted by his father-in-law George Lytle, John H. Pickel, and Hugh McCammon. Conger later went on to prospect Middle Park and the Breckenridge area, and also developed a reputation for self-promotion, which may be why he is currently credited with the Caribou strike.[69]

One version of Conger's discovery suggests he encountered silver specimens on one of his hunting expeditions into the Indian Peaks and failed to recognize what they were until observing a carload of similar ore on a train in Wyoming in 1869. The carload of ore came from Nevada's Comstock area and was bound for the East. Excited, Conger enticed William Martin and George Lytle to examine his find and they formed a party. In summer of 1869, Conger sank a discovery shaft on what he called the Poor Man, and Martin and Lytle sank shaft on their Caribou claim.[70] Boulder County historian Donald Kemp, however, identified several fatal flaws with this account. First, the transcontinental railroad was not completed until the Promontory Point connection in May, 1869, followed by a long lag in freight traffic. Second, because California and Nevada already possessed smelters, the reasons for shipping carloads of silver ore to the East remain unknown. Given this, Kemp argues that Conger most likely did not observe silver ore in Wyoming in the summer of 1869.[71]

According to another version of Conger's discovery, Alexander Boyd, Warren Favor, and Thomas Oyler staked claims in the Caribou area in search of gold early in July, 1864. The activity drew prospectors later in the month, including Conger, Hiram Perigo, Ulysses and Francis Pugh, A.S. Lang and others. They staked claims on the south flank of Caribou Hill and Conger sank a prospect shaft directly into rich silver ore, but he did little more than pile the payrock together. Because of a lack of roads and the great shipping distances to the mills in Gilpin County, Conger waited for five years until requesting William Martin and George Lytle help him pack the ore out. While ascending Caribou Hill to Conger's discovery shaft, Martin and Lytle noticed pieces of silver float (ore specimens that eroded off an ore vein), sank their own shaft, and exhumed the Caribou Lode.[72]

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[69] Kemp, 1960:78.
[70] Bixby, 1880:426; Fossett, 1876:379; Kemp, 1960:31; Smith, 1974:1-2.
[71] Kemp, 1960:31.
[72] Fossett, 1879:65; Kemp, 1960:30.

Like the Comstock ore version, the above account has a few flaws that render it questionable. First, when prospectors discovered ore, most immediately developed the claim and packed out as much ore as possible both for promotional purposes and to sell to an ore buyer. If the claim was distant and difficult to access, prospectors often conducted development and retrieved ore over the course of several trips. This was the process by which many of Colorado's remote mines began life. Second, it seems unlikely that Conger, in need of income, would have let his discovery remain fallow for five years without trying to bring it into production. Third, if Conger allowed the discovery to remain undeveloped for five years without conducting annual assessments, another prospector would have probably assumed title to the claim.

The most plausible account involved not only Conger, but also William Martin, who had considerable experience with silver ore. During the late 1850s, Martin, who was age 16, lived in Iowa and joined a passing wagon train that was bound for the west. Along the way, the train split into two factions with one party interested in going to Oregon and the other to California. Martin went with the California group, and once in the Golden State, he took an interest in the potential offered by mining. By the late 1850s, however, the gold rush was over, so Martin crossed east over the Sierra Nevada Mountains to Virginia City, Nevada, which boomed with the Comstock silver excitement. During his seven years there, Martin could not help but learn the fundamentals of silver mining. While in Virginia City, he made the mistake of entrusting a friend with $1,000 in savings, and in a fit of moral weakness, Martin's friend absconded with the money and began extensive travel. Enraged, Martin pursued the thief across the West to Ohio and back to Colorado. How Martin was able to track the thief remains unknown, but he finally caught the man in Central City, surprised him, and demanded the return of his money in no uncertain terms. In fear for his life, Martin's pursue pleaded forgiveness, and because he already spent most of the booty, Martin relented.[73]

While in Central City, Martin befriended Samuel Mishler, who offered him a job at the sawmill and ranch, and there he met Conger. During the summer of 1869, Conger and a partner returned to the ranch from one of their Arapaho Peak expeditions and displayed a collection of curious mineral samples that they found. Based on his experience in Virginia City, Martin at once recognized the samples as silver ore, and Lytle, who had been among the silver mines at Cariboo, Alberta, concurred, which fomented excitement among the crew. Sensing opportunity, Mishler, McCammon, and Pickel offered a grubstake to Conger, Martin, and Lytle if they could find and develop the discovery. Conger described the area where he found the samples then led Martin and Lytle on an expedition with an ox cart full of tools. The prospectors found the group of hills, followed samples of float to a source area, and began excavating prospect pits. Lytle and Martin, working separately, revealed two veins of high-grade ore, which the party named the Poor Man and the Caribou, after Lytle's Canadian experience.[74]

When Martin and Lytle reported their high-grade strike to Mishler, the ranch crew traveled to the site to stake as many claims as they were legally entitled. Conger, Martin, Lytle, Samuel and Harvey Mishler, and John H. Pickel officially claimed the Caribou. Conger, Lytle,

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73 Kemp, 1960:31-32.
74 Fossett, 1876:380; Fossett, 1879:65; Fritz, 1933:145-146; Kemp, 1960:51; Smith, 1974:2.

Pickel, Hugh McCammon, and the Mishlers claimed the Poor Man. Perhaps aware that mixed ownership could lead to trouble, Conger wanted the Poor Man all to himself, so he exchanged his share in the Caribou for total possession, which later proved unwise.[75]

Through the rest of the 1869 working season, Martin, Conger, and Lytle sank shafts and began extracting ore, proving their property's wealth. During this time, Conger probably camped in a wall tent but Martin and Lytle took the time to erect a primitive log cabin at the east toe of Caribou Hill. By the fall, the prospectors gathered together a wagon-load of ore and hacked a path through the forest down to the Niwot & Black Hawk Road, which J.V. Pomeroy and partners graded from Ward.[76]

At that time, Dayton, also known as Middle Boulder, was the nearest settlement, and it consisted of a collection of cabins where the Niwot & Black Hawk Road crossed Middle Boulder Creek. Nathan W. Brown and family initially settled the place when Brown applied for a homestead after a dismal experience prospecting in Gilpin County. Strategically located on the busy road, Brown built a two-story log cabin that was both home and a hotel, which the family ran. As ranchers established homesteads in the surrounding hills, Brown's Mountain House became the nucleus for a small settlement.[77]

After the working season ended, Conger and partners impatiently idled the winter away and could not help but spread word of their discovery. Before the ground was clear of snow, a hoard of prospectors ascended to Caribou Hill during the spring of 1870 and fanned out onto the surrounding slopes. Within quick succession, prospectors uncovered a number of additional silver veins, lending fuel to a growing rush. They unearthed the Idaho, Grand Island, Sovereign People, Conger, Monitor, No Name, Seven Thirty, Spencer, Comstock, Potosi, and other ore formations, and began development. Like most intense rushes, prospectors turned the ground over in search of yet more.

Martin and partners wasted no time and organized the Caribou Mining Company to work their Caribou claim, then enjoyed production. They were not alone in bringing rich silver ore to daylight, and despite the lack of equipment, profits were high. Conger realized around $15,000 from a relatively shallow 70 foot shaft on the Poor Man, prospector W.B. Jenness mined $5,000 to $6,000 in first 20 feet of workings on his Idaho claim, and Donald, Shaw & Company surpassed that on their No Name Lode.[78]

By the summer, the hills were alive with around 500 prospectors who formed the population base for several settlements that began to take shape. According to one historical account, at first there was no order to the area. "They camped under trees, in brush houses, and in tents until log cabins and frame buildings, stores and hotels had been erected, and the town of Caribou was fairly under way."[79]

[75] Fossett, 1876:380; Fossett, 1879:65; Kemp, 1960:52; Smith, 2003:3; Wolle, 1991:503.
[76] Fossett, 1876:380; Fossett, 1879:65; Kemp, 1960:53; Smith, 2003:3.
[77] Kemp, 1960:87; Southworth, 1999:58.
[78] Fossett, 1876:381, 387; Kemp, 1960:53, 80, 82; Smith, 2003:5.
[79] Fossett, 1876:381.

Forecasting the growth of a settlement, Mishler, Conger, Pickel, Lytle, Martin, and William F Sears, who were by no coincidence behind the Caribou Mining Company, were quick to plat the townsite of Caribou. They chose a site where a settlement was most likely to grow, which surrounded Martin and Lytle's original cabin at the east base of Caribou Hill. A surveyor arranged a grid of lots and blocks separated by five named avenues, with Caribou and Idaho streets defining the main business district. By the fall of 1870, a population of around 500 supported several saloons and gaming houses, a billiard hall operated by Werley and Sears, two mercantiles run by Leo Donnelly and Van & Tilney, and other businesses. For those services unavailable in Caribou, residents traveled to Central City, which was the nearest commercial center.[80]

The Caribou rush fostered the growth of several satellite communities, which grew around support industries and additional mineral discoveries. Cardinal City was the most substantial, and like the Caribou rush, it began with Samuel Conger. In 1870, Conger and a partner followed what they thought was an eastern extension of the Caribou Vein, and on the east slope of Boulder County Hill, they discovered another vein rich with gold and silver ore. Conger and partner named the formation the Boulder County Vein, and the find drew a number of prospectors who then located the Trojan, Mammoth, Spotted Jack, and Sovereign People claims in the surrounding area.[81]

Conger brought the Boulder County into production, another outfit developed the Trojan, and these two mines became the foundation for Cardinal, which grew on flat terrace on Boulder County Hill's east slope, around one mile east of Caribou. A group of investors then formally platted Cardinal with lots and blocks, although the wagon road from Dayton to Caribou actually served as the main street. Within a year, a population of as many as 200 supported several mercantiles and lived in log cabins and a boardinghouse. An assay shop catered to local prospectors.[82]

Alfred Tucker established Keysport, which was another of Caribou's satellite communities, in Coon Track Gulch a short distance south of Cardinal. Tucker planned the settlement as the center of an employees' cooperative industry where all shared in both the work and the profits from harvesting natural resources. The principal business was Tucker's Grand Island Lumber Company, which logged the surrounding forest and milled the logs into lumber, window sashes, and doors. Employees could also work on Tucker's new ranch or treat ore for customers in an arrastra. While the scheme was noble, Keysport failed because only around ten workers were able to forego regular pay for the sporadic income of profit-sharing.[83]

The booming growth of town of Caribou and the mines generated a tremendous volume of traffic that required formal roads. Several important arteries converged at Dayton, and while they went to Boulder, Ward, and Black Hawk, the routes were circuitous. To link Caribou with

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[80] Bixby, 1880:427; Fritz, 1933:166; Kemp, 1960:54; Smith, 1974:10; Smith, 2003:6-7, 94; Wolle, 1991:504.
[81] Kemp, 1960:83.
[82] Fritz, 1933:168; Kemp, 1960:84; Smith, 1974:117; Southworth, 1999:57; Wolle, 1991:502.
[83] Fritz, 1933:168; Kemp, 1960:85.

Dayton, someone graded a road up Coon Track Gulch, but the road was steep, narrow, and rocky.

Because the road to Black Hawk was the quickest and easiest from Dayton, Caribou residents relied on Black Hawk and Central City for those goods and services unavailable in the mining district. Aware of this loss, a group of Boulder investors financed a direct route that would allow Boulder to compete with Black Hawk. In 1869, Clinton M. Tyler, William Pound, Major W.F. Buttles, Amos Widner, and Anthony Arnett subscribed $85,000 to grade a road that many thought impossible. Specifically, the group proposed a route from Tyler's sawmill at Orodelfan directly up Boulder Canyon to Dayton and on to Caribou. During the winter, when Boulder Creek was at its lowest, survey crews plotted the road's course, which crossed the creek 33 times and clung to the canyon's sheer walls. By 1871, workers finished the Boulder & Caribou Wagon Road, also known as the Boulder Canyon Road, and it immediately saw much traffic, including Well, Fargo & Company stages from the transcontinental railroad at Cheyenne. Toll gates stood at both ends and the Half Way House at Boulder Falls provided stops. Because the canyon was narrow, the road featured great stretches without pullouts, which caused consternation among teamsters. In many cases, light wagons had to be emptied and tipped on their sides to allow freighters to pass by.[84]

During 1870, partnerships and small outfits clearly demonstrated that the Caribou district was a treasure trove, which attracted wealthy capitalists who were mostly from the East. These investors were absolutely crucial to the development of Caribou because they gladly furnished the money needed not only for work at depth, but also for intensive underground exploration and for milling. Abel D. Breed and Benjamin Cutter were among the wealthy capitalists drawn to Caribou, and their interest paved the way for others. Breed was born in 1811 and made a handsome profit from patent medicine and undertaking in the Midwest and East. He apparently began mining investment at Black Hawk during the early 1860s and, after several years, assembled a tidy group of productive mines and mills in Gilpin County. Less is known of Cutter, although his experience in mining began in the California goldfields. At some point, Breed and Cutter met and formed an investment partnership.[85]

In 1870, Breed and Cutter approached William Martin with an offer to buy the Caribou, which was obviously the richest mine in the district, but Martin and partners were unwilling to release the entire property. Instead, they sold the west half of the Caribou claim to Breed and Cutter for $50,000 in 1870 and mined eastern half through the year. With swollen bank accounts, Martian et al relented in 1871 and sold the east half to Breed and Cutter for $75,000, who now possessed the entire Caribou property. Breed and Cutter retained Martin as manager of operations probably because of his experience with silver and the Caribou Mine.[86]

After completing their deal for the Caribou, Breed and Cutter invested heavily in new facilities to maximize production. At the mine, William Martin oversaw the construction of one

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84 Bixby, 1880:393; *Boulder Camera* 5/31/49, p5; Kemp, 1960:28-29.
85 Fossett, 1876:381; Smith, 2003:6.
86 Fossett, 1879:67; Kemp, 1960:53; Smith, 2003:5; Wolle, 1991:503.

of the most advanced surface plants on Colorado's Front Range. At Dayton, metallurgist William Bryant was given charge with the task of building a smelter, which saved Breed and Cutter from having to pay the high shipping costs and treatment fees levied by the Black Hawk Smelter. William Bryant originally worked in Black Hawk then moved to Sugar Loaf (Wallstreet), where he built the Husher Mill. There, Bryant became acquainted with Breed, who solicited him to oversee the construction of, and probably even design, the Caribou Mill at Dayton.[87]

Bryant oversaw construction and several test runs at what was known as the Breed & Cutter Mill through 1871. The mill incorporated both chlorination and amalgamation processes enclosed in a stair-step building 100 by 125 feet in area, and it stood on the north side of Middle Boulder Creek at Dayton. After some adjustments, Bryant started the mill in January, 1872, and it ran at high efficiency for almost 13 years under his watchful eye.[88]

The Caribou Mill became a stabile anchor for Dayton, which blossomed as a result of the trade and traffic brought by the Caribou rush. In 1871, the Postal Service recognized the settlement by commissioning the post office of Middle Boulder, and entrepreneurs established a variety of businesses on what developed into a main street. Residents and passers-by patronized several saloons, a pool hall, and three mercantiles, and local children attended a school. Miners and prospectors purchased their materials in John H. Pickel's mining supply business, had their equipment maintained in Henry Lippoldt's and N.B. Greer's blacksmith shops, and stayed in Brown's Mountain House. In 1872, Brown was drummed out of Middle Boulder because of his belligerence. When drunk, which was often, Brown became quarrelsome, angered community members, and became mired in debt. After three of his children died, Brown's wife divorced him, and unable to continue business, he sold the hotel to J. Wesley Hetzer.[89]

As the early 1870s progressed, Caribou's mining industry went through a period of adjustment where poorly developed mines rose to the status of major producers while several of the best operations collapsed. After realizing a fortune from the Caribou Mine, Breed and Cutter determined to sell the property in 1873, which was alarming news for the mining district. At this time, the Federal Government took the U.S. Treasury off the bi-metallic standard in favor of a gold standard, which fostered uncertainty surrounding silver's value. This, a growing national depression, and a sense that the Caribou Mine's best days were over probably influenced Breed & Cutter's decision. Breed and Cutter interested disreputable Colorado speculators Moses Anker and M.A. Shafferberg in a deal, who then took a bond on the Caribou to act, in essence, as middlemen in its sale. Anker sailed to Holland to court investors there, and after pitching to them the wonders of the property, the investors pledged $1.5 million ($40 million today) to Anker and another $1.5 million to Breed and Cutter. The Dutch then organized the Mining

87 Bixby, 1880:428; Fossett, 1876:383; Fritz, 1933:170; Kemp, 1960:60, 90, 94; Smith, 2003:14.
88 Kemp, 1960:91.
89 Bauer, et al, 1990:98; Bixby, 1880:428; Kemp, 1960:89, 91-94; Meyring, 1941; Smith, 1974:117.

Company Nederland and dispatched an expert to examine the Caribou, and after his favorable reports, the Dutch and Anker consummated the deal.[90]

Breed and Cutter were not through with the mine, however, and after the Dutch examiner left, they employed a large crew of miners who hastily removed as much ore as possible. When the Mining Company Nederland took possession, they hired Shafferberg as manager, and he not only found the workings a wreck, but also realized that the massive ore reserves were not as voluminous as they supposed. After Shafferberg bungled operations, the company dispatched mining expert P.H. Van Diest to supervise the mine and he ran into heated conflict with Shafferberg and Anker. When Van Diest resigned in disgust, the company appointed someone else who had no experience and ruined the operation. Even though the company realized $130,000 in 1874 and $200,000 the following year, mounting debt caused the operation to collapse. Further, the miners, who had not been paid in months, angrily filed a lien on the property, which suspended operations.[91]

At the same time that the Caribou Mine was failing, out-of-state capitalists off-set the loss by developing other promising properties into profitable operations. The Poor Man Mine was among these, and while Samuel Conger certainly profited from the rich silver, he worked the property on a small scale. In 1873, Neil D. McKenzie realized that Conger had not developed the Poor Man and felt that, with some work, the mine would yield handsomely. McKenzie persuaded Conger to sell, installed a mechanized surface plant, and made the property one of Caribou's stable producers.[92]

Levi M. Bates, a wealthy capitalist from New York City, came to a similar conclusion regarding the Sherman and No Name mines. In 1874, Bates purchased both properties for $80,000 and hired engineer M.A. Smith, who installed steam hoists and began systematic development. Once miners began production, Bates felt confident enough in the operation to spend another $25,000 on a chlorination and amalgamation mill in imitation of the Caribou facility. Workers completed the Bates Mill in 1875 on North Boulder Creek (on Caribou Ranch) and tested batches of ore, and much to Bates' disappointment, the mill experienced trouble and had to be remodeled. Later in the year, the mill was successful, and a crew of 25 to 30, who lived in the adjoining settlement of Batesville, treated ore. By the end of the year, Bates was mired in debt and out of operating funds, and sold his mines and the mill.[93]

Other investors, some of whom were local, repeated the pattern of developing Caribou's primitive mines into stable producers. William Martin and partners were particularly active and reinvested the proceeds of their Caribou profits with great success. They purchased the Idaho around 1872 and the Missouri Valley Mine on Caribou Hill in 1873, and leased the Seven-Thirty the following year. At the same time, Adin Alexander and a Mr. Hale, both from New York City, bought the Native Silver Mine and developed it properly.[94]

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[90] Fossett, 1876:381-382; Fossett, 1879:67; Kemp, 1960:62; Smith, 2003:17-20; Wolle, 1991:504.
[91] Fossett, 1876:381-382; Fossett, 1879:67; Kemp, 1960:62; Smith, 2003:17-20.
[92] Kemp, 1960:80; Smith, 2003:40; Wolle, 1991:503.
[93] Fossett, 1876:387; Fossett, 1879:75; Kemp, 1960:82; Smith, 1974:41; Smith, 2003:29.
[94] *Colorado Mining Directory*, 1879:103; Kemp, 1960:81; Smith, 2003:36, 39.

As a stable mining industry evolved out of the frenetic boom, the town Caribou matured into a working-class settlement populated by around 400 workers and families. The business district offered typical establishments such as saloons, dance halls, restaurants, and mercantiles, and reflecting the growing family demography, the town also featured a jeweler, several bakeries, a few butchers, and a cobbler. The town also supported family-oriented institutions including a church and a school, and little crime existed. Daily life was trying at times due to the altitude and climate, which contributed to two epidemics of scarlet fever and diphtheria.[95] In terms of the climate, Boulder County historian Donald Kemp observed: "The Cousin Jack miner in Werley's Saloon who said he didn't know how long winter lasts because he had 'only been there three years' may have been the same who exclaimed, plaintively, 'Gawd, I hope when summer does come, both days is nice!'"[96]

The development of a mining industry also benefited the hamlet of Middle Boulder. When the Mining Company Nederland purchased the Caribou properties, the directors changed the name of the Caribou Mill at Middle Boulder to the Nederland Mill, which the town then adopted as its title. In 1874, the Postal Service officially recognized the name change, and the following year, a town board consisting of William Bryant, John Pickel, C.A. Sherwood, and A.A. Smith made it final. The mill, however, reverted to its former name of the Caribou. By 1875, around 300 people inhabited Nederland, which continued to thrive as a crossroads community. In this capacity, Nederland saw a small hotel boom to accommodate an increase in travelers. J. Wesley Hetzer sold the Brown Hotel to Beeler and Browning and built the fine Hetzer House, and David S. Jones constructed the New Nederland House. The business district expanded slightly, and Jean Rouillard built a small stamp mill just east of town in 1874 to treat silver ore on a custom basis.[97]

During the mid-1870s, Caribou saw two trends become prominent. On one hand, many of the small operations closed because miners quickly exhausted the shallow ore bodies, and on the other hand, wealthy capitalists continued to purchase, improve, and consolidate the principal producers. As a result, the town of Caribou and the outlying settlements contracted around populations of mostly company employees. With fewer people spending money, some of Caribou's businesses left, but the town of Middle Boulder grew slightly.

This transition marks the end of first Period of Significance. The Period began in 1869 with the discovery of several rich silver ore bodies and ended around 1875 when many of the principal properties were purchased and consolidated. In the first year, a rush developed and the mining district's population soared from a handful of people at Dayton to over 500 at Caribou. Between 1870 and 1875, prospectors developed more than twenty deep exploratory operations. Partnerships and companies generated ore in at least ten small mines, around five medium-sized operations, and three large producers. In addition, several mills attempted to treat some of the

[95] Fritz, 1933:166; Kemp, 1960:56; Smith, 2003:77, 93; Wolle, 1991:504.
[96] Kemp, 1960:60.
[97] Cobb, 1999:122; Kemp, 1960:94-96; Meyring, 1941; Southworth, 1999:58.

ore. Between 1875 and 1880, the number of deep prospects decreased to around ten, the numbers of active mines and mills increased, and Caribou's population shrank slightly.[98]

In the first Period of Significance, prospectors discovered silver at Caribou, which stimulated one of Colorado's early and important rushes. Afterward, Caribou saw the development of its mines, promotion outside of Colorado, and the investment of capital on the work and infrastructure needed to extract ore from depth. Caribou's mining industry decreased in rampant, blind speculation and moved toward organized and formulated development. As a result, Caribou's mines generated a significant volume of ore that contributed to the economies of Boulder, Gilpin County, and Nederland.

The first Period of Significance also saw the rise of the social and commercial center of Caribou high in the mountains, which was the first settlement of its kind in the county. Earlier mining settlements were small, informal, rough, and based on mineral booms and rushes. Caribou, by contrast, evolved into a stable, quiet, and orderly industrial town with social order based around a working-class population. Most of the county's other mining towns would follow this pattern in later decades. As Caribou evolved, the mining industry fostered the development of regional transportation, commercial, communication, and banking systems, and ore production on a significant scale.

E 4.3.2: Stabilization and Consolidation, 1875 - 1884

During the mid-1870s, most of Caribou's miners and other workers held jobs at the principal mines, although each individual mine was not necessarily a reliable employer. Such was the case with the Sherman and No Name properties. In 1875, Bates sold them to Robert G. Dun, Martin A. Smith, and William Fullerton, who had the resources necessary to maintain operations. Dun was born in 1826, joined a New York City investment agency, and owned it by 1859. Ultimately, the firm evolved into today's Dun & Bradstreet. While Dun was visiting his brother James in San Francisco, James introduced Dun to Comstock mining magnate William Ralston, who drew Dun into the world of mining investment. Dun and Fullerton were friends, and Dun naturally included Fullerton in opportunities when they materialized. Smith came with the No Name and Sherman mines since he managed them for Bates prior to the sale.[99]

Operating the No Name and Sherman mines engendered more expenses than Dun and Fullerton expected, and Fullerton apparently left most of financial matters to Dun. A high water table was partly to blame, the need to develop the ore bodies was another problem, and protracted law suits with neighboring companies was a third issue. After producing around $60,000, the three owners disagreed with each other on what to do and shut down both mines and the Bates Mill in 1876.[100]

[98] The numbers of active mines came from surveys of *Colorado Mining Directories* and other archival sources.
[99] Fossett, 1876:387; Fossett, 1879:75; Kemp, 1960:82; Smith, 2003:30.
[100] Smith, 2003:33-35.

Two major operations took the place of the Sherman and No Name mines, and Caribou residents were glad to see that one of the operations was the Caribou Mine. After the Mining Company Nederland workers filed a lien and shut down the Caribou Mine, the company allowed some to extract ore to recover their lost wages. This was not enough, however, to repay a pile of outstanding debts, and in response to motions filed by creditors, the sheriff seized the property in 1875 and threatened to auction it off. The distant Dutch responded too slowly and lost the property to the gavel the following year.[101]

The highest bidders were none other than Jerome Chaffee and David H. Moffat, who were prominent members of Colorado's founders and mining elite. Chaffee and Moffat then employed Eben Smith, Chaffee's personal friend and investment partner, to manage the mine and put it back on a paying basis. Smith wasted no time and formulated a program to straighten out the mess left by the Mining Company Nederland's inept managers. He simultaneously had miners extract the accessible payrock, formally developed the ore vein for future production, and conducted underground exploration for more ore. To increase the tonnage brought to daylight, Smith installed highly advanced equipment including an impressive four-drum steam hoist and an air compressor that powered several rockdrills underground. It should be noted that rockdrills had been introduced to the mining industry around 1873, and given this, Smith was among the first in Colorado to employ the machines. In reward, Smith saw the mine's production increase to $200,000 per year, which continued for some time. In 1878, Smith then hired William Bryant to start the idle Caribou Mill.[102]

The other major operation that replaced the idle Sherman and No Name mines involved a group of wealthy investors from New Jersey and Pennsylvania. As noted, Adin Alexander and a Mr. Hale bought the Native Silver Mine in 1874 and spent their capital on the acquisition. The property had all the signs of becoming a rich producer, but Alexander and Hale probably ran out of the funds to sustain operations prior to receiving their due profits. In need of capital, Alexander interested John T. Graham, A.G. Curtan, D.S. Stetson, and Thomas H. and Edward Dudley in the mine. In 1876, these capitalists organized the Mining Company of New Jersey, and Graham, who held an interest in the Caribou Mine, was the driving force and economic powerhouse behind the group. The company then improved the surface facilities at the mine and spent $65,000 on a chloridizing and amalgamation mill east of Caribou at the head of Coon Track Gulch. After the mine successfully began production, Graham retired and left company management to his partners, who had little experience. Archival sources disagree on whether the mill was successful at first, but it was ultimately a failure and cost the company dearly. Because of this and mismanagement, the company finally collapsed by around 1879.[103]

The Native Silver Mine, however, was by no means finished, nor were A.G. Curtan and John T. Graham. Unwilling to sink more money into the Native Silver, the Mining Company of New Jersey directors instead leased the property to Joseph Irwin in 1879. Irwin successfully operated the mine into the 1880s and was an important employer for the town of Caribou. While

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[101] Fossett, 1879:67; Smith, 2003:22.
[102] Fossett, 1879:67, 70; Kemp, 1960:63-64; Smith, 1974:69; Smith, 2003:45-48.
[103] *Colorado Mining Directory*, 1879:107; Fossett, 1876:388; Fossett, 1879:73; Kemp, 1960:81; Smith, 2003:37.

Curtan and Graham distanced themselves from the Mining Company of New Jersey, they remained quite active among Caribou's mines. In 1879, Jerome Chaffee and David Moffat decided to sell their Caribou Mine in part to reap the profits from their investments, and in part to avoid growing law suits from adjoining property owners. Curtan and Graham were more than interested in the Caribou since they already owned shares in the mine, and the two capitalists felt that if they could cooperate with surrounding litigants such as R.G. Dun, no more money would be wasted on lawyers. In 1879, Curtan and Graham were victorious and organized the Caribou Consolidated Mining Company with M.A. Smith, Chaffee, Moffat, and Fullerton to collectively work the Caribou, No Name, Spencer, American Flag, Columbia, and other mines on the Caribou Lode.[104]

The town of Caribou naturally stood to gain from the consolidation since this move further stabilized its local mining industry. Caribou was quite vibrant during the late 1870s and sheltered a population of around 550 workers and families, which may have been slightly more than preceding years. Life was still difficult at times, and 1879 saw several small disasters. One was a fire that blew in from the west, consumed the Caribou Mine's buildings, and spread to town before being extinguished with the town's advanced hydrant system. The other was a scarlet fever epidemic that took the lives of many children.[105]

In addition to the Caribou and the Native Silver mines, a number of other operations smaller in scale kept some of Caribou's workers employed. In 1878, Gilbert Lehmer bought the Seven-Thirty, installed a steam plant, formally developed the vein with a crew of 40, and realized $35,000 in the first year. William Martin and partners had the Missouri Valley Mine in production, and E.A. Hupper operated the Monitor on Idaho Hill. Other mines included the Great Western, the Northwestern, the Silver Point, the Mintor, the Brick Pomeroy, the Thatcher, and the Potosi.[106]

While the mines immediately around Caribou were undergoing improvement and consolidation, the outskirts of the Grand Island district were still in their infancy and a few hotspots began to attract interest. The hotspots formed around viable ore bodies that prospectors discovered during or shortly after the initial Caribou rush, and because Caribou was the bright star of attention, potential investors took little interest in the hinterlands at first. But as Eastern capitalists acquired most of Caribou's important mines, lesser investors saw potential in the remote and unproven properties.

The Blue Bird was one such mine, which Caribou prospectors Westman, Jones, and Conklin discovered in 1871 where North Boulder Creek abruptly ascends into the Indian Peaks. With little money, Westman and partners were only able to extract the surface ore from an open-cut, but they realized $6,000 for their efforts. Around 1874, a medial doctor who was ironically named D. Mortimer convinced Curtis R. and Albro L. Parsons to buy the Blue Bird, and they hired a small crew to conduct formal development. In addition to being a Denver physician, Mortimer operated several gold mines in the Gold Hill district. Little is known of the Parsons.

[104] Fossett, 1879:72; Kemp, 1960:64; Smith, 2003:39, 51, 127.
[105] Kemp, 1960:58-59; Schulz, 1977:1880-5; Smith, 2003:51.
[106] *Colorado Mining Directory*, 1879:103; Fossett, 1879:74, 76; Kemp, 1960:81.

In need of capital, Mortimer interested Charles Ellis in the operation, and in addition to being able to finance necessary work, Ellis had the most experience in the group with mining investment. Ellis was born in Waldo, Maine in 1858 and joined the silver rush to Rosita, Colorado at the youthful age of 18. There, Ellis prospected and failed due to a lack of experience, and ended up working as a miner for a year-and-a-half. In 1878, he tried his luck again during the Ten Mile district rush and discovered the Aftermath Mine, which became one of the best producers in the Kokomo area.[107]

Figure E 4.3.2. Caribou Hill was the economic and industrial center of the Grand Island Mining District as it existed around 1880. The long, dark shaft house immediately below the hilltop belonged to the Caribou Mine, and the waste rock dumps at the hill base right of center mark the Seven-Thirty Tunnel. The town of Caribou is left and out of view. Source: Boulder Carnegie Library, 219-2-9.

[107] *History of the Arkansas Valley*, 1881:403; Kemp, 1960:82-83.

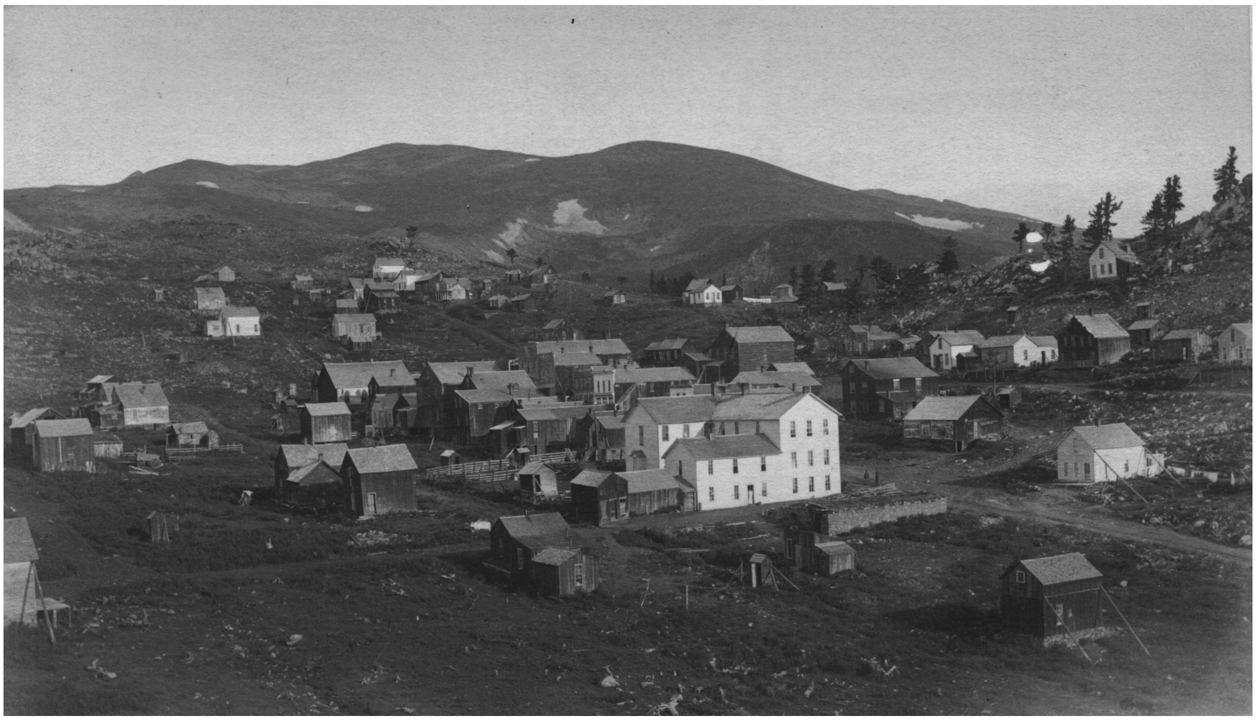

Figure E 4.3.3. By the early 1880s, the town of Caribou matured into a quiet industrial community populated by working-class families. The photograph depicts the business district, which is predominated by the large, white Sherman House hotel. Source: Boulder Carnegie Library, 213-1-7.

In 1877, Mortimer and partners organized the Santa la Saria Mining Company not only to bring the Blue Bird into significant production, but also to speculate with other nascent operations in the Grand Island district's northern perimeter. Work began slowly but picked up pace by 1880 and culminated in the construction of a mill in 1881.[108]

Forced out of Caribou by competition for claims, C.C. Alvord prospected the headwaters of Middle Boulder Creek around five miles to the northwest around 1872 and discovered a vein that carried copper, silver, and some gold. Alvord staked it as the Fourth of July and immediately began development, but because the property lay above treeline on a ridge with westward exposure, his working seasons were very short. By the late 1870s, Alvord sank a shaft and proved enough ore to justify a tunnel intended to cut the vein at depth.[109]

To the east of Caribou, the town of Cardinal continued to thrive. Popular publications suggest that this was because Cardinal was the suburb of sin to which the prostitutes and gaming

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[108] Bixby, 1880:428; *Colorado Mining Directory*, 1879:114.
[109] Fossett, 1879:76; Kemp, 1960:132.

houses were banished when Caribou was gentrified.[110] While this could be true, the surrounding mining industry also served as a sound economic base. Samuel Conger's Boulder County Mine was the best producer and largest operation, followed by the Trojan Mine. At some point, Conger interested investors not only in his Boulder County Mine, but also in productive properties to the west, and the investors proposed a massive underground drain and haulageway to undercut the entire Caribou district, starting with Conger's property. In 1875 or 1876, they formalized their plan as the Consolidated Caribou Belt Mining Company and began driving a 7 by 7 foot tunnel from the bottom of Coon Track Gulch below Cardinal. As a highly progressive move to expedite driving the tunnel, the company installed an air compressor to power rockdrills underground. It seems likely that this same company also constructed a water-powered mill to treat ore expected to be hauled out from the Boulder County Mine. The investors probably failed to anticipate the true cost of the project and suspended operations.[111]

In 1877, James A. Austin, Ira Pendleton, and Conger organized the Boulder County Mining, Tunneling, Milling, Land & Town Company to further develop the Boulder County Mine and apparently to resume driving the drain and haulageway. The operation acquired the water-powered mill in Coon Track Gulch and the beginnings of the Boulder County Tunnel, which was around 350 feet long. By 1879, Conger's company ran out of funds after driving the Boulder County Tunnel to a length of 700 feet and so sold the entire operation to Edwin Lord and George H. Morrison, of New York City, and they organized the Boulder Consolidated Gold & Silver Mining Company. Miners then finished the Boulder County Tunnel and began treating ore in the adjacent mill.[112]

The early 1880s saw the Caribou district slide into decline. Many of the marginal mines closed as their economic ore reserves waned, and those that possessed ore found that pumping the constant flow of groundwater offset the ore's value. Such was the case with the flagship Caribou Mine. In 1882, the Caribou's main shaft was more than 1,000 feet deep, and the lower workings consumed an enormous amount of money to keep drained. As a result, manager Eben Smith shut off the pumps and allowed the workings to flood, which send a ripple of alarm racing through the town of Caribou. Production continued, however, on a reduced scale until 1884, when the sheriff seized the property for unpaid debts. The sheriff, however, was merely an unwitting participant in a sneaky plan devised by the Caribou Consolidated Mining Company to eliminate its mounting debt. Dun purposefully allowed the sheriff to take possession of the property then bought it back during the sheriff's auction at the rate of dimes on the dollar. The seizure and forced sale cleared the property of debt, and the proceeds of the sale were divided among the creditors. Dun, however, was through with trying to keep the costly operation active and instead allowed the workings to flood while he sought a buyer.[113]

The owners of some of the other large mines suspended operations as their costs of production increased. In 1883, Gilbert Lehmer closed his Seven-Thirty, Joseph Irwin stopped

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[110] Wolle, 1991:502.
[111] Fossett, 1876:390.
[112] *Colorado Mining Directory*, 1879:76; *Colorado Mining Directory*, 1883:446.
[113] Kemp, 1960:64; Smith, 2003:125.

work in the Native Silver the following year, and Neil McKenzie ended work in the Poor Man in 1885. In response, many miners took matters into their own hands and leased the former producers. But when the largest employers closed their doors, the bulk of Caribou's residents departed, leaving a population of around 140 in 1885.[114]

The mining industry's transition from large company operations to small parties of lessees, and the dissipation of around 65 percent of Caribou's population, defines the end of the second Period of Significance. The Period began in 1875 when powerful investors acquired, improved, and consolidated the principal mines, and closed out around 1884 when the largest operations were suspended. During the Period, mining was largely a function of capital and large, organized companies that maintained high levels of production. The companies continued their role as important employers, which fostered the town of Caribou's orderly, working-class culture and environment.

Investors spent much of the capital on formal underground development, and on advanced machinery to work at great depth and keep the workings drained of water, which was a losing battle. Some of the machinery included state-of-the-art steam hoisting systems and compressed air systems for rockdrills. It should be noted that machinery manufacturers introduced rockdrills to the mining industry on a commercial scale around 1873, and within three years, the Caribou Mine, the No Name Mine, and the Boulder County Tunnel employed the machines. Given this timeframe, these operations were among the earliest in Colorado to do so.

The second Period also saw the expansion of the mining district's social geography. Nederland became transportation and small commercial center, and assumed the role of being a permanent fixture in the western portion of the county. Cardinal remained a viable community of workers employed in the Boulder County and adjacent mines.

The fringes of the Caribou district saw increased attention during the second Period. Because little investment opportunity remained in Caribou for minor capitalists, they turned their attention to new properties being developed outside of the Caribou area. As a result, the Blue Bird, Boulder County, Trojan, and other mines saw improvement and some production. Ultimately, some of these operations would contribute to the local economy after mining at Caribou collapsed.

E 4.3.3: Irrecoverable Decline, 1884 - 1893

As the 1880s progressed, the various lessees and small companies that continued production at Caribou had an increasingly difficult time, despite their low operating costs. Two factors in opposite synchronicity were to blame. One was that the quality and richness of the ore declined while at the same time the value of silver slid, which attacked profitability on two fronts. The decrease in silver's value began in 1885 when the metal was over $1.10 per ounce and continued through 1889 when the price slid to around $0.94 per ounce. Given this, it comes

[114] Kemp, 1960:80; Smith, 2003:129, 137.

as no surprise that R.G. Dun tried harder than ever to sell the idle Caribou Mine, and Neil McKenzie took the same approach with the Poor Man. Around 1887, he joined forces with Horace A.W. Tabor, who made a fortune from mining at Leadville, and used Tabor's capital to unwater the Poor Man and put it up for sale. As long as the workings were dry, McKenzie and Tabor decided to bring the mine back into production.[115]

Those few mine owners and residents who remained in Caribou through the dismal late 1880s were given reason for hope when the instability of silver's value turned in their favor. In response to the decline in silver's value, Western legislators clamored for a return to a pro-silver policy to bolster the sagging mining industries in their states. Well organized, they succeeded in 1890 and passed the Sherman Silver Purchase Act, which required the Federal Government to buy 54 million ounces silver per year at $1.05 per ounce.[116]

In response, handfuls of miners actually returned to Caribou, increasing the population to almost 170 at the end of 1890. While lessees produced small lots of ore in the Western Slope, Native Silver, Potosi, and other mines, the sale of the Poor Man was major news. Tabor managed to convince a group of Scottish investors to purchase the Poor Man in 1890, and they organized the Poor Man Silver Mines Company to secure the $510,000 price. Within the year, miners rehabilitated the workings and brought the property into the first significant production that Caribou had enjoyed in years. The district's overall poor response to the Sherman Silver Purchase Act, however, confirmed that Caribou possessed little viable ore above the unalterable watertable.[117]

E 4.3.4: The Great Silver Crash, 1893 - 1897

While Caribou's mining companies attempted some level of a recovery after 1890, several forces were at work to bring this to an end. First, reformers were unhappy with what amounted to both government subsidized silver mining and profiteering among powerful capitalists, and the reformers clamored for repeal of the Silver Purchase Act. Second, an economic crisis loomed, which created instability and factions in the Federal Government. Last, Great Britain, one of the main consumers of American silver, also faced economic uncertainty. Then, in 1893, the above factors came together to bring at first the ruination of the western mining industry, followed by a nationwide depression. President Grover Cleveland called a special session of congress to repeal the Sherman Silver Purchase Act in late 1893, hoping this would stop an impending economic crash. At the same time, Britain decided to adopt a gold standard and abolish its silver standard, as well as minting no more Indian rupees. Given the above, the market for silver evaporated and the metal's value at first slipped to $.78 per ounce, then plummeted to an abysmal $.62. The result was cataclysmic. Mines across the West suspended operations and thousands of workers suddenly found themselves jobless. A financial

[115] Kemp, 1960:80; Smith, 2003:129.
[116] Reyher, 2000:179; Smith, 1982:92; Voynick, 1992:62.
[117] *Boulder News* 12/21/93; Schulz, 1977:1890-2; Smith, 2003:150.

panic first swept the West then rippled out to the rest of the nation, ushering in a depression that lasted through much of the 1890s. Colorado, which relied to a great degree on silver, was devastated, and Caribou saw its handful of active mines close. A few lessees attempted to scrape together enough ore to subsist, but the district was largely quiet for years.[118]

E 4.3.5: The Late 1890s Revival, 1897 - 1905

As the decade of the 1890s waned, a variety of factors came together to spell a revival of mining across Colorado and in Boulder County. First, the economy rebounded, investors again were willing to risk capital, financing could be found, transportation improved, and goods and services were readily available. Second, mine owners were more than willing to extend themselves to bring their idle properties back into production or sell them to investors to avoid sustained financial losses. Fourth, the demand for industrial metals such as lead and zinc greatly increased. Last, advances in mining technology and engineering decreased the costs of mineral production, and improved milling methods permitted complex and low-grade ores to be profitably concentrated.

While a climate conducive to mining finally returned to Colorado, silver still fetched only $.61 per ounce, which provided little incentive to reopen those mines plagued by high operating costs. Gold, however, commanded much interest because of a constant value of around $20.70 per ounce, and during the late 1890s, investors increasingly turned to historic producers for the precious metal. Because Caribou's mines were based around silver and the ore offered little gold, the late 1890s revival crept slowly into the area at first then gathered momentum during the early 1900s.[119]

Around 1897, a handful of miners attempted to reopen several of Caribou's historic producers, and when they proved successful, other partnerships and small outfits joined them. Between 1897 and 1900, around five small mines, one medium-sized operation, and one significant producer resumed operations in the Caribou area. The Beacon, Black Monitor, St. Louis, and Belcher were among the small operations, and they employed around 45 workers who lived in town. R.G. Dun assessed the situation and reopened the flooded and quiet Caribou Mine. He sensed that the climate was better than it had been in years for selling the venerable producer, so he tried unwatering it and hired a small crew to generate enough ore in hopes of paying the high costs. The town of Caribou, however, was largely vacant and featured a population of less than 50 inhabitants. In 1899, a fire burned all the commercial and residential buildings on the north side of Idaho Street. Nothing was rebuilt and the small population may not have missed the mostly vacant buildings, although the charred lots were a grim reminder that Caribou was a ghost town.[120]

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[118] Saxon, 1959:7, 8, 14, 16; Smith, 1982:92; Smith, 1994:184, 187.
[119] Saxon, 1959:7, 8, 9, 14, 16, 17.
[120] *Colorado Mining Directory*, 1898:111; Schulz, 1977:1900-4; Smith, 2003:162; the number of active mines was estimated from a survey of the 1898 *Colorado Mining Directory*.

By the early 1900s, the revival enjoyed by the rest of Colorado and Boulder County finally caught up with Caribou, although the activity was a shadow of times past. Between 1900 and 1905, almost ten small mines were in production, around five medium-sized and one large operation yielded ore, and the area even had several concentration mills. The St. Louis, East St. Louis, Monitor, and Anteitam all employed from four to eight miners each. William Martin reopened his Idaho property, and Irwin & Hathaway's Belcher was one of the largest operations with a crew of twenty. Neil McKenzie, who regained the Poor Man when the Scottish investors defaulted on their payments, even tried his luck with the historic producer. Underground exploration convinced him, however, that the mine was truly exhausted above the watertable.[121]

Figure E 4.3.4. Today's Cardinal Mill, formerly known as the Boulder County and the Midget, has changed little since it was built during the 1890s. The Boulder County Tunnel is left and out view. Source: Carol Beam.

[121] *Colorado Mining Directory*, 1902:2, 4, 11, 15, 21, 22; Kemp, 1960:80; the number of active mines was estimated from a survey of the 1902 *Colorado Mining Directory* and other archival sources.

The Boulder County Mine's gold ore drew the interest of the Midget Mining & Milling Company, which rehabilitated the shaft and tunnel then began production during the 1890s. At first, the company tried concentrating the ore in what was known as the Midget Mill in Nederland, and when this proved to be a failure, the mill was dismantled. The company either built a new facility at the tunnel in Coon Track Gulch, or repaired the original mill constructed during the late 1870s. In either case, the company operated the property through 1902. It remains uncertain whether Chauncy F. Lake was involved with the Midget company, but it is known that he possessed the mill by 1903 and used it to concentrate tungsten ore (see Boulder Tungsten District history).[122]

The site of the Boulder County Tunnel experienced a small explosion of activity due to several factors. First, the tunnel assumed the role of the Caribou area's most important producer. Second, Chauncy F. Lake converted the Cardinal Mill into a fulltime tungsten concentrator, which drew keen interest by the Primos Chemical Company, which developed several important tungsten mines. Last, the Colorado & Northwestern Railroad graded a line across the gulch on its way to Eldora during 1904. While the railroad's destination was Eldora's mines, the directors knew that the Nederland area and its growing tungsten mining industry were a sound freight and passenger market. To accommodate this, the railroad established a station in the gulch. With the increase in activity and population, community residents requested a post office, which the Postal Service granted in 1905 under the name of Cardinal. Local residents, however, referred to the place as New Cardinal to avoid confusion with original Cardinal, where a few miners still lived.[123]

After around 1905, the Caribou area became largely quiet, ending the Caribou-Grand Island district's third Period of Significance. Lessees exhausted that ore which remained above the watertable, and no one was willing to invest the fortune necessary to drain the deep workings where plenty of medium-grade ore still existed. Even the Boulder County Tunnel was idle at times, and the Blue Bird operated relatively briefly then ceased. The national economic recession of 1907 only ensured that Caribou's mines would remain dark and abandoned for years to come.

The third Period of Significance lasted from 1897, when Boulder County saw a revival of mining following the 1890s depression, and ended in 1905. During the Period, the Caribou area experienced a small revival that maintained some semblance of its mining industry and an accompanying workforce. Local investors and their employees constituted the mining industry, which contributed to the economy of Nederland. The Period also saw Cardinal (New Cardinal) rise as an important milling and railroad center.

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[122] *Colorado Mining Directory*, 1902:5; Kemp, 1960:115.
[123] Bauer, et al, 1990:30; Crossen, 1992:156; Fritz, 1933:198; Holder, 1981:95; Kemp, 1960:218.

E 4.3.6: World War I Renewal, 1915 - 1922

When World War I began in 1914, manufacturing industries at first in Europe and then in the United States mobilized to meet a heavy wartime demand, and as the war progressed and devastated Europe's economy, governments there sought stability in silver. To the delight of the American mining industry, the value of both industrial metals and silver slowly rose during the first years of the war then shot upward as the war dragged on. The value of silver ascended slowly from an abysmal $.54 per ounce to $.73 by 1916, and continued to ascend. As silver approached $.98 per ounce in early 1918, the legislature decided to lock in the price and use the foreign interest, mostly European, to leverage profits at home and support for silver mining. Given that the Western states hosted most of the mining, it comes as no surprise that the movement started with Nevada legislators. In April, the Federal Government formalized the price program as the Pittman Act, which fixed the value of silver at $1.00 per ounce.[124]

Like the turn-of-the-century revival, the World War I silver situation granted the Caribou area a minor renewal on life. In contrast to the late 1890s revival, large- and medium-sized mines outnumbered the small operations, and local individuals even developed around five deep prospects. In total, three large- and three medium-sized mines employed enough workers to increase Caribou's population to around 50. Regardless, the Postal Service cancelled the Caribou post office in 1917.[125]

What had once been the most productive mines naturally attracted attention since they were likely to still offer low-grade ore above the watertable. Only a few, however, saw any activity. In 1915, F.H. Wickett of Chicago organized the Caribou Mines & Mills Company and leased the Caribou Mine until 1918. Tungsten king John G. Clark then assumed the lease under the Caribou Silver Mines Corporation and realized as much as $300,000 from the Caribou over the course of several years. This figure was impressive considering that everyone thought the mine was exhausted. In 1918, Todd Dunston leased the Belcher Mine, and the Allied Gold Mining Company sank a new shaft on the Congo Chief Mine north of Caribou.[126]

The World War I revival rippled outward into the Caribou-Grand Island district's fringes. In 1919, the North Boulder Creek Mining Company worked the Blue Bird property through its three principal tunnels and enjoyed production for several years. Between 1915 and 1918, another outfit reopened the long idle Up-to-Date Mine, located slightly more than one mile west of Caribou, and may have treated ore in a mill. When Clark leased the Caribou, he did likewise with the Boulder County Tunnel and invested a considerable amount of money refitting the mill and electrifying some of the machinery.[127]

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[124] "Events and Economics of the War"; Henderson, 1926:216; "Industrial News from Washington"; King, 1977:183; Saxon, 1959:7-17.

[125] Bauer, et al, 1990:30; Schulz, 1977:1920-6; the number of active mines was estimated from a survey of Colorado Mine Inspectors' Reports.

[126] Colorado Mine Inspectors' Reports: Allied Gold Mining Co., Belcher, Caribou; Smith, 2003:188.

[127] Colorado Mine Inspectors' Reports: Blue Bird, Boulder County Tunnel, Caribou, Up-to-Date.

The declaration of Armistice in 1918 not only brought a long-awaited end to the ravages of World War I, but also it precipitated the irreversible decline of silver and industrial metals production in much of Colorado, including the Caribou district. However, the economic and political trends of 1919 belied the impending doom. As soon as the war was over, European nations began the costly and protracted process of rebuilding both physically and economically, which maintained the high demand for and value of silver and industrial metals. During 1918, the price of silver was around $1.04 per ounce and, much to the delight of mining interests, it actually crept as high as $1.11 by the beginning of 1920. With metals values increasing for almost two years after the war's end, declining ore reserved seemed to be Caribou's only problem.[128]

The dreaded event finally arrived in 1920 and struck not only Boulder County, but also the Caribou area with full force. As normalcy returned to the United States and Europe, the demand for and value of silver and industrial metals began to fall. Silver slid to around $.82 per ounce and lead and copper reverted to their pre-war prices. The high times enjoyed by the greater mining industry came to an abrupt end and, as if this were not enough, a deep, post-war depression crept over the entire United States, bringing with it economic woes of all types.[129]

If conditions were not bad enough, the Federal Reserve began fussing about the Pittman Act, which created a sense of insecurity in the silver market, but western senators, representatives, and capitalists were unwilling to see the mining industry collapse again. They contested the anti-Pittman sentiments and preserved the Act through 1922, but the Comptroller General forced the Act to expire in at the end of the year. As a result, silver reverted to its former low value of around $.65 per ounce. The few mining operations around Caribou, dependent on low-grade silver ore, were no longer profitable and closed, leaving the Boulder County Tunnel as the last mine of importance.[130]

The cancellation of the Pittman Act ended the Caribou-Grand Island district's fourth Period of Significance. The Period began in 1915 when the value of silver increased as a result of World War I and ended in 1922 when nearly every mine in the district closed. During the Period, the Caribou area experienced a small revival that maintained some semblance of its mining industry and an accompanying workforce. Local investors and their employees constituted the mining industry, which contributed to the economy of Nederland.

E 4.3.7: Dark Times, 1923-1932

During the 1920s, Caribou and Cardinal reversed roles in terms of their importance. Caribou saw almost no activity because nearly all the ore was gone and the paucity of material that did remain was too impoverished to be profitable. By contrast, mining was alive and well at

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[128] Henderson, 1926:113; Saxon, 1959:8.
[129] Henderson, 1926:216; Saxon, 1959:7-9, 14, 16.
[130] "End of Pittman Silver Purchases Cut Profits Sharply"; "News from Washington".

Cardinal. During the early 1920s, John G. Clark ran into financial trouble with the Boulder County Tunnel and, at one point, he even had to turn the mine over to the employees so they could recoup back-pay by working it for themselves. Between the national depression and the cancellation of the Pittman Act, Clark decided to sell the mine in 1923 and focus on his tungsten empire. The following year, John Bergren and F.M. Holmes organized the Fairview Mining Company to resume where Clark left off then hired a workforce of as many as fifty miners, who produced ore in economies of scale. While Bergren and Holmes owned the tunnel and the Cardinal Mill, they had to lease the Boulder County, Trojan, Cardinal, and other claims, which the miners worked through the tunnel. With Caribou quiet and the tungsten mining industry at a standstill, the Boulder County Tunnel became the most important operation in the Nederland area.[131]

As the 1920s progressed, it seems that miners exhausted much of the ore, which required Bergren and Holmes to front money for underground exploration. In disagreement over what to do, Holmes decided to leave the company, which forced the company to suspend operations in 1928. Bergren, however, was not finished with the mine and interested new investors who organized the Dixie Mining Company the next year. They purchased the property and prepared to resume operations when the nation entered its worst depression ever.[132]

In 1929, the United States descended into one of its worst depressions ever, which lasted until World War II. The nation's economy collapsed, thousands were thrown out of work, financial systems disintegrated, and many goods and services were curtailed or became unavailable. Under President Herbert Hoover, who ironically was a highly renowned mining engineer, the nation's economic climate worsened and capital for mining became dear.

These conditions was almost impossible for a new mining venture such Bergren's Dixie Mining Company, yet Bergren convinced his investors that the Boulder County Tunnel would be a sure source of income, especially given that gold still fetched a constant $20.70 per ounce. Bergren was able to round up just enough capital to keep a crew of eight busy mining and treating the mine's gold and silver ore, but by 1933, profits were insufficient so he sold the property to the Atlantic Smelting & Refining Company.[133]

Bergren was not the only individual to attempt mining in the Caribou district during the depths of the Great Depression. Immediately below the townsite of Caribou, George W Teal's Cross Gold Mining Company rehabilitated the Cross Tunnel and shaft in pursuit of low-grade gold and silver ore in 1932. Like Bergren, Teal, who had experience with Boulder County's tungsten mines, saw the gold as a stable investment. So did a few unemployed people who lacked the resources to reopen old hardrock mines. In 1932, several parties worked the depleted Beaver Creek placer diggings south of Nederland for gold dust left by inefficient miners of the

[131] Colorado Mine Inspectors' Reports: Boulder County Tunnel, Fairview; *Mineral Resources of the United States*, 1926:265; *Mineral Resources of the United States*, 1927:542.
[132] Colorado Mine Inspectors' Reports: Fairview; *Mineral Resources of the United States*, 1928:833.
[133] Colorado Mine Inspectors' Reports: Fairview.

past. During the Great Depression, placer mining was an ideal source of income because it required only basic hand tools and time, which were resources in abundance.[134]

E 4.3.8: Mining During the Great Depression, 1933-1942

In 1932, Franklin Delano Roosevelt was elected president and immediately began developing a variety of programs to revive the nation's dismal economy. A year later, Roosevelt and advisors devised a clever program intended to simultaneously devalue the dollar while stimulating metals mining on a broad scale. As part of the plan, the Federal Reserve took the dollar off the gold standard and bought gold at inflated prices. The plan worked well and stimulated gold mining as expected, proven by an increase in the volume of gold that flowed into the treasury. In 1934, satisfied with the test, Roosevelt signed into law the Gold Reserve and Silver Purchase acts in hopes that they would resuscitate mining. The Gold Reserve Act raised the minimum price of gold from around $20.67 to $35 per ounce and the Silver Purchase Act raised the value of silver from around $.40 to $.70 per ounce.[135]

Roosevelt's plan provided an economic incentive for a return to gold and silver mines provided that they still offered profitable ore. Few properties in the Caribou district, however, did. As a result, the Depression-era mining revival that gave relief to other regions passed the Caribou area by and only a handful of individuals attempted to reopen some of the idle mines.

With the increase in the values of gold and silver, George Teal convinced investors to finance a new surface plant at the Cross and employ a crew of six miners to drive exploratory workings in search of ore. They in fact encountered a few stringers of ore, but not enough to keep the mine operating on a constant basis. In 1933, Richard Harvey & Associates brought the Saint Louis Mine back into minor production. Harvey treated the ore in a mill on-site for several years, then a series of lessees worked the mine fitfully until 1940. In 1936, the Great Western Mines Trust worked Anchor Mine west of Caribou for gold on small scale then quit.[136]

At Cardinal, the Boulder County Tunnel maintained its position as the area's most important operation. John G. Clark bought the property back in 1934 and ran it for a year, then sold to the Rocky Mountain Gold Mines Corporation. Scott Hendricks, who came from California, directed the operation and may have found capital from mining interests in his home state to make improvements. In 1936, he refitted the Cardinal Mill and enjoyed production until 1941, and probably sensing that an end to ore was in sight, Hendricks sold to the Donora Mining Company.[137]

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134 Colorado Mine Inspectors' Reports: Cross; *Minerals Yearbook*, 1932:152.
135 McElvaine, 1993:164; Saxon, 1959:7, 8, 12, 14, 16.
136 Colorado Mine Inspectors' Reports: Anchor Mine, Cross, St. Louis.
137 Colorado Mine Inspectors' Reports: Fairview; *Mountaineer-Mineral Age* April, 1936:11.

E 4.3.9: Mining during the Modern Era, 1942 - Present

In 1941, the United States was drawn into World War II, and under President Roosevelt, the Federal Government initiated a series of programs to organize and administer to economic, material, and labor resources as part of the war mobilization effort. With domestic mineral and metal resources suddenly of supreme importance, the government naturally passed several pieces of legislation that emphasized mining. War Production Board Ruling L-208 was among the legislation and, much to the dismay of Depression-era mine owners across the West, it mandated an immediate suspension of gold mining on grounds that it did not contribute to the war effort. Another important piece of legislation addressed the values of those metals sanctioned by the government. When the United States entered the war, the value of industrial metals and silver began to ascend to record levels, much to the delight of the greater mining industry. However, given the penchant of mining companies to maximize income, the War Production Board placed price caps on the metals to prevent enervating profiteering. The general result was a wave of mine closures. Mining gold was against the law and low-grade silver ore was not profitable to produce.[138]

In the Caribou area, the handful of active silver mines closed permanently and the Donora Mining Company suspended operations at the Boulder County Tunnel. From 1942 to the present, only several mines operated in the Caribou district during any given time. During World War II, the War Production Board allowed the Great Western Silver Mines Corporation to work the Blue Bird Mine because, while the ore offered gold, the silver and copper content was high enough to meet requirements. In 1946, Great Western closed the Blue Bird, and in its place, Consolidated Caribou Silver Mines, Incorporated became the region's principal operation.[139]

Investors organized Consolidated Caribou as yet another attempt to solve the water problem and bring the Caribou Mine back into production. Instead of working the shaft, however, the company planned to drive the Idaho Tunnel and intersect the Caribou vein at the 500 foot level. The tunnel, abandoned as incomplete during Caribou's boom, would serve as a working level, a drain, and a haulageway. Above the 500 foot level, miners could extract the impoverished low-grade ore left by previous mining outfits, and below, the miners could pump the watertable low enough to access deeper ore. The operation was well-funded, and investors paid for new equipment and a modern surface plant, which was the most significant construct since the late 1890s boom. By 1948, miners finally reached the vein and began producing an impressive 10 tons of ore per day, which workers trucked to the Valmont Mill, located on Valmont Butte east of Boulder (see Gold Hill Mining District for mill history).[140]

By 1950, the investors achieved a partial victory over an issue that had confounded mining in the Caribou area for decades, which was the water problem. The company continued production primarily above the tunnel level and, in 1950, decided to build a mill on-site to

[138] *Minerals Yearbook*, 1942:80; Saxon, 1959:17.
[139] Colorado Mine Inspectors' Reports: Blue Bird.
[140] Colorado Mine Inspectors' Reports: Caribou; Smith, 2003:189; Wolle, 1991:504.

eliminate the costs of shipping the ore to Boulder. After four years of extracting the low-grade ore and a few rich stringers left by miners of the past, the company faced the choice of pumping out the Caribou Mine's flooded workings and exploring for more ore, or suspending operations. Unwilling to invest the necessary capital, the company chose the latter course of action and closed the Caribou district's only producing mine.[141]

From 1955 until 1975, the Caribou district saw a handful of small outfits that conducted underground exploration in several of the formerly rich producers, such as the Boulder County Tunnel, the Blue Bird, and the Idaho Tunnel. Unsuccessful, these efforts largely ceased. In 1975, Tom Hendricks became the last operation of note in the Caribou district when he reopened the Cross Tunnel and began exploration at first, then production within several years. By 1977, the Hendricks Mining Company trucked ore down to the Valmont Mill while conducting extensive exploration in the Cross workings. After regular shipments ended in 1982, Hendricks began a program to locate and define ore bodies of sufficient volume to support long-term production. Today, Hendricks is still working the Cross and making preparations for a sustained and environmentally compatible operation.

E 4.4: The History of the Snowy Range Mining District

Activity in Snowy Range Mining District was largely a function of the booms and busts at Ward and Caribou, which were close and very important neighbors northeast and south, respectively. Because of these relationships, most of the Snow Range district's Periods of Significance parallel those at Ward and Caribou.

As noted, the interestingly named prospector Rocky Mountain Smith discovered silver ore in 1860 (near Lake Albion), which was one of the first discoveries of the metal in Colorado. He interested other prospectors who organized the Snowy Range Mining District and found few additional ore bodies during the following year. But because they were interested in gold and had little use for silver at the time, the prospectors moved on to other areas.[142]

In 1866, when the Ward district was in the throws of its first hardrock mining boom, several prospecting parties revisited the Snowy Range district, probably still interested in gold. Instead of finding gold, which is often associated with silver, the prospectors merely found more of the white metal and staked the formations as the Carmack and Comanche claims. Little was then done with the properties for years.[143]

While prospecting was intermittent between 1860 and 1866 and no mines came of the efforts, this timeframe represents the Snowy Range district's first Period of Significance. During this time, prospectors made one of the first silver discoveries in Colorado, organized one of the

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[141] Colorado Mine Inspectors' Reports: Caribou; *Minerals Yearbook*, 1949:1429; *Minerals Yearbook*, 1950:1449; Smith, 2003:189.
[142] Bixby, 1880:384; Eberhart, 1987:103; Wolle, 1995:516.
[143] *Colorado Mining Directory*, 1879:78; *Colorado Mining Directory*, 1883:49.

earliest mining districts in the territory, and were among the first to explore and quantify the Niwot Ridge and Mount Audubon areas.

The early 1870s silver boom in the Caribou-Grand Island district naturally drew more prospectors to Caribou than there were available ore bodies, and some of the surplus population migrated north into the Snowy Range district. Undoubtedly, the Caribou excitement kindled the memories of the early prospectors who found silver around Mount Albion, and some of them probably returned. In any case, prospectors were at work in the Snowy Range district again but were unable to find the stuff of bonanza rushes.[144]

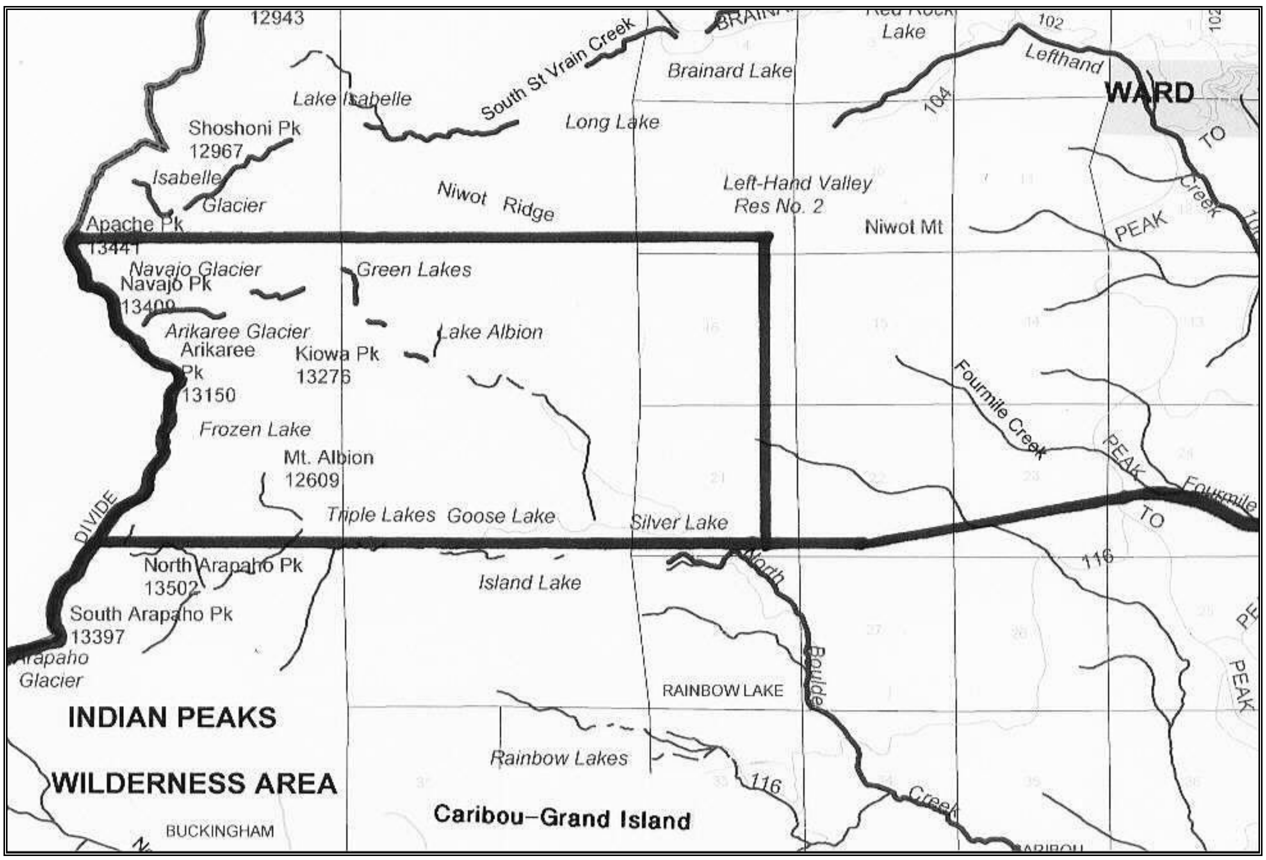

Figure E 4.4.1. The map approximates the boundaries of the Snowy Range Mining District, which are poorly defined in today's archival records Base map provided by Boulder County Land Use Department.

[144] Boulder County Metal Miners' Association, 1910:51.

Figure E 4.4.2. Camp Albion experienced several incarnations and consisted of little more than a few prospectors' cabins, several company boardinghouses, and the Albion and Century mines, one of which is at lower center. Albion was one of the county's highest and most remote settlements. Source: Boulder Carnegie Library, 213-1-3.

By the late 1870s, investors finally considered the Albion discoveries on a serious level. A boom in the Ward district at this time may have inspired enough confidence in the area to interest the daring investors in the unproven Snowy Range district. The Albion Mining & Milling Company acquired the Carmack and other claims, which lent some legitimacy to the area and drew additional prospectors. When the settlement that local prospectors and Albion company employees established had reached a critical mass, they named it Camp Albion. In 1881, Albion hosted its second organized company of substance. Benjamin F. and John H. Wood, investors from New York City, organized the Century Mining & Smelting Company, purchased the Comanche, Williams, Washington, White, and Victoria claims, then drove a 300 foot tunnel to undercut them at depth. Even though ore had not been proven in profitable amounts, the company erected a small mill anyway.[145]

[145] *Colorado Mining Directory*, 1879:78; *Colorado Mining Directory*, 1883:49; Fritz, 1933:163; Eberhart, 1987:103; Wolle, 1995:516.

For various reasons, Camp Albion was largely abandoned by the mid-1880s. The area's remote nature and the short working seasons were partly to blame, but mostly, rich ore amenable to concentration did not materialize. It may be that the Century company purposefully perpetrated investment fraud, which construction of the mill in advance of ore suggests.

The Snowy Range district's second Period of Significance lasted from around 1877 to 1884. During this time, prospectors searched for additional silver veins and investors organized two companies that developed the only two principal ore bodies known at that time. The introduction of the capitalized, mechanized outfits combined with the prospectors who remained resulted in the district's only settlement, which was an unincorporated assemblage of residences probably clustered around the Century Mill.

While ore had yet to flow down from Camp Albion, the district continued to draw attention intermittently for several decades. After passage of the Sherman Silver Purchase Act increased the value of the white metal, prospectors returned to Camp Albion in hopes of making the two ore formations pay. In 1892, camp residents applied for a post office, which the Postal Service granted under the name of Gulch. When Gulch was abandoned after the value of silver collapsed at the end of 1893, the Postal Service revoked the station.[146]

Albion lay quiet until the early 1900s, when the Silver Lake Mining & Milling Company hired a crew of five miners to develop what officials called the Silver Lake Mine. Miners sank several shafts probably on a consolidation of claims and may have refitted the 1881 Century Mill, but were no closer to making the ore pay than their predecessors. The company gave up and possibly sold its property to the Cashier Mining & Milling Company. During the 1900s, the Cashier company hauled in a diamond drill to sample several mineralized veins at depth and found what it thought was profitable gold and silver ore. In preparation for production, the company built a concentration mill and found that the ore's high asbestos content fouled the treatment process. At first, the metallurgist tried an air blast system to float the lighter asbestos off the ore, and while this worked for a while, increased amounts of asbestos again interfered with concentration. In response, the metallurgist adopted a wet filtration process which also became fouled too frequently to render the technology effective. By 1910 the mine was abandoned, and with it the associated settlement of Albion.[147]

The Snowy Range district's final Period of Significance lasted from around 1900 to 1910, when the last company of substance applied advanced technology to make the ore formations pay. The Period reflects a peak of investment and the application of science and engineering, and it also reflects the failure of such to render the complex ore profitable. Albion was abandoned in a nascent state where industrialization and settlement began to invade the wilderness.

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[146] Bauer, et al, 1990:67; *Boulder County Post Offices.*
[147] Boulder County Metal Miners' Association, 1910:51; *Colorado Mining Directory*, 1902:26; Fritz, 1933:177; Lovering and Goddard, 1950:284.

E 4.5: The History of the Eldora-Grand Island Mining District

E 4.5.1: Discovery, 1880 - 1894

During the late 1890s, Eldora hosted one of the last significant mineral rushes on the Front Range. This timeframe is quite late relative to the rest of Boulder County, and it seems ironic that Eldora lay almost literally in the shadow of Caribou, which was among the county's earliest rushes. Curiously, when prospectors flocked to Caribou in 1869, they were obsessed with silver and missed the numerous veins of telluride gold on Spencer Mountain only three miles to the south. While Eldora's mines produced no millionaires, their discovery created quite a furor that had significant local and regional impacts.

It seems likely that prospecting for placer gold was the first activity in the Eldora-Grand Island district. Prospectors initially drawn to B.F. Langley's Deadwood Diggings near Rollinsville in 1859 or 1860 almost certainly examined the Middle Fork of Boulder Creek for its potential. If so, they would have left frustrated because the segment west of Nederland did offer traces of gold, but the gravel proved to too course and boulder-ridden to make the deposits economical.

Few individuals thought to search for the source of the placer gold until the 1880s, and even then, only a handful of parties spent appreciable amounts of time doing so. John H. Kemp may have been the first knowledgeable individual to suspect that the Middle Fork valley held potential for not only placer gold, but also hardrock ore. Kemp, who managed several mines in Central City, examined the area around 1882 and almost certainly sampled the gravel of Middle Boulder Creek for gold. Intrigued, Kemp returned to Central City and kept the idea of further exploration in the back of his mind. Charles H. Firth and James T. Phillips, of Sugar Loaf, were among the early prospectors to the Middle Fork valley, and they may have been the first to actually discover ore. In 1887, Phillips found a mineral vein on Spencer Mountain that carried some gold and staked the formation as Huron Lode. They sank a shallow prospect shaft but did little more with their property.[148]

Marion Rogers examined the Middle Fork valley during the late 1880s and liked the area so much that he decided to establish a residence there. To sustain himself, Rogers logged and ran a one-stamp mill for prospectors and miners who brought small batches of ore. John A Gilfillan was apparently the second individual with extensive mining experience to survey the Middle Fork valley. In 1889, a group of investors hired Gilfillan to find them a gold mine, so he began in the mountains around Caribou where he worked as a mining engineer. Like Phillips, Gilfillan closely examined Spencer Mountain's metamorphic rock outcrops and found a second vein, which he and a partner staked as the Clara. It remains unknown whether Gilfillan reported the find to his investors, but he and partner sank a shaft, built a log shaft house around the

[148] Kemp, 1960:133, 134; Wolle, 1995:498.

opening, installed a primitive blacksmith shop in the building, and engaged in the Eldora area's first formal mining development.[149]

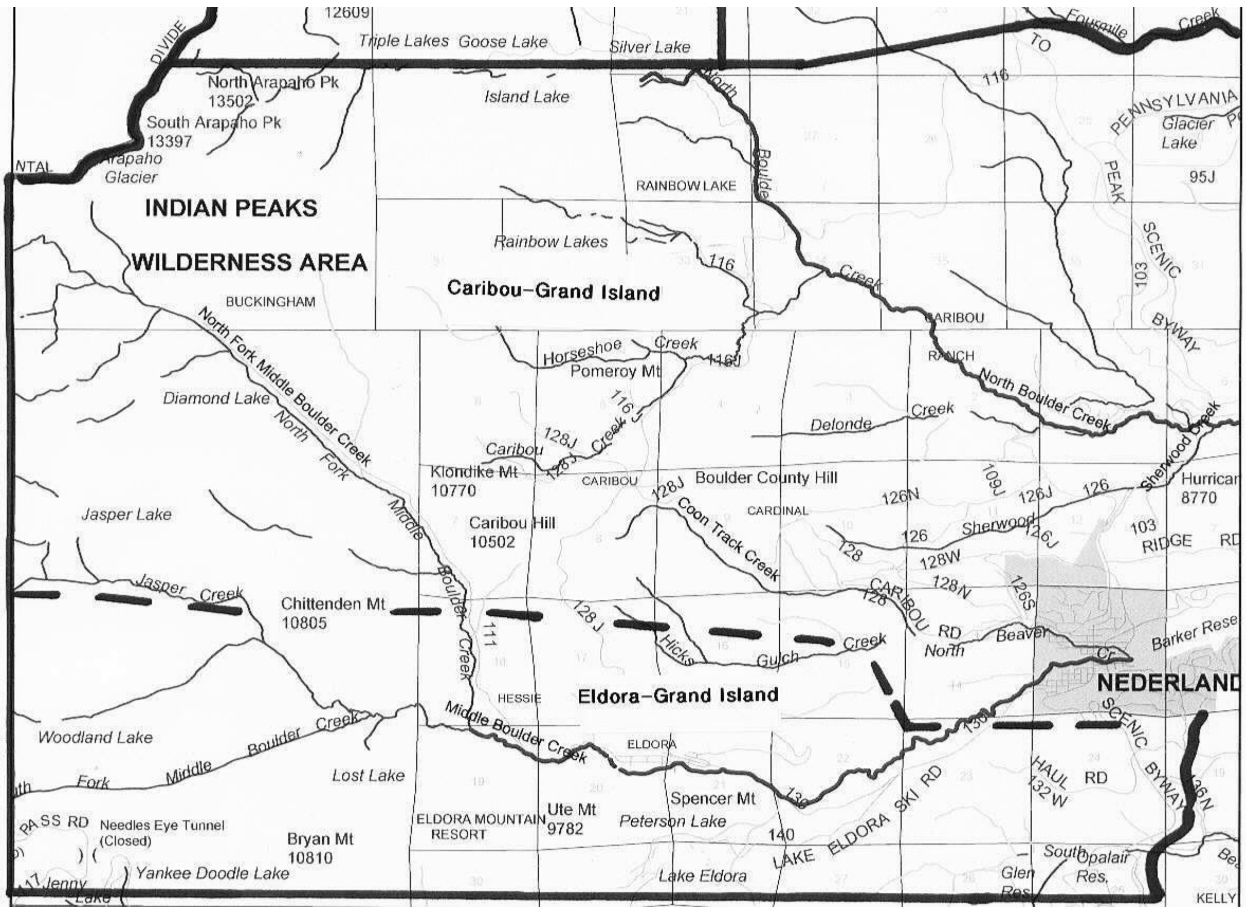

Figure E 4.5.1. The map illustrates the Eldora-Grand Island Mining District, at bottom, which was an informal amendment to the original Grand Island district. The dashed line approximates the Eldora-Grand Island district's northern boundary. Base map provided by Boulder County Land Use Department.

Perhaps it was coincidental, but shortly after Gilfillan and Phillips proved the existence of hardrock ore, Kemp returned to further examine the potential for economical placer deposits. Satisfied, he staked a group of claims known as the Happy Valley Placer on the valley floor in 1891, hired a workforce, and made the preparations for a large, company operation. The workers established a base of operations to the west of the workings then began constricting a system of sluices and ditches.[150]

[149] Kemp, 1960:133-135.
[150] Kemp, 1960:133-134; Wolle, 1995:498.

The news of placer- and hardrock claim activity at Spencer Mountain trickled out but had relatively little impact in the surrounding region. A few parties of prospectors drifted in to what was now known as Happy Valley, pitched camp at the base of Spencer Mountain, and inspected the area. M.D. Morrison and B.F. Spencer were next to find ore near the summit of the mountain named after Spencer and claimed it as the Village Belle. Both were seasoned prospectors, and like Kemp, Morrison operated several mines near Central City. Ludwig H. Iverson may have been the fourth prospector to experience success with the Bonanza.[151]

By 1893, a small wave of prospectors finally responded to the reports of gold at Spencer Mountain. Kemp's Happy Valley Placer was now fully underway and he relocated his base of operations to the north side of the creek to be near the workings. Kemp's camp consisted of several log cabins and a two-story boardinghouse for the miners, and it became the nucleus for the prospectors who arrived during the working season. Once the settlement reached a critical mass of probably several dozen individuals, someone applied the name of Eldorado Camp.[152]

Kemp's placer mine quickly took shape as one of the most advanced in Boulder County. Because the course gravel and boulders interfered with hand-mining, he used hydraulic methods in which a monitor, or a large nozzle, blasted banks of gravel with a high-pressure jet of water. A worker played the jet against the gravel, which loosened, then used the device to push the gravel into a system of sluices that recovered the gold. Kemp's hydraulic operation required an infrastructure of ditches to control water, a pipeline to pressurize the monitor, and graded beds for the sluices. Despite the operation's advanced nature, Kemp found that the returns were less than expected, in part because the boulders increased in number and size toward bedrock, and because he may have over-estimated the amount of gold.[153]

While Kemp and the Happy Valley prospectors sought gold, issues regarding silver forced them to suspend their activities. At the end of 1893, a conspiracy of factors caused the value of Silver to collapse, which caused the ruination of silver mining across the West, including Colorado (see Caribou-Grand Island district for full account). This combined with a growing economic uncertainty ushered in a deep depression that lasted through much of the 1890s. For the prospectors and miners of Happy Valley, this meant that the capital necessary to purchase and develop their discoveries was simply unavailable. As a result, Kemp had to shut down his mine and most of the prospectors left, and Eldorado Camp became largely quiet.

In 1894, the First Period of Significance in the Eldora-Grand Island district came to an end. The Period began around 1880 when occasional parties of prospectors gave thought to examine the area for hardrock gold. During the Period, prospectors conducted the first extensive explorations of the area, made the earliest ore discoveries, and were the first to permanently settle the Middle Fork of Boulder Creek. The first Period also saw the first mining, albeit in the form of placer, the first company operation, and the first unincorporated settlement, all of which lent legitimacy to and drew other prospectors.

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[151] Kemp, 1960:192.
[152] Kemp, 1960:135.
[153] Kemp, 1960:135.

E 4.5.2: The Eldora Boom, 1896 - 1905

Initially, the silver crisis ruined what appeared to be a gathering excitement at Happy Valley, but the continuing depression created the conditions for renewed interest in the telluride gold ore . With the economy in a poor state and anything having to do with silver mining an unattractive investment, experienced investors seized upon gold for its constant value, which was an unchanged $20.70 per ounce. Gold mining areas were suddenly of interest, and investors not only sought out producing mines, but also were more than willing to speculate with unproven properties.

In this buoyant environment, prospectors began to return to Happy Valley in 1896 and congregated in Eldorado Camp, where Kemp may have resumed placer mining. As they prospected Spencer Mountain, more wealth-seekers confirmed the presence of telluride ore, which came at a fortuitous time. During the mid-1890s, the frenetic boom of the Cripple Creek Mining District, which was a telluride bonanza, drew the rare ore into popular attention and created excitement over areas featuring similar deposits. Promoters, aware of this trend, suggested that Eldorado was the next Cripple Creek, and in so doing they launched a substantial rush. By the summer of 1897, 300 prospectors arrived and began to blanket Spencer and Ute mountains with claims, and in response, community activists prepared for the gathering boom. It was probably Kemp who tried to secure a post office under the name of Eldorado, but since a town by that name already existed in California, the Postal Service contracted the name to Eldora. Gilfillan organized the Mogul Drainage & Transportation Tunnel Mining & Milling Company to drive a haulageway into the north base of Spencer Mountain, even though prospectors had yet to prove ore in economical volumes.[154]

By 1898, a small rush began in earnest, fanned by exaggerated accounts of discoveries and rich ore, and in addition to prospectors, a number of speculators, businessmen, and investors arrived to take stock of the excitement. It remains uncertain who thought to plat a formal townsite first, but Kemp and Alonzo L. Tomblin found themselves in a heated race for what was sure to be a real estate bonanza. Kemp was in the lead since his Happy Valley Placer was already the center of Eldora, but Tomblin thought that he could establish a better town. Kemp and Tomblin went to court over the matter, and when the local court sided with Tomblin, Kemp took the case to the Secretary of the Interior who reversed the decision. Tomblin acceded and amicably joined Kemp's Eldora organization. Kemp became mayor and Tomblin served on the organization committee.[155]

[154] Bauer, et al, 1990:50; Kemp, 1960:138, 198.
[155] Kemp, 1960:139-140.

Figure E 4.5.2. Eldora exploded with activity in 1898 and 1899, and the town's boom was based on speculation instead of a proven mining industry. In this westward view, some buildings at left are still under construction. Source: Boulder Carnegie Library, 213-1-12.

Eldora grew almost overnight as a population of around 1,000 swarmed the valley and another 500 prospectors perused the surrounding mountains. As can be expected, a business district developed around Kemp's original camp, and while residents could not control all eleven of the saloons and gaming houses, they tried to contain the worst of the moral offenders in the Monte Carlo addition on the south side of the creek. All were levied a sin tax to fill the town's coffers for improvements. The usual businesses opened their doors on the main street, two newspapers, the *Miner* and the *Record*, began publication, and the Gold Miner, Vendome, Eldora, and Tucker hotels took in guests. The constant influx of people quickly outstripped the hotels, boardinghouses, and rooms for rent, and those individuals who were prepared for the field camped on the fringes of town.[156]

The participants of the boom were able to buy much of what they needed, but some goods and services had to be secured locally. Lumber was among these, and the demand kept four sawmills in constant operation. The firm of Felch & Jones ran the largest sawmill at

[156] Kemp, 1960:143, 173, 176, 183, 187.

Woodland Flats, located at the mouth of Jasper Creek, Quigley & Company had a second substantial sawmill at Hessie, and Marion Rogers continued to make lumber at his tiny facility.[157]

While construction, traffic, and business created a roar in the valley, prospectors and new mining companies were at work high on the surrounding mountains. Spencer Mountain dominated the emerging mining district both physically and mineralogically. The Clara owned by Gilfillan, the Village Belle in possession of M.D. Morrison, the Bonanza being worked by the Laramon Mining & Milling Company, the Bird's Nest, and the Enterprise, owned by Phillips and Firth, were the most promising but had yet to be brought into meaningful production. All were less than 150 feet deep, which was relatively shallow, and they were the only shafts in the district equipped with steam hoists. Gilfillan's Mogul Tunnel, proposed to be over 1,000 feet long, reached less than 100 feet, and the Populist Tunnel was only 175 feet long.[158]

Ore had been at least proven in the above mines, and prospectors were busy on the surrounding mountains searching for more veins. The north side of Bryan Mountain held the most promise, where partnerships developed the Revenge and Lost Lake mines. Prospectors were also at work on Ute, Chittenden, and Eldorado mountains, but they had yet to prove the existence of truly profitable ore bodies.

The growing interest on Bryan Mountain gave rise to the small settlement of Hessie, located on flat ground where the North Fork and South Fork of Middle Boulder Creek converged. J.H. Davis established the settlement and named it after his wife, and he was probably the individual who secured a post office in 1898. Around twenty to thirty people lived in Hessie, another fifty prospectors and loggers inhabited the surrounding area, and their business supported several stores. Quigley & Company's sawmill was located nearby, and local children attended a school.[159]

Promoters platted two additional settlements in hopes of profiting from the boom, but they failed to materialize into anything more beyond collections of cabins. Someone surveyed the townsite of Grand Island on the North Fork of the Middle Boulder on the assumption that ore would surely be found. Colorado Springs interests organized the townsite of Sulphide on Sulphide Flats several miles east of Eldora and built a two-story hotel, an office, and several houses. Activity beyond prospecting, however, had not yet reached these locations, and so the settlements lacked the economic foundations necessary for viability.[160]

Because of over-promotion and rampant speculation, the growth of Eldora and the satellite hamlets was completely out of proportion with the actual mining industry. People still came, however, and some established services that truly productive mining industries required. One of these services was ore concentration, and like the Gold Hill boom of 1860, investors built at least four mills on the mere assumption that Eldora's mines would yield handsomely. Also

[157] Kemp, 1960:144, 181.
[158] *Colorado Mining Directory*, 1898:113.
[159] Bauer, et al, 1990:71; Kemp, 1960:206-207.
[160] Kemp, 1960:204.

like the Gold Hill boom, the millmen designed their facilities to treat free-gold instead of the complex telluride ore, and as a result, only one mill proved successful.

Marion Roger's tiny stamp mill was the original facility and Rogers never intended to process telluride. The Hart brothers and John F. Tucker built small stamp mills between Spencer and Tennessee mountains, and these failed within a short time. Neil M. Bailey built the largest mill at a cost of $75,000 on the south side of the valley a short distance west of Eldora. Bailey had little experience with milling and ran into trouble before he got under way. The mill was based on the chlorination process, which proved only partially successful on Eldora's telluride ore after a trial run, so Bailey had to refit the facility. But before he finished, Bailey's principal investor from New York City died, leaving Bailey with debt, unpaid workers, and insufficient funds to start the facility. Bailey convinced his family in New York to sell their farm and he poured the money into refitting the mill, to no avail. No closer to realizing income, Bailey postponed paying his workers who grew angry and revolted. They peppered his home with rocks, shot him in the arm, and frightened him out of the district.[161]

The wave of mill failures certainly disappointed Eldora's emerging mining industry, which was finally producing ore. In the absence of local mills, the companies were limited to producing ore that was rich enough ship to the telluride concentration facilities around Gold Hill. The Enterprise Mill & Mining Company, which operated the Enterprise Mine, thought that the Bailey Mill could function with improvements and so purchased the facility. By 1901, the company started up the mill and began treating its own ore and probably custom orders with success.[162]

During the first years of the twentieth century, the Eldora district's boom continued but evolved away from frenetic speculation toward a productive mining industry. Popular literature suggests that the boom ended in 1899 or 1900, but in the first years of the twentieth century, the district actually had more deep prospects and mines in production than any other time. Between 1897 and 1900, at least 25 deep prospects and 10 small mines were active, and between 1900 and 1905, the same number of deep prospects was being developed while the number of mines increased to around 20 small operations and several medium-sized producers. The population, however, contracted as speculators, some prospectors, and other boom participants left. By 1900, around 400 people lived in Eldora, around 70 inhabited Hessie and area, and another 500 prospectors, miners, and workers were scattered throughout the rest of the district.[163]

Together, the Enterprise Mine and Bailey Mill were clearly Eldora's most important operation with a crew of fifty, and the Mogul Tunnel with its crew of twenty was second. Since its inception, miners drove thousands of feet of workings and began to mine some of the ore veins that it penetrated from the bottom up. In addition, the Clara, Helene W., Revenge, Birds Nest, Village Belle, Virginia, Terror, and the Bonanza all yielded rich ore. Gilfillan still drove his Mogul Tunnel as an attempt to undercut the Spencer Mountain mines at depth, thereby

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[161] Kemp, 1960:200.
[162] *Colorado Mining Directory*, 1902:11.
[163] Schulz, 1977:1900-4; the number of active mines was estimated from a survey of the 1902 *Colorado Mining Directory*.

allowing miners to work the veins from the bottom up and haul the ore out the tunnel. Unable to carry the enormous cost himself, Gilfillan searched for investors, which was easy in the atmosphere of Eldora's promotion.[164]

In 1898, J.T. Blair, Samuel B. Dick, C.W. Mackey, and Thomas R. Mann and bought a significant interest in Gilfillan's tunnel company, and their association in the organization was not coincidental. These men already knew each other by running railroads and steel mills in Pennsylvania, and through the Colorado & Northwestern Railway, which wound its way in the mountains of Boulder County. The Pennsylvania group, along with fellow Charles B. Culbertson, organized the railroad in 1897 to replace the Greeley, Salt Lake & Pacific, which flashfloods destroyed in 1894. To ensure that the railroad would have plenty of freight business, the Pennsylvania group financed the massive Culbertson chlorination mill on Valmont Butte to take in ore from Boulder County mines. Culbertson and Dick initially secured a pledge of great tonnages of ore from the Big Five Mine owners at Ward, but when this fell through, the railroad directors began seeking other sources. Dick immediately saw the opportunity for the railroad and the Mogul Tunnel company to form a symbiotic relationship similar to the one that the directors expected with the Big Five. Dick hoped that the tunnel with its proposed high volume of ore would provide an incentive for the Colorado & Northwestern to grade a track to Eldora, and that the railroad would then reward Gilfillan with low freight and milling rates.[165]

Dick and Culbertson argued over the matter for five years because Culbertson clearly saw that Eldora was, unfortunately, not a source of ore. In 1898, Dick put a track gang to work grading a line from Sugar Loaf westward, which created a celebration atmosphere in Eldora. The elation was short-lived, however, because Culbertson countermanded the order and stopped the work. By 1904, the railroad was in financial trouble and teetered on the brink of seizure, so Culbertson and Dick declared it bankrupt, put the system up for sale, then quietly bought it back as the Colorado & Northwestern Railroad. In so doing, they eliminated some of the debt and minor stockholders, and allowed Dick to own a controlling interest. Dick was now free to finish his Eldora project, which he completed later in the year.

A majority of Eldora's residents turned out to cheer the first train to chuff into town. Had Dick taken stock of the crowd, he might have noticed that there were fewer people than could be expected in 1898. The reason was that Dick and the Colorado & Northwestern arrived too late. The actual extent of Eldora's ore systems, which were shallow and inconsistent, did not match the extravagant claims of the promoters, and by 1903, prospects were being abandoned as failures, small mines became exhausted of ore, and people left the district.

Within several years, Eldora's struggling mining industry collapsed, bringing the district's second Period of Significance to an end. The Period began in 1896 with the first significant wave of prospectors and ended by 1905. The Eldora district reached its pinnacle in terms of prospecting, the discovery of ore bodies, actual production, the development of industry and infrastructure, population, and the development of settlements. During the Period, Eldora

[164] *Colorado Mining Directory*, 1902:11, 20, 29.
[165] Crossen, 1992:61, 62, 67, 81; Holder, 1981:8; Kemp, 1960:218.

became the subject of speculation, promotion, exaggerated reports, and an overall frenzied boom. The event was a typical mining rush, except that it occurred in a compressed amount of time and during the relatively late date of around 1900. Given this, the Eldora boom had several impacts on Boulder County. First, it drew a considerable amount of attention, people, and money to the county and especially the Nederland area. The timing was important because Nederland suffered when mining in the Caribou district collapsed a decade earlier. Second, the Eldora event lured the Colorado & Northwestern Railroad into the Nederland area, even though Samuel Dick was too tardy to profit from the boom. The railroad was of great benefit because it fostered a transition from mining to tourism, which was a stable source of income, and helped the tungsten mining industry to thrive. Third, the boom awoke many investors to the county's other mining districts, especially Gold Hill, Jamestown, and Sugar Loaf, which offered similar types of telluride ore.

E 4.5.3: In the Shadow of the Boom, 1906 - 1929

The latter half of the 1900s was not kind to Eldora. By 1906, Gilfillan and Dick drove the Mogul Tunnel far enough to realize, much to their disappointment, that the veins on Spencer Mountain did not offer rich ore at depth as they assumed. Unable to pay the pile of debts, the county sheriff seized the Mogul Tunnel and auctioned it off, leaving Gilfillan and Dick as the losers. The stress of both such a loss and continued problems with the railroad probably contributed to Dick's death the following year. The sale of the Mogul cast a pall over Eldora and reversed what little confidence was left over from the boom.[166]

Eldora's mining industry was not completely dead, however, and a few outfits acquired the principal properties on a speculative basis. The Spencer Mountain Tunnel Company purchased the Mogul Tunnel during the sheriff's auction, which inspired tempered optimism in Eldora. W.B. Connell sold the Revenge Mine to superintendent and Eldora mayor R.H.B. Little, who maintained a low level of production. The Swarthmore Copper Mining Company purchased the Golden Fleece, the Enterprise, and the Scranton Tunnel and employed H.H. Carpenter as superintendent. The Swarthmore company was so confident in the Scranton Tunnel that it rehabilitated a centralized compressor house and laid a compressed air main to the tunnel. The efforts of all the above parties, however, were minor, although the Swarthmore company kept the Enterprise in production for several years. In all, Eldora's mining industry combined with logging and tourism kept a population of around 100 people in town and an additional 80 elsewhere in the district.[167]

The 1910s were no different than the previous decade for Eldora residents, some of whom may have looked with jealousy at nearby Nederland, which was in a tungsten frenzy. The Lost Lake Mining & Milling Company developed the Lost Lake Mine in 1916 and 1917, and Isaac Sutton did likewise with the Bonanza. Around this time, superintendent Otto Victor struck

[166] Crossen, 1992:171; *Eldora Area Mines and Mining*; "Obituary" *Mining Reporter* 5/16/07 p453.
[167] Boulder County Metal Miners' Association, 1910:47; *Eldora Area Mines and Mining*; Schulz, 1977:1910-9.

several stringers of rich ore in the Bonanza, which he described as the "richest ever struck in the camp." The days of promotion were not completely over. The Consolidated Leasing Company, based in Ohio, replaced the Swarthmore outfit as Eldora's most important operation by 1915, in part because Consolidated Leasing merely leased Swarthmore's properties. Eldora's residents even continued the eternally optimistic search for gold, and between 1915 and 1920, various partnerships developed around 10 deep prospects. However, Eldora's population reflected the overall dismal state of mining in the district. By 1920, only around 35 people lived in town and another 42 inhabited the district, with many prospectors and miners drawn off by Nederland's tungsten boom.[168]

By the 1920s, Eldora's mining industry contracted to a handful of partnerships that actually invested in their properties and were rewarded with a little ore. In 1920, the Consolidated Leasing Company took an option on the Gold Dust, located one mile west of Eldora, and developed a vein. The outfit built a water-powered concentration mill, produced small volumes of ore, then quit in 1921. At the same time, the Huron Gold Ores Company began seasonally developing the shallow Huron in Eldora and found ore in the tunnel. President Jacob Pavela built a tiny gasoline-powered stamp mill equipped with a Wilfley table. In 1922, the company began production and ended when miners exhausted the ore in 1925. J.B. Rawley developed the Shirley in 1922 and followed tiny stringers of gold ore through 1924, when they gave out. By 1926, only one small mine remained active in the entire district and individuals tinkered with another five deep prospects.[169]

E 4.5.4: Mining During the Great Depression, 1929 - 1942

In 1929, the economic ravages of the Great Depression settled down onto Boulder County. The failures of banks, personal estates, and companies had a devastating effect and hundreds of individuals were thrown out of work. The county's mining industry, which had been in decline since the early 1920s, was hit particularly hard. Many mines closed because they lacked the funds necessary to pay their operating costs. In their place rose what was tantamount to a small cottage mining industry in which unemployed people, primarily miners, returned to many idle gold producers to eke out a subsistence-level income. Because these miners expected only to get by, their needs were very simple and several dollars' worth of ore per day was sufficient.

This movement was most noticeable between 1929 and 1933 in the county's formerly productive districts. Eldora, however, not only drew its share of subsistence miners during this time, but also interested several partnerships that had enough capital to at least attempt

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[168] Colorado Mine Inspectors' Reports: Gold Dust, Lost Lake, Misc. C; *Eldora Area Mines and Mining*; Schulz, 1977:1920-6; the number of active prospects was estimated from Colorado Mine Inspectors' Reports.
[169] Colorado Mine Inspectors' Reports: Gold Dust, Huron, Shirley.

production. In terms of the subsistence miners, they prospected in the workings of around five old producers and generated small batches of ore in one small mine.[170]

In 1930, during the depths of the depression, the Mogul Enterprise Production Company attempted to bring the Mogul Tunnel back into production. The company employed four miners who rehabilitated the Mogul and Swarthmore tunnels then ran out of capital before realizing any ore. Several other outfits continued the search for ore during the next several years, and in 1933, Jane Eggleston Goodykoontz was the last to work the tunnel before suspending operations. While four different firms all failed with the Mogul, the activity was important for the spirits the 16 people who still lived in town.[171]

An additional 17 prospectors and miners lived elsewhere in the Eldora district, mostly among a handful of productive properties in the Lost Lake area. From 1931 until 1933, C.F. Payne leased the Shirley Mine and enjoyed minor production. In 1933, President Franklin Roosevelt launched a pilot program intended to simultaneously devalue the dollar while stimulating metals mining. As part of the plan, the dollar was taken off the gold standard and the Federal Reserve bought gold at inflated prices. In 1934, satisfied with the test, Roosevelt signed into law the Gold Reserve Act, which raised the minimum price of gold from around $20.67 to $35 per ounce. The increased price gave property owner J.B. Rawley incentive to work the Shirley himself and not renew Payne's lease. Rawley also owned the Amy Paul, located in the same area, and leased it to Anthony Mayer then J.B. Kennedy. The partners drove workings in search of ore and finally found small stringers by 1941.[172]

The Norway Mine, located near Lost Lake, was the most important operation in the Eldora district during the Great Depression. When the depression began, Emery Olson and G.H. Loustalet strongly suspected that the Norway had great potential because miners began a tunnel to undercut a proven vein during Eldora's boom but stopped short of the target. At that time, the Norway Mine featured a 200 foot long upper tunnel and a second, lower adit less than 50 feet long. In 1932, Olson and Loustalet organized Prosperity Gold Mines, Incorporated and determined to lengthen the lower tunnel to tap the vein. In 1933, the company invested in what was probably the first new surface plant that Lost Lake had seen in 30 years. The facilities included a frame shop and change house, a ventilation blower, a gasoline compressor, an ore bin, and a residence. In need of capital, Olson reorganized the company as the Norway Syndicate in 1936 to include additional investors, and continued work on the lower tunnel. Finally, after a costly 1,100 feet, they encountered the vein. Extraction of the telluride ore proved so successful that the company acquired a small concentration mill from the Mason Mine, located west of Loveland, and re-assembled it at the Norway Mine in 1937. Under Boulder County mill expert Harrison Cobb, miners produced and treated 15 tons per day until the fateful year of 1942.[173]

In 1941, the nation's entry into World War II set in motion a series of events that deeply impacted what little mining continued in the Eldora district. Under President Roosevelt, the

[170] The number of active mines was estimated from a survey of Colorado Mine Inspectors' Reports.
[171] Colorado Mine Inspectors' Reports: Spencer Mountain Group; Schulz, 1977:1930-7.
[172] Colorado Mine Inspectors' Reports: Amy Paul, Shirley.
[173] Colorado Mine Inspectors' Reports: Norway; *Minerals Yearbook*, 1938:262.

Federal Government initiated a series of programs to organize and administer to economic, material, and labor resources as part of the war mobilization effort. With domestic mineral and metal resources suddenly of supreme importance, the government naturally passed several pieces of legislation that emphasized mining. War Production Board Ruling L-208 was among the legislation and, much to the dismay of Depression-era miners throughout Boulder County, it mandated the immediate suspension of gold mining by the end of 1942 on the grounds that gold was not of strategic importance. Reliant on gold ore, all the mines in the Eldora district closed, which brought to an end to anything more than occasional exploration efforts in the Mogul Tunnel.

E 4.6: The History of the Gold Hill Mining District

E 4.6.1: Return to Gold Hill, 1866 - 1872

In 1866, the Postal Service revoked Gold Hill's post office for one reason. The town and the rest of the mining district were almost completely deserted. The throng of prospectors, miners, and rush participants left because they exhausted the easily won placer deposits and free-gold ore. The gold, however, was not completely gone. Some ore remained in the form of rebellious and refractory material, which most gold rush participants left because they knew not how to process it. A few visionary individuals understood that at some point in time, technology would render the ore valuable and so retained ownership of the richest but mostly idle mines such as the Horsfal and Alamakee. A few prospectors also remained in the district because they felt that a few veins offering free-gold had yet to be found and merely awaited the pick and shovel.

Henry Neikirk was among these individuals, and he still held out great hope for the district's untapped potential. Neikirk was born in Elkhorn, Illinois during 1839 to a pioneering farm family that valued education. Neikirk attended the Mt. Carroll Seminary in Illinois then began studies in law under the partnership of Miller & Smith in 1859. This was apparently not to his liking, because after only a year, Neikirk left for Nebraska and continued on to Colorado. Responding to the lure of adventure and gold, Neikirk went to Gilpin County only to end up working for wages in the Bobtail Mine. The mining lifestyle, however, satisfied him and he stayed for several years, ascending to the position of foreman. With practical knowledge, Neikirk felt that he had a chance of finding his own mine and took the path of many prospectors. Specifically, between 1865 and 1867, he worked as a miner when in need of income and prospected Gilpin and Boulder counties in between jobs.[1]

Neikirk finally realized his dream in 1867 when he discovered the Hoosier Lode, located on what he named Hoosier Hill southwest of Gold Hill. Because he lacked capital, Neikirk continued to work in other people's mines, such as serving as foreman of Bela S. Buell's rich Central City operations. Neikirk developed the Hoosier over the course of the next several years as his savings allowed, and may have interested a partner or two for additional capital. During this time, Neikirk constructed the tiny Hoosier Mill most likely in Four Mile Canyon (at Wallstreet) where he could harness waterpower, which was a favorite motive source for operations with insufficient capital for steam equipment. Within several years, Neikirk fell into the same pattern with the Hoosier that plagued the hardrock miners during Gold Hill's boom. Specifically, he exhausted the easily treated ore, encountered complex and refractory payrock that would not amalgamate, and had to puzzle out the mineralogical problems. Ultimately, Neikirk would patiently wait until the mid-1870s when he amassed enough savings.[2]

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[1] *History of Boulder and Clear Creek Valleys*, 1880:667.
[2] Anderson, 2005:3; Cobb, 1999:80; *History of Boulder and Clear Creek Valleys*, 1880:667.

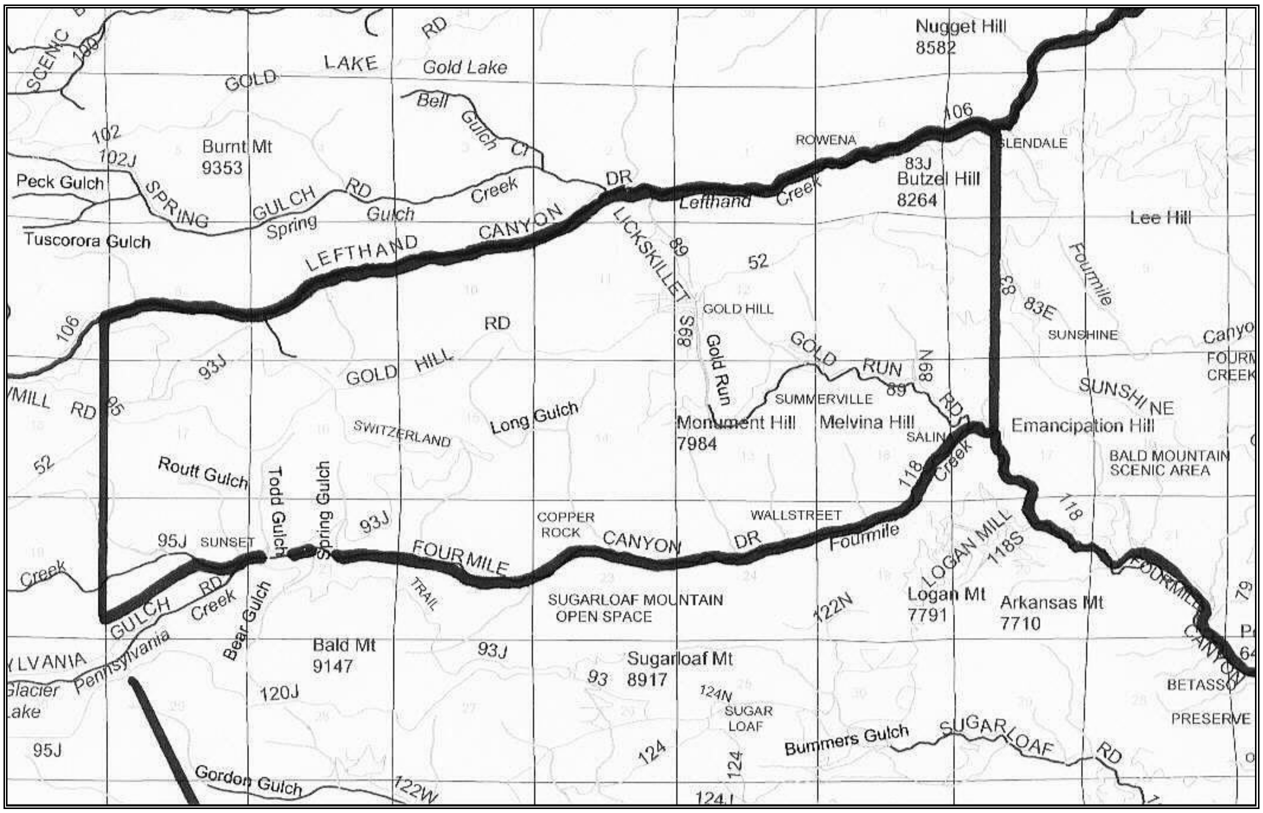

Figure E 4.6.1. The map illustrates the general geography of the Gold Hill Mining District. The Sunshine Mining District lies to the east, the Sugar Loaf district is south, and the Central district extends north. The boundaries are approximate. Base map provided by Boulder County Land Use Department.

Neikirk was not alone in discovering gold-bearing veins in the district during the late 1860s, nor was he the only individual frustrated by the refractory material encountered at alarmingly shallow depths. Other prospectors had similar experiences, and after scratching out the thin cap of free-gold ore in a number of veins, they quit when they ran into the troublesome ore. During this time, renowned metallurgist Nathaniel P. Hill delivered a solution that allowed these prospectors to finally profit from the troublesome ore. In 1868, Hill opened the doors to his Black Hawk Smelter, which he built with the express purpose of treating similar gold ore that consternated miners in Gilpin and Clear Creek counties. After treating a backlog of the troublesome ore from local mines, Hill finally began accepting payrock from elsewhere, including Boulder County.

Suddenly, miners in the Gold Hill district, and other areas in the county, had somewhere reasonably economical to ship the refractory ore. But it quickly became apparent that Hill's smelter offered only a partial solution to their problems because a number of factors required that the ore fetch at least $100 per ton. Freighting costs to Black Hawk were exorbitant, Hill's smelter charged a lofty $35 treatment fee per ton and lost ten percent of the metals content to inefficiency, and the remoteness of Gold Hill increased the costs of extracting the ore from the ground. Such expenses limited miners to particularly high-grade ore, which was difficult to find.[3]

Regardless, Hill's smelter started a small furor in Boulder County, and knowledgeable prospectors returned to the Gold Hill district in search of the troublesome ore that they cursed ten years prior. Between 1865 and 1870, companies and partnerships sought ore of sufficient richness in approximately ten deep prospects and actually extracted the material from half as many small mines, and all were located around Gold Hill. The slow return to the Gold Hill district may have been greater were it not for one important factor. Specifically, the reports of massive formations of silver ore ready for discovery in the Caribou-Grand Island district, to the west, drew prospectors away from Gold Hill as quickly as they arrived.

E 4.6.2: The Telluride Boom, 1872 - 1880

Around the same time that the Caribou boom was underway, two prospectors became responsible for a discovery that fostered one of the more important mining movements on Colorado's Front Range. To understand the event, we should review the Gold Hill district's principal forms of gold ore, which can be divided into three categories. The first was the free-gold that prospectors mined from near ground-surface, and the second consisted of the pyretic ore rendered profitable by the Black Hawk Smelter. While miners extracted these two forms of ore, they ironically cast aside the third form, which was telluride gold, because they did not realize its value.

One of gold's alluring qualities has always been its chemical stability. Gold forms very few chemical compounds, does not oxidize, and is usually encountered in its native state, which is readily recognizable. Telluride gold, however, is a very rare chemical compound consisting of gold, sulphur, and tellurium, which is an uneconomical metal. Telluride gold ores tend to appear lustrous, from off-white to black in color, and often lack obvious free-gold. Based on these properties, miners could not confirm telluride gold through visual recognition, which was the traditional means for identifying most ores in the field, and thorough assaying was the only sure means. The ore occurred by itself in veins and often with free- and sulphide gold throughout the Gold Hill, Sunshine, Central, Sugar Loaf, and Magnolia mining districts.

One of the reasons for the mystery surrounding telluride gold was that, until its recognition in Boulder County, it was known to exist in only a handful of places world-wide, and then not in commercial quantities.[4] Writing of the abundance of rare telluride ores in the county,

[3] Boulder County Metal Miners' Association, 1910:6; Fossett, 1876:160, 164, 392.
[4] Boulder County Metal Miners' Association, 1910:4; Canfield, 1893:116; Fossett, 1876:394; Fossett, 1879:77; Fritz, 1933:153.

modern geologists observed: "Boulder County, Colorado, has long been known as one of the few classical areas of telluride mineralization in this country. Its fame rests chiefly on the truly remarkable variety of rare metallic minerals that are abundant in the telluride veins."[5] Given rarity of all forms of telluride compounds, it comes as no surprise that assayers in Boulder County did not know to test for telluride gold and that miners, almost amazingly, cast the ore off as an interesting but worthless waste rock!

In 1872, history brought together five individuals, Christian Holk, Joseph Steppler, J.F.L. Shirmir, J. Alden Smith, and Dr. F.A. Genth, who played key roles in the recognition of the rare telluride gold. As with Samuel Conger's discovery of silver in the Caribou district, historical sources differ as to the exact events. According to some sources, Gold Hill miners Christian Holk and Joseph Steppler encountered samples of mineralized float (pieces of ore broken off a vein by weathering) on the east side of Lick Skillet Gulch and traced them to their source. Unable to determine exactly what the ore might be, Holk and Steppler sent samples to Denver assayer J.F.L. Shirmir, who was adept at his profession. Shirmir not only found the specimens to be rich with gold, but also realized that the ore was a rare telluride compound.[6]

Others accounts suggest that Holk and Stepper were working in the Red Cloud Mine, which they had already developed on the east side of Lick Skillet Gulch, and encountered the mystery ore underground. They sent samples to an assayer, who was Shirmir according to some sources, and he determined that the samples were telluride.[7]

The preponderance of historical sources agree that this last version is probably the most accurate, which additional information clarifies. During the early 1870s, Holk and Steppler owned and operated the Alamakee Mine, which was immediately above the Red Cloud, and these two properties may have been one and the same at the time. Holk and Steppler were almost certainly not the first individuals to question the content of telluride specimens, since miners at Gold Hill encountered the material during the early 1860s, but Holk and Steppler were the first to send specimens for thorough testing.

In 1872, Holk and Stepper interested Boulder assayer J. Alden Smith, who may have been the best in his trade in the county. Smith was born in Kennebec, Maine in 1830, attended public school and became a printer's apprentice at age 14. After three years, he moved on as an apprentice to the textile industry then realized that the road upward would be a long one, so he tried stone cutting at age 20 and came to a like conclusion. In 1854, Smith reverted to printing and saved enough money to buy the Bethel *Courier* at age 27. Meanwhile, Smith avidly pursued his avocational interest in geology and not only read all he could obtain, but also hired several tutors. In 1864, Smith's avocation became the foundation for a profession when investors hired him to go to Colorado and examine several mines. Smith fell in love with Colorado and its mining industry and stayed. He combined his geological knowledge with his interest in mining and printing experience to serve as local editor of the *Miner's Register*, which quickly became the authority on Colorado mining. Around 1870, Smith shifted his focus to assaying and opened

[5] Kelly and Goddard, 1969:5.
[6] Fritz, 1933:151; Smith, 1981:54.
[7] Bixby, 1880:426; Boulder County Metal Miners' Association, 1910:4; Southworth, 1999:54; Wolle, 1995:484.

an assay office in Boulder and, within four years, he became a prominent mine engineer and manager.[8]

In addition to running the usual assays on the Holk and Steppler's specimens, Smith tried other tests and came to the conclusion that the ore was telluride gold. While Shirmir could have assayed the ore as well, it was Smith who recognized the ore's rarity and mailed samples to Dr. F.A. Genth, who was a chemist, mineralogist, and geologist at the University of Pennsylvania. Interested in the ore's scientific importance, Genth subjected it to a raft of tests and concurred with Smith's findings. Genth was so impressed with the ore, which was known in as many as three locations in the world at the time, that he requested additional samples for study.[9]

The discovery and subsequent confirmation of telluride gold incited a rush that began at Gold Hill and rippled outward to the rest of the county. Prospectors were not the only people who were interested in the ore. The rarity of telluride made the county a prominent area of interest among geologists from throughout Europe and the United States. The numbers of prospectors that walked over and ignored the dozens of telluride veins in their search for free-gold during the previous ten years can only be guessed. The irony moved one mining expert to hint at the reason why: "Tellurides are so different in appearance from ordinary gold and silver ores that prospectors had passed over these lodes for years, never dreaming of the hidden wealth they contained."[10]

Following the collapse of mining during the mid-1860s, the settlement of Gold Hill consisted primarily of a cluster of cabins, several small boardinghouses, and possibly a few business interests in Lick Skillet Gulch and at the head of Gold Run. A few additional residences were located at the confluence of Lick Skillet Gulch and Left Hand Creek, where the milling industry was once located. Popular publications claim that the shift in activity caused residents to move the town off the top of Gold Hill (the landform) and down to the head of Gold Run, but the town probably grew at the head of the gulch to begin with. Repeating the pattern of the original boom, by 1873, prospectors congregated around Gold Hill and fostered the development of a business district and an expansion of the town. Someone forecasted the rush immediately after the telluride recognition and applied for a post office, which was granted in 1872 under the name of Left Hand. The name suggests that it was located in Left Hand Canyon.[11]

During the first two years of the rush, prospectors did not have far to go to find veins quite rich with telluride ore. Wealth-seekers developed the Cold Spring Mine in Lick Skillet Gulch a short distance downslope from the Alamakee Mine, the Slide northeast of the Alamakee, and the Black Cloud, Cash, Crown, Evans, Keno, Mountain Treasure, Tammany, and Victoria on the south slopes of Big Horn Mountain and Gold Hill (the landform). Not all the rich strikes

[8] *History of Boulder and Clear Creek Valleys*, 1880:678; "Obituary" *EMJ* 8/8/96 p131.
[9] Bixby, 1880:384; Cobb, 1999:10; Fossett, 1876:395.
[10] Fossett, 1876:395.
[11] Bauer, et al, 1990:88.

were in virgin ground, and some companies examined their existing mine workings for telluride veins, which proved fruitful.[12]

Figure E 4.6.2. The Cold Spring Shaft at left was one of the first important telluride mines developed near Gold Hill. The mine was small but productive, and the view is to the north. Source: Boulder Carnegie Library, 219-2-27.

[12] Anderson, 2005:5; *Colorado Mining Directory*, 1879:75, 81, 119; Fritz, 1933:106.

Figure E 4.6.3. The telluride boom brought new life and people to Gold Hill during the mid- and late 1870s. This western view depicts the main street during the 1880s, which is now a historic district. Lick Skillet Gulch descends right and Gold Run descends left. Source: Boulder Carnegie Library, 213-1-30.

With a new mineral to search for, prospectors fanned out throughout the Gold Hill district during 1874 and 1875, and found one vein after another. They were particularly successful in the hills and drainages south of Gold Hill, which offered concentrations of ore formations. The growing populations of prospectors and miners established several satellite settlements in the topographical areas that were conducive to town-building. Prospectors working on the south slopes of Gold Hill (the landform) and Big Horn Mountain pitched camp at the confluence of Blackhawk- and Gold Run gulches, which was no more than a wide spot in an otherwise narrow drainage. The prospectors originally called the cluster of tents and cabins Victoria Camp but changed the name to Summerville. As early as 1874, when the area was being prospected, around eighty people, including families with children, lived in the primitive settlement.[13]

Prospectors found more telluride veins near the confluence of Four Mile and Gold Run creeks, approximately one mile downstream from and east of Summerville. According to popular publications, prospector O.H. Hamilton led a party up to the confluence where they found hardrock gold in 1873 or 1874 and named their settlement after Salina, Kansas.[14] In actuality, Hamilton was a mineral surveyor en route to the San Juans, and he and four partners detoured to Gold Run in 1874 to examine the new telluride discoveries. They were impressed with the area's potential, decided to prospect, and named the growing collection of tents at the confluence Salina after their point of origin in Kansas. Once established, Hamilton began a very lucrative surveying business while his partners staked a number of profitable claims.[15]

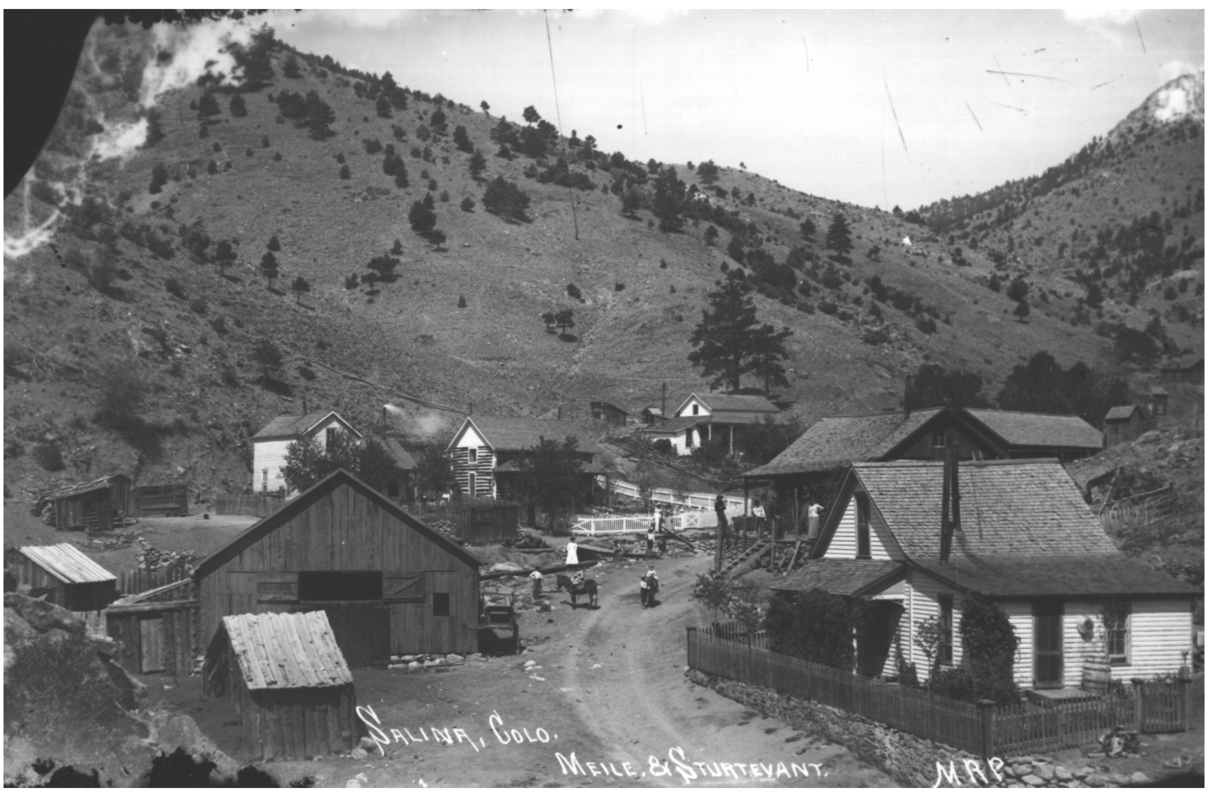

Figure E 4.6.4. Salina, at the confluence of Gold Run and Four Mile Canyon, was a sleepy working community surrounded by mines and mills. This 1880s view is northwest up Gold Run, and most of the buildings still stand today. Source: Boulder Carnegie Library, 213-3-16.

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13 Anderson, 2005:5, 13.
14 Fritz, 1933:172; Pettem, 1980:35; Smith, 1981:56; Wolle, 1995:487.
15 Anderson, 2005:7.

Prospectors discovered yet more telluride veins several miles to the west of Salina, on the north side of Four Mile Canyon. The settlement of Sugar Loaf (Wallstreet) already existed there, and while it consisted of no more than a handful of cabins, Sugar Loaf already boasted a post office, Henry Neikirk's idle Hoosier Mill, and the Sivyer Mill, which was in operation by 1873.

During the mid-1870s, miners, prospectors, and investors worked side-by-side in the Gold Hill district. The investors organized companies that brought the veins of ore into production as quickly as prospectors unearthed them. The town and landform of Gold Hill were particularly busy. Around 1874, E.W. Pierce, J. Harvey Jones, and D.F. Brown organized the Golden Crown Mining Company to speculate with and work some of the best telluride claims such as the Golden Crown, St. Joe, White Cloud, and Keystone properties. Brown and Pierce already owned interests in Ward's mines and Jones was a successful investor in Central City. At the same time, Frederick Pocock, A. Wilder, and Lawrence Singer owned and worked the Marblehead Mine on Big Horn Mountain. In 1875, Loudon Mullin and others organized the Freiberg Mining & Tunnel Company to work a vein in Gold Run Gulch. At the same time, James H. Ralston, Judson B. Shaw, and telluride discoverer Joseph Steppler organized the Winona Gold Mining Co to work the Winona Mine, located on the Slide Vein. Both Ralston and Shaw were investors of local importance. In 1876, Jean Rouilliard, W.H.J. Nichols and others organized the Tellurium Crown Mining Company to speculate with claims, and other partnerships developed the Register, Columbia, Keystone No.2, and South Star mines.[16]

The Slide Vein proved to be one of the Gold Hill area's most important ore bodies, and it attracted several individuals of note. J.G. Pell discovered the Slide in 1872 and other prospectors found several parallel veins to the northwest and southeast. The veins were so rich that George C. Corning personally took time away from the Bank of Boulder to examine them and purchase an overlying claim. Corning was a founding member of the bank and came to Boulder in 1871 after running the Topeka Bank in Kansas. Corning commissioned the Corning Tunnel to penetrate the veins at depth in 1873 and, in need of capital to complete the tunnel, interested Fred Squires and Dan Robinson. In 1875, these individuals of means organized the Corning Tunnel, Mining & Reduction Company, which built a concentration mill near the tunnel portal.[17]

Squires was Corning's equal in terms of capital. Squires was born in Granville, Massachusetts in 1819 and worked the family farm when not in school. At age 16, he became a tinsmith's apprentice in Berlin, Connecticut and ran his own tin shop beginning in 1838. He did so well that owner Newton Clark made him a partner in a year, then moved the facility to Chepachet, Rhode Island. There, Squires married Marinda Wade. Interested in a change, Squires sold the tin business in 1856 and moved to Genesco, Illinois, where he operated a livery and hotel. Squires arrived in Boulder in 1860, formed a partnership with Jonathan Tourtellote, and bought Samuel Breath and William Davidson's mercantile when they decided to devote all their time to the Niwot Mine in Ward. In 1866, Squires established his own mercantile, ran a sawmill, and invested in mining. When Tourtellote died, Squires sold the sawmill and focused on his store. Through investment and local politics, Squires became a significant community

[16] *Colorado Mining Directory*, 1879:87, 89, 101, 123; Fossett, 1876:396.
[17] Cobb, 1988:13; *Colorado Mining Directory*, 1879:81; Fritz, 1933:106.

figure. In 1864, he and other Boulder merchants contributed capital for the Boulder Valley & Central City Wagon Road Company, in 1868, he and other businessmen organized the Boulder Count Agricultural Society, and in 1871, Squires was appointed president of the town trustees and helped draft ordinances.[18]

After mining the rich surface ore, Pell sold his Slide claims around 1876 to William L. Campbell, David Moffat, and a Colonel Seymore, who were members of Denver's mining elite. They continued to use Pell's shaft and upgraded the hoisting system, but they eyed Corning's tunnel with interest. The trio contemplated a mutual arrangement with Corning to use his tunnel to access the Slide at depth in exchange for a share of their profits. Corning only improved the desirability of his operation in 1876 with the completion of his mill. Within several years, the two parties came to terms and put crews to work driving the tunnel the necessary 1,100 feet to the Slide Vein, and over the course of this distance, the miners breached several blind, or hidden, veins that were a bonus for George Corning. Technically, the American Consolidated Gold & Silver Mining Company owned and worked the Slide Vein and retained J. Alden Smith as superintendent.[19]

During the late 1870s, the wave of prospecting that swept the area immediately around Gold Hill matured into a productive mining industry dominated mostly by investors of local importance. Various partnerships continued to work the Triune, Keystone, Montana, Alamakee, and other small producers. Truman Whitcomb, who began mining in Gilpin County, purchased the Cold Spring in 1873, sank the shaft to the respectable depth of 400 feet, installed a steam hoist to serve the shaft, and had a crew of miners drive a tunnel. James B. Gould, James M. Carnahan, and George W. Chambers owned the St. Joe Mine, which was a moderate producer on the south slope of Gold Hill (landform).[20]

Chambers was intimate with the Gold Hill area because he was among the first wave of prospectors to stake claims. Chambers was born in Westmoreland County, Pennsylvania during 1826 and spent his boyhood in school and working the family farm. At age 18, Chambers became a school teacher and moved to Iowa in 1853, where he taught during the winter and worked as a carpenter during the summer. Two years later, Chambers went into the pharmacy business and married Eliza Jones. When business struggled due to the 1857 depression, he summoned up the courage to join the Pikes Peak Gold Rush. When Chambers finally exhausted his Gold Hill claims, he established a homestead five miles east of Boulder. Once on the plains, Chambers entered local politics and was appointed one of Boulder County's first county commissioners in 1861, then was elected county treasurer. Still interested in mining, Chambers quickly responded to the telluride discoveries at Gold Hill in 1872 and returned to his stomping ground. He stayed for four years, speculating, examining, and managing mining operations. During this time, he acquired the St. Joe, Golden Crown, White Cloud, and other properties.[21]

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[18] Bixby, 1880:393, 402; *History of Boulder and Clear Creek Valleys*, 1880:681; Smith, 1981:36.
[19] Cobb, 1988:13; *Colorado Mining Directory*, 1879:81, 115.
[20] Bixby, 1880:426; *Colorado Mining Directory*, 1879:79, 117, 119; Fossett, 1876:396; Fossett, 1879:80
[21] Bixby, 1880:425; *History of Boulder and Clear Creek Valleys*, 1880:625.

Stephen McBarnes and William Stoddard were two more individuals of local importance who invested in Gold Hill's telluride boom. McBarnes had practical experience mining while Stoddard was a trained engineer. McBarnes was born in Wooster, Ohio in 1840 and worked the family farm while attending school. Deciding that farming was not for him, McBarnes left at age 16 to work in the lumber business, probably as a logger, in Indiana. In 1863, he joined the Union Army and served until the war's end, then struck out west for Colorado. Interested in mining, he headed for California Gulch and found that he was much too late for easy gold. Instead, McBarnes found work in Horace Tabor's placer mine, which was a company operation. McBarnes managed to save enough to purchase the Rob Roy claim and worked it successfully until 1875. At that time, he went northeast to Boulder County in response to the telluride gold excitement and acquired interests in several properties at Crisman, which proved profitable.[22]

Stoddard was born in Vernon, New York in the early year of 1818 and, like many of Boulder's capitalists, worked the family farm and attended school as a boy. In 1838, Stoddard was given the opportunity for a higher education and attended a university in Oneida, where he studied civil engineering. After graduating, Stoddard went to work as an engineer for the New York Central Railroad, the Auburn & Rochester, then the Erie Railroad, all at a time when railroading was in its infancy. Afterward, Stoddard worked for the State of New York on construction of locks on canals. In 1844, he changed tracks and started a lumber business that milled in New York, Pennsylvania, and Canada. In 1878, interest in mining drew Stoddard to Boulder County.[23]

In 1878, McBarnes and Stoddard approached Matthew L. McCaslin and other members of the Gold Hill Mining Company with an offer to reopen and lease the long-idle Horsfal Mine. The owners agreed, McBarnes and Stoddard unwatered the 250 foot shaft, and brought the mine back into production after it was tied up in litigation for years. The Horsfal returned to its status as one of Gold Hill's significant producers.[24]

The rise of a mining industry restored the town of Gold Hill's standing as one of Boulder County's important settlements. By 1878, 200 people called Gold Hill home and another 425 miners, prospectors, and their families were scattered throughout the rest of the district. The main street again featured establishments that catered to daily life, including several saloons, a few mercantiles, a butcher, a clothing store, and a cobbler. Stages delivered passengers from Boulder who could find accommodations in the Gold Hill House, the Wentworth Hotel, and the Blue Bird Lodge. A lumber yard and several builders attended to the booming construction trade, and entrepreneurs opened service businesses such as engineering practices and a livery.[25]

The development of the mines around Summerville created as much noise and dust as the activity around Gold Hill. Summerville's mining industry, like Gold Hill, developed at a brisk pace as companies and investors acquired the most promising properties. In 1875, James H.

[22] *History of Boulder and Clear Creek Valleys*, 1880:663.
[23] *History of Boulder and Clear Creek Valleys*, 1880:685.
[24] Fossett, 1879:80; *History of Boulder and Clear Creek Valleys*, 1880:663, 685.
[25] *Colorado State Business Directory and Annual Register*, 1878; Schulz, 1977:1880-5; Wolle, 1991:484.

Boyd, A.J. Bean, and Corydon Sanborn organized the Cash Gold & Silver Mining Company to work the Cash Mine. All were investors of local importance, and Boyd wanted the Cash as a reliable source of ore for his smelter in Boulder (discussed below). At the same time, George F. Batchelder, Edward F. Wallace, Henry Moore, and Judson B. Shaw organized the Victoria Mining Company to operate the rich Victoria Mine. Shaw was already interested in other Summerville mines, and Batchelder and Wallace partnered in a number of other companies. In 1876, John B. Mass, John Richardson, John Mitchell, and Eben Rowland organized the Black Cloud Gold & Silver Mining Company to work the Black Cloud Mine. The mine was so promising that Rowland built a concentration mill directly over Gold Run Creek to treat the ore in 1877. The Black Cloud was not the foursome's only venture, and they cooperated in a number of other companies.[26]

Charles G. Buckingham and others owned and worked the Victor, which was a small but rich producer. Buckingham was born in Van Wert, Ohio to a family of privilege that sent him to the Greenway Academy then Kenyon College after a basic public education. In poor health, Buckingham decided to travel to recuperate, and when well, he worked for the First National Bank of Van Wert then moved on to clerk in a hardware store, and poor health forced him to resign. Like many ill Easterners, Buckingham came to Colorado to recuperate, and he settled in Greeley in 1870. Drawing on his experience in Van Wert, Buckingham and other entrepreneurs established the bank of Emerson, West & Buckingham at Greeley, and finding this line of business sound, Buckingham and brother Walter A. opened the Buckingham Brothers Bank at Boulder in 1874. Buckingham stayed in Boulder, reorganized his institution as the National State Bank, and used his profitable Summerville experience as a gateway into the world of local mining investment. During the late 1870s and early 1880s, Buckingham assembled a portfolio around some of the Gold Hill district's best producers. He also acquired the Magnolia Mine in the Magnolia district.[27]

Because of the local mining industry, Summerville grew into a hamlet with a handful of businesses and a population primarily of mine workers that probably numbered around 150. Charles E. Pugh opened a store in 1877, and other entrepreneurs established a hotel for investors and travelers, and a boardinghouse for workers.[28]

During 1874 and 1875, prospectors still revealed rich veins at Salina, even though most of Gold Hill and Summerville had been blanketed with claims by that time. During 1874, Oliver P. Hamilton's party discovered the Kansas, Salina, Baron, and Leona lodes then organized the Salina Consolidated Mining Company and brought them into production. Other prospectors found the Washington to the east, the Wren to the northwest, and the Last Chance and others in the general area.[29]

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[26] *Colorado Mining Directory*, 1879:75, 78, 120; Fossett, 1879:80; *History of Boulder and Clear Creek Valleys*, 1880:663, 685.
[27] Bixby, 1880:416; *History of Boulder and Clear Creek Valleys*, 1880:613.
[28] Anderson, 2005:6, 13.
[29] Fossett, 1876:400

The Ingram was one of the richest and most important, which Hiram Fullen and Thomas Shires began developing in 1874. Fullen and Shires were prospecting partners and did well in Boulder County. Fullen was born near Lebanon, Virginia in 1839, son of a farmer. At age 18, when old enough to leave home, Fullen took up a homestead in Winona, Minnesota and worked long enough realize that farming was not for him. In 1859, Fullen joined the Pikes Peak Gold Rush, and when he arrived in Colorado, he found that gold was not as easy to find as he thought. In need of income, Fullen went to work at the New York and the Gunnell stamp mills at Black Hawk, where he labored for four years. During this time, Fullen learned enough about building and operating mills to establish his own facility. In 1869, he obtained capital from several investors and built the Fullen & Bottolfson Mill in Left Hand Canyon near Lick Skillet Gulch. Fullen operated the White Rock Mine near Gold Hill at the same time, probably to supply the mill with ore. Responding to the recognition of telluride gold in 1872, Fullen, Shires, and other partners spent the next several years prospecting with great success.[30]

The Melvina Mine was Salina's other key operation, and Henry Meyring discovered it almost by accident. At age 14, Meyring left England as a sailor on a British ship, came to the United States in 1865, and enlisted with the navy. In 1868, he was discharged and learned carpentry in New Jersey, married, then decided to come west in search of opportunity. Once in Boulder County in 1875, Meyring was offered a job building a mill in Salina, and when he arrived in the hamlet, Meyring found that the project was postponed. In need of income, Meyring worked odd jobs and tried his luck prospecting. When he asked local prospectors how to search for ore, they merely sent him into the hills and instructed him to dig. Meyring was excavating a pit unaware of the rich telluride ore that he was shoveling out when the experienced Henry Neikirk happened by. Neikirk at once recognized the ore and offered to develop the vein in exchange for an interest. The Salina residents were no doubt astonished at Meyring's discovery, which Meyring named the Melvina. With Neikirk's expertise, the property became one of the region's most important producers.[31]

Like Summerville, the town of Salina grew in response to the local mining industry. During the mid-1870s, 100 miners and prospectors, and 30 families, inhabited the town, and they patronized several mercantiles, more than one saloon, and a butcher shop. Visiting guests and investors stayed in Nicholas Baron's Salina House hotel (for whom the Baron Lode was named) and dined in Perry D. Hopkins' restaurant. Prospectors had assayer Lowell H. Smith test their ore samples, and local children attended a school. It was probably Oliver Hamilton who requested a post office, which the Postal Service granted in 1874 under the name of Salina.[32]

Several miles to the west in Four Mile Canyon, the settlement of Sugar Loaf was another hub of prospecting during 1874 and 1875. Prospectors found several rich veins on Wood Mountain, which loomed to the northwest of town. Ivers Phillips owned one vein and pioneer

[30] Bixby, 1880:431; Cobb, 1999:10; *History of Boulder and Clear Creek Valleys*, 1880:638.
[31] Anderson, 2005:9; Bailey, 1982:17; Fossett, 1876:400; Fossett, 1879:82; Pettem, 1980:35, 38.
[32] Anderson, 2005:9, 11; Bailey, 1982:17; Bauer, et al, 1990:127.

Gardner P. Wood possessed another. In 1875, Phillips began developing his Phillips Vein and Wood started the Wood Mountain Tunnel to undercut his Wood Mountain Vein.

Wood was born in Chesterfield, New Hampshire in 1833 to a family of limited means that moved to Massachusetts. At age 13, Wood had to find work and labored for pennies until he secured a job in a cotton mill, and during this time, he attended school as best he could. With some money saved, Wood spent the next several years wandering and dabbling in various occupations. In 1854, he worked as a carpenter in Massachusetts, the following year he tried his fortune on the Minnesota frontier, and in 1857, he returned to Fitchburg, Massachusetts and married Sara Phillips. In 1859, Wood established his own cotton mill under Coggshall & Woodland, probably with his father-in-law's capital, and apparently went to fight in the Civil War. When he was discharged, Wood and wife came to Colorado when it was still wild and bought a group of placer claims in Four Mile Canyon in 1866. At Sugar Loaf, he was a community activist and contributed to a wagon road needed to link the primitive camp with Boulder, in 1867. The road also served a sawmill that Wood imported from Massachusetts in the same year. Becoming increasingly involved with mining at Sugar Loaf, Wood secured the Sugar Loaf post office in 1868 then erected the first stamp mill to serve the area in 1869.[33]

At the confluence of Pennsylvania- and Four Mile gulches, approximately three miles west of Sugar Loaf, prospectors found yet another concentration of veins bearing both telluride gold and silver. The prospectors named their small camp Pennsylvania Gulch, or Penn Gulch (Sunset), and developed a number of veins through the late 1870s. During this time, the Sacramento, San Francisco, Geneva, Dolly Varden, and Webster City mines began to take form. Impressed with the potential, John H. Pickel built a concentration mill at mouth of Pennsylvania Gulch in 1878, and while its process was successful, there was not yet enough ore to keep it busy. Hardrock ore was not Penn Gulch's only material of interest. It seemed that the miners of the early 1860s missed an important deposit of placer gold. Under Eben Rowland, the Webster City Gold & Silver Mining Company claimed the deposit as the Webster City Placer Mine and worked it with an organized infrastructure and crew.[34]

In terms of profiting from the Gold Hill district's telluride ore, mining was the easy part of the overall process. By contrast, treating the ore and achieving the final separation of gold from waste proved to be highly problematic, and mining absolutely depended on success in this arena. Because telluride ore was virtually unknown to the greater world, no precedent for its treatment existed. Metallurgists and geologists had to learn effective means for separating out the gold, and the county's ore became the stuff of experimentation and innovation. The metallurgists at the Black Hawk and later smelters found that telluride responded well to roasting and smelting, and so they quickly devised effective processes. The inherent problem for the county's miners, however, remained unchanged from the issues that they faced with the

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[33] Bailey, 1982:55, 57; Bixby, 1880:394; *History of Boulder and Clear Creek Valleys*, 1880:699.
[34] *Boulder County News* 5/4/77; *Boulder County News* 7/26/78; *Colorado Mining Directory*, 1879:122; Fossett, 1876:402.

refractory, pyretic gold during the late 1860s. Specifically, the elevated costs of transportation and smelting limited the miners to producing only the highest grades of ore. If the problems of economical treatment could not be resolved, telluride mining would collapse when the rich payrock was exhausted.

Fortunately, competition and a desire for the county's ore among smelting industry investors and metallurgists saved the nascent telluride mining industry. Competition partially resolved the problem of high smelting fees. Nathaniel Hill's Black Hawk Smelter lost its monopoly when investors built the Golden Smelting Works in 1872, the Denver Smelting Company built a facility north of Denver in 1873, and the Colorado Dressing & Smelting Company built another smelter at Golden in 1876. James H. Boyd, who had a personal stake in the Gold Hill district's telluride mines, was the most aggressive competitor. He understood the potential that the telluride mining industry offered and began a smelter at the mouth of Boulder Canyon in 1874. Two years later, he blew in the furnaces and began treating ore to the accolades of the county's mining interests. Threatened by all this new competition, Hill then opened the Boulder Sampling & Crushing Works near Boyd's smelter in 1876. Hill's facility was intended to sort and physically reduce ore for shipment to Black Hawk instead of providing complete treatment. The proximity of at first the Golden and Denver smelters, followed by the Boyd Smelter, partially solved the second problem for the county's mining industry, which was the high transportation costs.[35]

A few mining companies, however, realized that concentrating the ore prior to shipment could recover some gold and complete many preparatory stages for which the smelters charged. Turning plan to action, the Gold Hill district became a proving ground for methods and technologies that were effective for concentrating the complex telluride ore. During the mid-1870s, the Gold Hill district saw a small wave of mill building, and while some proved successful, many failed. Over time, metallurgists developed effective treatment methods by observing both the successes and the failures, and no single process was universally applied.

The town of Sugar Loaf quickly rose as one of the Gold Hill district's milling centers, albeit as small as it was. In 1875, three interests constructed mills with different processes, most of which failed. Gardner P. Wood ran the Austin Mill, a Mr. Dana refitted the old Hoosier Mill, and Ivers Phillips built the Phillips Mill, which he equipped with a battery of stamps for crushing and Pomeroy concussion tables for concentration. In 1876, Wood and Phillips then contracted with A.M. Rouse to build the Rouse Mill at the Wood Tunnel as a joint operation. Companies from as far away as Summerville sent their ores to the three mills in Sugar Loaf to be treated.[36]

Summerville and Salina both received several mills of their own during the latter half of the 1870s. The Atchison Mining Company built a mill at the mouth of Gold Run in 1876, another firm built a second mill in the area, and the Black Cloud company constructed a facility at Summerville, which failed. George Corning financed Gold Hill's first mill in 1876 to treat ore

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[35] Bixby, 1880:417; Boulder County Metal Miners' Association, 1910:6; Cobb, 1999:142; *Colorado Mining Directory*, 1879:125; Cox, 1989:26; Fossett, 1876:392, 409-410.

[36] *Boulder County News* 12/24/75; *Boulder County News* 5/26/76; *Boulder New* 8/15/79; Cobb, 1999:86; *Sunshine Courier* 7/24/75.

from the Corning and Slide mines. At least one more mill went up in Rockville (Rowena) in Left Hand Canyon.[37]

Like James Boyd, F.A. Hunt saw the potential market in treating telluride ore not only from the Gold Hill district, but also from the surrounding areas. In 1874, he organized Hunt, Barber & Company to build a concentration mill at Orodelfan because of its strategic location. In 1876, Hunt's Mill began treating ore with success, and in 1877, he decided to add a smelter. When a settlement grew around the facility, it was probably Hunt who secured a post office under the name of Orodelfan. Companies sent their ore to the smelter through the late 1870s.[38]

By 1880, the Gold Hill district's mining industry was in the middle of a transition, and several trends materialized. First, most of the principal telluride veins had been discovered and defined, and significant strikes tapered off because the areas known for production had been subjected to almost twenty years of examination. Second, within a matter of a few years, some mining companies realized that, to their disappointment, the ore veins were short in length, shallow in depth, inconsistent, and quirky. Because these types of veins possessed limited amounts of ore, they were easily exhausted. As a result, many mines closed in infancy. Third, investors of local- and statewide importance acquired the richest and most promising properties, which began a socioeconomic separation between mine owners and workers. Those who belonged to a low socioeconomic status became less likely to ascend because the fact that most of the principal ore bodies had been found decreased their chances of realizing sudden wealth. Fourth, capital was now required as mining companies developed the substantial veins at depth.

The rise of the above trends mark the end of Gold Hill district's first Period of Significance, which began with the recognition of telluride ore in 1872. Between this time and 1875, prospectors engaged in around 35 deep exploration efforts and partnerships extracted ore from approximately 15 small mines throughout the entire district. Between 1875 and 1880, as the telluride boom gained momentum, prospectors were at work in at least 50 major exploration operations in the Gold Hill area alone. In addition, partnerships and companies in the Gold Hill area produced ore from around 25 small mines, 10 medium-sized operations, and 1 large mine. In the Four Mile Canyon area, prospectors developed around 25 deep explorations, and partnerships worked 10 small mines and several medium-sized operations. The entire district also featured at least 8 concentration and amalgamation mills, where only 3 or 4 operated before.[39]

It may be fair to observe that the telluride boom played a major role in a radical jump of Boulder County's total population in a compressed amount of time. The population more than doubled from 1,939 people in 1870 to 5,325 by 1873, and almost doubled again to 9,723 by 1880. The population growth slowed after the boom subsided, and by 1885, only around 1,000

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[37] Anderson, 2005:11; Fossett, 1879:84
[38] Bauer, et al, 1990:108; *Boulder Camera* 9/8/76; *Boulder County Courier* 911/1/78; *Boulder County News* 9/6/78.
[39] The number of active mines was estimated from surveys of 1879 and 1883 *Colorado Mining Directories* and other archival sources.

additional people moved into the county.[40]

During the first Period of Significance, the Gold Hill district's telluride boom had implications on local, state-wide, and national levels. One event that was significant on all levels was the recognition of gold and silver telluride ore. Telluride compounds were known in only a handful of locations throughout the world in 1872, and as mining interests developed dozens of veins in the Gold Hill district, geologists and scientists from Europe and the United States acknowledged several trends. One was that the county's ore deposits were direct contributions to the advancement of geology and mineralogy. The other trend was that this knowledge could be used to recognize telluride ores elsewhere and predict their occurrences, which, in fact, occurred at Telluride and Cripple Creek.

Another implication that was significant on all levels resulted from the growing body of knowledge regarding telluride ores. Specifically, Boulder County was the first or second place in the world where telluride ores were discovered in commercial quantities. Because of this, absolutely no precedent existed for finding and developing telluride ore bodies, for producing economical grades of ore, nor for separating out the gold and silver from the waste material. As a result, Boulder County became a proving ground where the telluride mining industry set a workable precedent in these arenas through a combination of success and failure. Various interests in other areas of the world then applied the methods for discovery, production and treatment established in Boulder County.

Boulder County's telluride industry had several impacts on a state-wide level. One was the contribution of several millions of dollars to the economy in a relatively short time. Another was a slight shift in the state's social geography when prospectors and miners migrated to the county. A third was the contribution of enough to ore to reinforce the expansion of the Front Range smelting industry during the 1870s, which caused treatment costs to fall. Combined with a decrease in other costs, this allowed mining companies to produce lower grades of ore than before, which resulted in a surge in mining throughout the Front Range. A fourth impact was the rise in the county's importance on a state-wide level due, in part, to the above factors.

Boulder County's telluride industry had impacts on a local level, and one of the most important was a county-wide revival of prospecting and mining. This resulted in a massive population increase, a rearrangement of the county's social geography, and a demographic shift toward a class system. In addition, the expansion of mining led to the growth of supportive industries such as farming, ranching, transportation, and fuels production. It also led to the growth of services and systems such as banking, commerce, communication, and infrastructure. Last, the rise of mining created wealth and drew investment that was redistributed throughout the county, often by capitalists of local importance.

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[40] Schulz, 1977:1870-4, 1870-9, 1880-2.

E 4.6.3: Consolidation and Industrialization, 1880 - 1893

The decade of the 1880s saw a number of inevitable transitions manifest in the Gold Hill district. As noted above, most of the telluride veins were short, shallow, and inconsistent, and as a result, miners quickly exhausted the rich ore and left much low-grade material in place as uneconomical. Such ore formations tended to be the domain of small companies and partnerships that lacked the capital to conduct the costly underground exploration required to find blind, or hidden, veins. By leaving deposits of low-grade ore in place, these outfits created conditions that encouraged investment, mechanization, and consolidation of properties and operations. It was the large and well-financed companies that were able to conduct exploration and produce low-grade ore in the economies of scale necessary for profitability.

While the Gold Hill district experienced a movement toward consolidation and industrialization, the limited and unpredictable telluride veins still offered plenty of opportunities for small organizations. Overall, however, the intensity of activity decreased from the boom's height during the late 1870s. For example, between 1880 and 1885, the number of deep prospects decreased from a peak of at least 50 down to approximately 30. Likewise, the number of small mines decreased from at least 25 down to half that, and the medium-sized producers dropped from more than 10 down to around 5. In contrast, the number of large operations more than doubled. These figures, especially prospecting, further polarized as the 1880s progressed.[41]

National recognized individuals provided the greatest form of investment that any mining district could hope for, which was a railroad. In 1881, when railroad companies pushed into the Rocky Mountains, John J. Bush, Junius Berkeley, C.W. Fisher, and Willard Teller proposed using Boulder County as a trunk for the branches of a massive and ambitious system designed to tap much of the Front Range. Specifically, they proposed grading a track from Boulder up Four Mile Canyon to Nederland, and from there, lines would extend north to Ward, south to Central City, west to Caribou, and over the Divide and into Middle Park. Backed by capital from the Union Pacific, the foursome organized the Greeley, Salt Lake & Pacific Railroad and began construction. Due to a labor shortage in Boulder County, the company brought in its own gangs of African-American labor.[42]

In 1883, the first train left Boulder and successfully made it to the end of the track, which was at Penn Gulch. Two years after the railroad was organized, the actual rail system fell short of the grand plan, but workers were busy through 1883 grading a bed easterly over to Sugar Loaf Mountain and back west again to Glacier Lake on their way to Nederland. But because freight traffic was not as great as supposed, the railroad company stopped further construction and left

[41] The number of active mines was estimated from surveys of the 1883 *Colorado Mining Directory* and other archival sources.
[42] Crossen, 1992:15, 19.

Penn Gulch as the end of the line. To improve its customer base, however, the railroad improved the local road network to encourage drayage companies to deliver their freight to a station.[43]

While the railroad and the mining industry shared a symbiotic relationship, the mining industry may have benefited more than the railroad because the telluride boom was already in decline by the time that the railroad finally established service. Conditions in all the communities in the Gold Hill district improved to some degree as the costs of living, ore production, and transportation fell. As a result, mining companies produced ores of even lower grades than before. Because the railroad was a narrow-gauge line, its freight cars could not be sent directly to the smelters in Denver and instead sacks of ore had to be manually transferred onto standard-gauge freight cars at Boulder. Regardless of the extra handling, this was much less expensive than shipping by wagon.

Considering all the Gold Hill district's settlements, those in Four Mile Canyon felt the railroad's impact the most, primarily because the railroad had a direct physical presence in these communities. Penn Gulch benefited in several ways. First, its small mining industry now enjoyed direct service, and second, this end-of-the-line community profited from the passenger traffic. Last, the hamlet became a resort destination for the Denver and Boulder elite, and this form of income was more sure and stable than that from mining. Given the settlement's growth, the town founders requested a post office in 1882 under the name of Penn Gulch, which the Postal Service granted then changed to Sunset the following year.[44]

Sugar Loaf (Wallstreet) benefited from the railroad for similar reasons as Sunset, although Sugar Loaf remained primarily a mining community. Gardner P. Wood and Ivers Phillips still ran the most important operations, although Phillips was beyond retirement age. Phillips was born in 1805 in Ashburnham, Massachusetts to a farming family. As a boy, he worked the family farm when not in school and started to teach, but had to assume the family operation when his father became ill. In 1832, Phillips was appointed Deputy Sheriff of Worcester County and served until 1849, when he radically changed careers. Phillips took charge of a textile firm, bought the factory, and leased it out. He then used some of the income to invest in railroads when the industry was in its infancy. In 1855, Phillips was president of the Fitchburg & Worcester Railroad then the Boston, Barre & Gardiner Railroad, but served only during construction. In 1866, Phillips received his first taste of the West when a group of Boston investors dispatched him to Colorado to examine mining operations. At the time, Phillips had no intention of staying since his railroad career was going so well. In 1873, when the Boston, Barre & Gardiner Railroad was complete, Phillips decided the time was right to move to Colorado and immerse himself in mining. He settled in Boulder and began investing in telluride mines and milling.[45]

Located at a crossroads, Salina became an important station on the Greeley, Salt Lake & Pacific Railroad. The economic benefits were needed because Salina stagnated when the telluride excitement cooled off. During the mid-1880s, probably 150 to 200 people lived in

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[43] Crossen, 1992:26; Kemp, 1960:218.
[44] Bauer, et al, 1990:112, 137; Crossen, 1992:319.
[45] *History of Boulder and Clear Creek Valleys*, 1880:672.

town, and they supported the same basis set of businesses that served the community since the mid-1870s. G.F. Mayer ran a store, J.J. Cullacott operated a saloon, and W.H. Nicholson, who rose to prominence as a local mining investor, ran an assay shop. Reflecting the slowdown, Salina's only hotel, the Salina House, had been converted into a dance academy, and the only drinking establishment closed when Cullacott went insane in 1886.[46]

Like other towns in the Gold Hill district, Salina experienced a wave of consolidation, the closure of small mines, and the concentration of properties into the hands of a few wealthy investors. The Ingram Mine continued to be one of the most important producers, and Charles G. Buckingham joined Anthony Arnett and Thomas Shires in ownership. These three Boulder capitalists held interests in most of the county's other mining districts by the early 1880s. Around 1883, Meyring, Neikirk, Melvin Bailey, and Marion Kessler had to sell their beloved Melvina Mine to the Scottish-Colorado Mining & Smelting Company in response to a hostile takeover. All netted a small fortune from the property, even though Bailey and Kessler joined relatively late. The well-financed Scottish-Colorado company then built a mill at Salina. In 1886, the partnership of Monnell & Mitchell built a new concentration mill immediately down-gradient from the mouth of Gold Run Gulch. A thirty-foot waterwheel powered the mill, and equipment designed by Monnell carried out some of the concentration. Around 1881, investors organized the Century Mining & Smelting Company, which acquired the Atchison and Grand View mines, and built a smelter at Salina. The company also began development in the Albion Mining District southwest of Ward.[47]

Summerville saw the consolidation of its mines on two fronts. The first was the consolidation of the numerous, disparate claims into single properties that collectively offered enough low-grade ore to sustain mining. The second form of consolidation was that a handful of investors acquired most of the mines. By early 1880s, Eben Rowland owned and worked the Black Cloud, Credit Mobilier, Evening Star, White Pilgrim, and Uncle Sam, and financed a second Black Cloud Mill to replace the first ill-fated facility. Around 1882, W.B. Stone and Howard Gove of Kansas, and Walter Gove of New York City, organized the Gold Run Consolidated Mining Company to consolidate the fabulous Victoria Mine with a number of surrounding properties. Henry Meyring, Marion Kessler, and Charles G. Buckingham operated the rich Goldsmith Maid and other claims on Hoosier Hill. In 1886, James H. Boyd built the Cash Mill in lower Summerville to treat ore from his Cash Mine, and the facility ran with success. In 1880, Henry Neikirk interested S.A. Griffin and A.J. Macky in his Hoosier Mine, probably for capital, and they organized the Hoosier Mining & Milling Company to work the Hoosier Vein at depth. The property already featured several shafts and a 600 foot tunnel, but more work was warranted.[48]

Both Griffin and Macky were local investors, and Macky's roots go back to the beginning of Boulder. Macky was born in Herkimer County, New York during 1834 and

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[46] Anderson, 2005:22, 29; Wolle, 1995:487.
[47] Anderson, 2005:25; *Boulder County Herald* 6/2/86; *Boulder County Herald* 8/4/86; *Colorado Mining Directory*, 1883:43, 49.
[48] Anderson, 2005:28; *Boulder County Herald* 5/15/89; Cobb, 1999:63; *Colorado Mining Directory*, 1883:45, 58.

worked the family farm when not in school. At age 18, he left to become a carpenter and moved up into the building supply business. In 1857, Macky filled lumber contracts in Wisconsin until the fateful year of 1858. He immediately responded to reports of gold at Pikes Peak and crossed the prairie with a party during the winter of 1859. The first stop was Boulder where the party learned of strikes at Gold Run, but the members were too late to stake profitable claims. Seeking better potential, they crossed over to the Deadwood Diggings on South Boulder Creek and continued to Gilpin County with the same result. At Golden, Macky sank his last pennies into town lots then returned to Boulder. In need of income, Macky revived his carpentering skills and began building a number of the town's first permanent buildings, including frame house and a business block. Still bent on gold, Macky seized opportunity and joined the rush to California Gulch (today's Leadville). There, he spent his earnings on a claim that proved worthless. Back in Boulder again, Macky worked as a carpenter and as a butcher with Hiram Buck. At this time, Macky became a community figure as the first postmaster then went on to fill a number of positions for the town of Boulder. He also served as Boulder County Clerk and Recorder, and Deputy Internal Revenue Collector from 1873 to 1874 for Boulder, Weld, and Larimer counties. In 1877, Mackey invested in the First National Bank of Boulder in 1877 and served as a director, and this position more than any other provided him with funds for mining.[49]

Above all other communities in the district, Gold Hill saw the most consolidation, takeover by wealthy investors, and in accord, the development of significant projects. David Moffat, William Campbell, and George Corning continued to work the Corning Tunnel, which penetrated eight veins, the last of which was the Slide. During the early 1880s, O. Christopher and William Boice drove the Excelsior Tunnel near the Corning, probably in hopes of penetrating the same veins, and built an effective concentration mill in 1883. Around 1881, A.D. Gifford and David Bestle of New York City organized the Prussian Mining & Milling Company to develop the Prussian and Pittsburgh lodes with six tunnels and a shaft. The Seeley Mill, also known as the Nichols Mill, came with the property and the Prussian company built a second facility. The mine, located near the Corning Tunnel, yielded $117,000 within a short time. Richard Crowe's Horsfal Mining Company worked the Horsfal Mine and deepened the shaft in 1883. Around 1880, New York City investors organized the Winona Gold & Mining Company to work the Winona, which featured a number of shallow shafts. In 1882, I.M. Reedy discovered a vein in Left Hand Canyon opposite Lick Skillet Gulch and developed it through the lengthy Prince Arthur Tunnel. In 1888, he and a partner bought a mill in Jamestown and moved it to the site.[50]

The trend of consolidation throughout the Gold Hill district continued through the late 1880s and into the early 1890s, and the mining industry changed little except for a gradual and noticeable decrease in production. To some Gold Hill residents, the gradual and slow decline was palpable as some of the older, historic producers fell idle. The richest operations, including the Corning Tunnel, the Prussian Tunnel, the Prince Arthur, the Black Cloud, the Cash, and other

[49] Bixby, 1880:402; Hall, 1891:293; *History of Boulder and Clear Creek Valleys*, 1880:661.
[50] *Boulder News* 10/25/88; Cobb, 1999:9; *Colorado Mining Directory*, 1883:54, 61, 76, 82.

mines maintained production and employed large workforces. Overall, the mining industry supported a population of 425 in Gold Hill, 206 in Salina, and 68 in Sunset. The Gold Hill area and Four Mile Canyon had almost as many active mines between 1890 and 1893 as during the 1880s, but fewer prospects.[51]

At the end of 1893, the Silver Crash (see Caribou-Grand Island Mining District for a full account) wrecked Colorado's mining industry and caused a nation-wide depression. While the Gold Hill district's telluride industry was based around gold, which maintained a steady value of $20.70 per ounce, the Silver Crash deeply affected the Gold Hill district. Due to financial uncertainty, the unavailability of capital, and a poor economic climate, the mining industry fell into a torpid state, which closed out the Gold Hill district's second Period of Significance.

The Period began in 1880 during a transition in which the mining industry underwent consolidation, contraction, and domination by companies and investors with capital. By the second Period, much of the high-grade ore was gone, leaving large reserves of low-grade material. The transition of around 1880 saw a number of forces come together that allowed such ore to be produced profitably. Investors with capital supplied the money necessary for underground exploration, the development of mine workings, and the mechanization that facilitated production in economies of scale. Organized companies backed by investors had the power and resources to acquire and consolidate large tracts of claims, which cumulatively possessed enough low-grade ore for profitability. Decreases in the costs of equipment such as large hoists, steam appliances, and pumps helped mining companies to generate ore. Improvements in treating telluride ore were crucial, because where as many mills failed during the late 1870s, they succeeded by the 1880s, which lowered the costs of production. Last, completion of the railroad in 1883 lowered the costs of living, mining, and transportation throughout the Gold Hill district.

Several important trends manifested during the second Period. As noted above, the district's industry underwent a period of consolidation and investment that allowed companies to profit from large reserves of low-grade ore. As a result, the Gold Hill district continued to prosper through the 1880s. In conjunction with this, the district and portions of the county received large projects such as the railroad, improved mills, and mechanized surface plants. The movement resulted in economic contributions in the forms of ore production and capital investment. A share of the profits realized from mining went into the pockets of capitalists, some of whom reinvested the money back into the district. The industrialization of the district also reinforced the class system, the county's social geography, and existing economic, communication, and commercial systems.

E 4.6.4: The Silver Crash, 1893 - 1897

As alluded to above, the Silver Crash of 1893 propelled the nation into a deep depression that affected the Gold District in several ways. Some of the ore veins around Summerville and

[51] Schulz, 1977:1890-2; the number of active mines came from a survey of archival records.

Sunset carried considerable proportions of silver, and the collapse of silver prices rendered the marginal grades of payrock uneconomical, which caused a number of mines to close. The greatest impact, however, developed from economic complications associated with the national depression. Capital for mining was difficult to secure, investors were unwilling to pay for underground development and exploration, and many mining-dependent businesses struggled or went out of business. As a result, mining companies scaled back their operations or suspended them altogether, and new ventures were unable to obtain funding.

If this were not bad enough, several local events that occurred in 1894 made matters worse for the Gold Hill district. First, in the frigid and windy weather of November, Gold Hill suffered its second major fire. The conflagration started in the forest south of Ward and was quickly blown eastward by one of the many windstorms that heralded the arrival of snow. Because the fire was far off, Gold Hill's residents had time to calmly collect their favored possessions then congregate on the summit of Gold Hill (the landform) and watch their homes burn. As the fire was on the edge of town, all braced themselves for the destruction, but the winds died down just in time, the snow arrived, and it put the fire out. The other event was not as forgiving. The spring of 1894 brought wave after wave of rain storms, which saturated the ground and prepared the ideal conditions for flashfloods. Then, one massive storm stalled over the county and poured rain for sixty hours, and the water had nowhere to go but directly into the drainages. The creeks rose and destroyed placer mines and buildings on the valley floors, and an intense downpour then created flash floods that washed out everything in their paths. The railroad, graded literally on the floors of Boulder- and Four Mile canyons, was totally destroyed. Much of the track and most of the bridges had to be rebuilt anew, and given the carrier's existing financial trouble, Willard Teller and associates abandoned the line. Without rail service, the costs of living, mining, and shipping ore went up, which required companies to abandon the voluminous low-grade reserves and extract higher grades of material. The problem was that such ore was difficult to find after almost twenty years of mining.[52]

Only a few large, well-capitalized companies in the district were willing to spend the money necessary to find and develop the higher grades of ore that were now economical. Most companies and property owners, however, either lacked the funds or were unwilling to part with them, and as a result, the Gold Hill district went into a depression. In the wake of the various troubles, only around five medium-sized mines and as many small producers were active in the Gold Hill area, and around five medium-sized mines and eight small operations were active in Four Mile Canyon.[53]

Summerville and Salina appear to have been the most active areas during the mid-1890s depression. The Richmond, Scotia, and Victoria mines were the principal operations at Summerville, and all produced respectable amounts of ore. William Beamond developed the Scotia at the late date of 1892 after several years' worth of protracted and fitful exploration efforts. The Richmond Mine was a classic example of consolidation and investment by important capitalists. During the early 1890s, William G. Smith, T Weedman, and partners

[52] Crossen, 1992:46; Fritz, 1933:199; Wolle, 1991:484.
[53] The number of active mines was estimated from a survey of archival records.

organized the Richmond Mining & Tunnel Company to consolidate the Richmond, Marblehead, and adjacent claims into a major producer.[54]

Smith was born at Newton, New Jersey in 1857, son of an education administrator, and moved with family to Detroit at age eight. His father saw to it that Smith received a proper education then brought the family to Golden in 1872. As a young man, Smith taught school for a year, then worked in the office of the Golden *Globe* newspaper. Smith acquired a half interest in the paper then full ownership in 1879, and was elected city clerk. In 1880, Smith began to rise into the political arena as secretary for Governor Pitkin, and married Lake E. Mealey of Iowa two years later. In 1888, Smith was elected lieutenant governor then sold the newspaper to work as a broker in the mining industry. Smith invested on his own account in Aspen, Cripple Creek, and Clear Creek County, and he thought highly enough of the Summerville area to acquire the Richmond and adjoining properties.[55]

Charles Davis was Smith's equal in terms of experience and investment behavior, and he purchased the Victoria Mine, which was one of Summerville's best producers and largest employers. Davis was born in 1850 and decided to journey to Colorado in 1871. He joined a group of pioneering cattlemen bound for Colorado's plains, and they delivered him to Rocky Ford. Davis stayed for a year then went to Colorado Springs and determined to try his fortune prospecting. He searched the Mosquito Mountains and California Gulch, and worked as a miner when in need of money. In 1873, he went north to Caribou in Boulder County, and arriving well after the initial discoveries, worked as a miner then set out to prospect elsewhere in the county. Davis was one of the first at Sunshine when telluride ore was found, and later he married Mary Griffin. Full of wanderlust, Davis thought that the remote San Juan Mountains offered potential and set out for Lake City in 1889. While there, he opened a hotel known as the American House and took a lease on the Golden Fleece Mine, which had been worked since1873. Davis found rich ore missed by previous operations but he was disinterested in actually working the property, so he sold his lease to another party. Davis returned to Boulder in 1891 and speculated on various mines for a few years, then managed to acquire and develop the Chingas Khan Mine and the Victoria at Summerville in 1896.[56]

In Salina, the Ingram and Melvina continued to be the most important producers and employers. Because a market for custom milling still existed, Ira Monnell refitted the idle Scottish-Colorado Mill in 1895, treated ore but only with difficulty, and sold the facility to Harry M. Williamson who brought the mill into profitability. Williamson would move on to importance at Jamestown during the 1930s. Sunset featured a few mines, but the loss of the railroad in 1894 destroyed a major component of the town's economy. Sugar Loaf (Wallstreet) was relatively quiet during the mid-1890s, except for several large parties of Chinese who rebuilt their placer mines in Four Mile Creek following the flood. They leased the Railroad Boy and other claims, and worked other segments of Four Mile Creek since the mid-1880s. The workers meticulously gleaned gold dust that previous miners could not be troubled to save. In 1895,

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[54] Anderson, 2005:41; *Boulder News* 12/21/93; *Colorado Mining Directory*, 1896:88.
[55] Byers, 1901:335; Hall, 1895, V.4:580.
[56] "Obituary" *EMJ* 4/8/99 p416; Smiley, 1913:791.

Sugar Loaf residents petitioned the Postal Service to change the settlement's name to Delphi, which was granted.[57]

E 4.6.5: The Late 1890s Mining Revival, 1897 – 1910

As the decade of the 1890s waned, a variety of factors came together to spell a revival of mining throughout Boulder County and greater Colorado. First, the economy finally rebounded from the depression, investors were again willing to risk capital, financing could be found for businesses, and goods and services were readily available. Second, mine owners were more than willing to extend themselves to bring their idle properties back into production or sell them to investors to avoid sustained financial losses. Third, advances in mining technology and engineering decreased the costs of production, and improvements in milling methods permitted ores of greater complexity and lower grades to be profitably concentrated than before. Last, a keen interest in gold as a stable form of investment among mining capitalists also played a large role in the revival. Because the value of gold held steady at around $20.70 per ounce, mining capitalists saw the metal as a sure and safe investment and sought out gold's source, which in the case of the Gold Hill district, were the mines.

The Gold Hill district enjoyed a wave of mining and prospecting not seen since the early 1880s. Between 1897 and 1900, the Gold Hill area hosted around twenty small mines, more than ten medium-sized operations, and five large producers. The Four Mile Canyon area had at least ten small mines, five medium-sized operations, and one major producer. Prospectors responded to the strong interest in gold by returning to the hills in search of veins that had been somehow overlooked during the past thirty years. In the Gold Hill area, wealth-seekers developed at least forty deep prospects, which was most since the first years of the telluride boom. In the Four Mile Canyon area, prospectors were at work in around fifteen deep exploratory operations.

The late 1890s revival saw two general trends develop in the district's mining industry. One was a steady movement of consolidation and interest among powerful capitalists, and the other was a return of small partnerships and companies, which the above figures reflect. Repeating an earlier event in the district's history, one particular group of powerful capitalists created conditions that fostered the revival.

Understanding how important a railroad was to Boulder County's mining industry, ex-locomotive engineer M.F. Leach proposed a baby-gauge railroad, like the Gilpin County tram, from Boulder up to Ward. In 1897, he interested investors Charles W. Mackey of New York City, and Samuel B. Dick, J.H. Dick, C.W. Culbertson, J.T. Blair, and other powerful investors from Pennsylvania in his project. They assumed the project, organized the Colorado & Northwestern Railway Company, and graded another narrow gauge line along the old Greeley, Salt Lake & Pacific Railroad grade.[58]

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[57] Anderson, 2005:44, 48, 51, 52; Bauer, et al, 1990:43, 148; *Boulder Camera* 6/3/95; *Boulder News* 12/21/93.
[58] Crossen, 1992:61, 67.

Unlike the original railroad, Dick and partners planned the railroad as part of an ore shipping and treatment system. To this end, they organized the Pennsylvania Mining & Milling Company and constructed the massive Culbertson Mill at Valmont in 1898, which the railroad served. Then, to insure enough freight traffic to support the railroad and mill, Dick and partners made an agreement with William P. Daniels for all the ore that his Big Five Mine at Ward could generate. Dick then heavily promoted the railroad within the Gold Hill district and called for ore.[59]

As the costs of living, mining, and ore shipments fell, the Gold Hill district's companies eagerly responded. The railroad hauled down ore and concentrates from the mills, and brought up supplies and fuel. The railroad also became a conduit for tourists who made Sunset, Gold Hill, and Ward their destinations.

Sunset thrived not only from the reappearance of tourists, but as a layover for trains that turned to climb the new line up to Ward. At least four substantial mines were in production and a number of small operations were under development. L.A. Ewing, who would late work Ward's White Raven Mine, operated the Dolly Varden. The Champion City Mining Company worked the Poor Woman Mine with a crew of seven, and the Sunset Gold Mining Company operated the Free Coinage Mine and Mill.[60]

In Salina, a number of companies and partnerships reopened formerly rich producers and joined ranks with the Ingram and Melvina as economic engines and employers. S.J. Race worked the Gardner Mine, the Scotia Mining Company operated the Scotia, and investors reopened the Tambourine Mine. In response to the need for ore treatment, Salina assayer W.H. Nicholson built the Black Swan Mill in 1902, and shortly after it was finished, William Loach with the Firth-Sterling company leased it as a pioneer tungsten concentration facility. By 1903, Nicholson resigned as metallurgist due to poor health, and the mill resumed treating local ores.[61]

Summerville may have seen the most mining activity during the late 1890s boom. The Cash, Black Cloud, Richmond, and Victoria, the reliable producers, employed more than fifty miners. The Victoria in particular created a sensation when its owner Charles Davis died and his widow sold the property to Boston capitalist George A. Blaisdell for an astounding $125,000. In addition to the above, L.H. Flanders reopened the Belle Tunnel, Henry Neikirk rehabilitated the Freiberg Mine, Keller & Buckingham operated the rich Goldsmith Maid Mine, and David Evans operated the Evans, which produced $18,000.[62]

The boom drew more workers to Summerville than there were accommodations, so some miners had to commute by foot from Salina and Gold Hill. Salina's population more than doubled from around 200 during the early 1890s to 462 by 1900. Summerville was also the scene of one of Boulder County's few labor unrests. In 1899, miners joined a state-wide movement for more pay and an eight hour day, and in response, Summerville mine owners met

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[59] Crossen, 1992:62, 81; Holden, 1981:8.
[60] *Colorado Mining Directory*, 1898:117; *Colorado Mining Directory*, 1902:24.
[61] Anderson, 2005:68; *Boulder Camera* 6/26/03; Cobb, 1988:73; *Colorado Mining Directory*, 1898:115, 117; *Colorado Mining Directory*, 1902:19, 28.
[62] Anderson, 2005:56, 68; *Colorado Mining Directory*, 1898:116; *Colorado Mining Directory*, 1902:6, 25, 29.

to discuss the demand. They concluded to shorten the shift but reduce pay accordingly for the fewer hours worked. The miners walked off and forced the mine owners to either accede or lose profits. The owners relented.[63]

Figure E 4.6.5. The Black Swan Mill was built in 1902 between Salina and Crisman to treat gold ore on a custom basis. Within several years, William Loach leased the mill to pioneer a treatment process for tungsten ore. Today, only foundations remain. Source: Boulder Carnegie Library, 219-4-44.

The Gold Hill area saw the most consolidation and interest among capitalists of note in the district. Willard Teller owned the Slide Mine, the Corning Tunnel, and the Corning Mill, and employed L.N. Denison as manager. Denison held several important properties on his own such as the Alamakee. Samuel Newhouse, who operated several large mines in Clear Creek County, worked the Prussian Mine and Mill. The Prince Arthur Mining & Milling Company drew ore from the Prince Arthur Tunnel and milled it on-site. In addition, the Horsfal, St. Joe, Alhambra,

[63] Anderson, 2005:57; Schulz, 1977:1900-4.

and others were in production. T.M. Williams' Cold Springs Mining & Tunnel Company became one of Gold Hill's most important operations during the late 1890s when it rehabilitated its shaft and 1,700 foot tunnel. In 1902, the company purchased and consolidated the Alamakee and adjoining claims then worked them through the tunnel. At this time, Williams built a mill at the tunnel portal.[64]

Delphi, formerly Sugar Loaf, hosted one of the county's oddest and most ambitious operations. In 1897, Charles W. Caryl organized the Gold Extraction Mining & Supply Company with New York capital to buy claims, begin mining, and reorganize Delphi into a utopian labor community. Participants were given military ranks and were paid proportionately with recruits being the lowest at $2.00 per eight hour day. Privates received $3.00 for semi-skilled work, sergeants received $4.00 for skilled work, lieutenants received $6.00 and were professionals, captains were skilled and fetched $10.00, and majors received $15.00 and were managers. Generals earned $25.00 and were company principals. Caryl then laid out, on paper, an ideal community segregated by rank and furnished with lakes, boulevards, a railroad, and a subway. How he planned to fit this into Four Mile Canyon was a mystery.[65]

While the community was still in the planning stages, Caryl certainly worked toward the mining and milling aspects of the grand scheme. In 1898, he began purchasing mines under several organizations to provide ore for a massive chlorination mill that was under design. During this time, Caryl used his wealthy Eastern investors to organize the Nancy Gold Mining Company and purchase the Nancy Mine, which was a haulageway that undercut a number of veins. He also purchased the Mammoth and Rebecca mines in the Sugar Loaf district, the Scandia at Ward, and the Last Chance in the vicinity of the Nancy.[66]

In 1900, Caryl and his New York and Boston investors organized the Wallstreet Gold Extraction Company to build the chlorination mill, although by this time, the investors were pushing the eccentric Caryl to the margins of the operation. By 1902, workers finished the mill, which was one of the largest and costliest in the county. The facility had a 200 ton per day capacity, turned out gold bricks valued at $7,000 each, and was equipped with an electrical generator. The mill also promised to become a major customer of Samuel B. Dick's railroad.[67]

Ultimately, the Wallstreet company had three major impacts on Delphi. One was that the company employed a large workforce building the mill and developing the Nancy Tunnel. As a result, the population increased to around 300 by the year 1900. Another was that Delphi became a center of attention, mostly promotional in nature. The third impact was that the settlement's name changed to Wallstreet, which the Postal Service formalized in 1898.[68]

While the Wallstreet Mill commanded the attention of Delphi residents, a number of other mines around the town were actually producing ore. The Faith Gold Mining Company worked the I.X.L. Mine, E.C. Allen operated the Forest Mine, J.A. Teagarden, who had much

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[64] Cobb, 1988:12-13; *Colorado Mining Directory*, 1898:113-114; *Colorado Mining Directory*, 1902:2, 8, 15, 25, 27.
[65] Pettem, 1980:75; *Wall Street Mines and Mining, Clippings.*
[66] Bailey, 1982:23; *Colorado Mining Directory*, 1902:13, 17, 19, 22, 25; Wolle, 1995:488.
[67] Bailey, 1982:47, 51; Cobb, 1999:85; Pettem, 1980:80; *Wall Street Mines and Mining, Clippings*; Wolle, 1995:488.
[68] Bauer, et al, 1990:43, 148; Southworth, 1999:61.

experience in the Sugar Loaf and Magnolia districts, managed the Wood Mountain Mining, Milling & Tunnel Company, and Harry M. Williamson operated the Great Britain Mine. In addition, the Chinese still worked Four Mile Creek for placer gold.[69]

The name of Wallstreet proved to be the only permanent mark that the Wallstreet company left on the community. In 1904, a lack of ore, the fact that most of Caryl's mines did not yield as expected, and faulty milling processes caused the Wallstreet organization to crumble and fall. While this event crushed spirits in Wallstreet, it also represented a larger trend of decline that crept throughout the Gold Hill district. During the 1900s, many of the low-grade ore reserves exhibited signs of exhaustion, no new ore bodies were discovered, and mines began to close. Sunset fell back onto its role as a resort destination and railroad hub. In Salina, many of the small mines shut down, leaving the Ingram and the Melvina as the principal producers, which miners leased sporadically. By 1910, the Ingram ceased due to a lack of ore. The Gold Hill area lost most of its small mines, leaving the only largest operations, and even these had to reduce their workforces. In Summerville, the usually reliable mines became unreliable, although some of the best producers still yielded ore. In 1905, the American Queen Gold Mining Company owned and worked the Cash Mine and finished the Cash Mill the following year. The Pollock Mining & Milling Company operated the Black Cloud Mine and built a concentrator known both as the Pollock Mill and the Black Cloud Mill (the third mill by this name over the life of the mine) in 1906. The facility, however, was a total failure and its machinery was incorporated into another mill at Salina in 1908.[70]

The Gold Hill district's decline was pronounced by the late 1900s, and this marks an end of the third Period of Significance. In 1910, miners generated only around 7,200 tons of ore for the year, which represents the work of less than forty individuals. The population of Gold Hill fell to less than 200 people, the population of the Salina area decreased to approximately 300, and the Sunset area featured less than 100 people. The reason for the decline was that partnerships and companies finally exhausted the profitable grades of ore.[71]

The third Period began in 1897 with a major and abrupt revival of mining. In general, the Gold Hill district experienced several important trends during the third Period of Significance. First, in terms of industry, the Gold Hill district saw significant levels of investment, ore production, promotion, and overall development. During the Period, the mines contributed heavily to local and county-wide economies, and the mining companies consumed a considerable amount of machinery and supplies. The vibrant mining industry also drew the railroad, which specifically targeted the Gold Hill district's mines as an important source of freight income. This strengthened the district's involvement with commerce, banking, finance, and communication. In terms of society and culture, the district's population reached its peak and increased the sizes of Rowena, Summerville, Salina, Wallstreet, and Sunset. The large population fostered cultural

[69] *Boulder Camera* 9/25/97; Cobb, 1988:87; *Colorado Mining Directory*, 1898:117.
[70] Anderson, 2005:79, 80, 82; Cobb, 1988:69; *Mineral Resources of the United States*, 1908:371.
[71] Schulz, 1977:1910-9; production figures were derived from a survey of *Mineral Resources of the United States.*

institutions, communication systems, and commerce for non-industrial goods and services. Further, by consuming fresh foods, the population contributed to the growth of Boulder County's agricultural industry.

E 4.6.6: Irrecoverable Decline, 1910 - 1933

After mining dissipated during the 1900s, the Gold Hill district grew unsettlingly quiet. Summerville was nearly abandoned, and handfuls of miners leased the formerly rich producers and gleaned ore from the easily accessed upper workings. Without capital, they were unable to keep the deep shafts unwatered, which then flooded. Salina was in a similar situation and lost enough of its population to move the Postal Service to revoke the post office in 1925. In 1920, only 173 people lived in the area, and almost one-third left during the next ten years. Wallstreet and Sunset were no better off, and while lessees worked the Wood Mountain Mine, the mill burned in 1911. Only around forty people lived in these two towns combined, causing the Postal Service to cancel Wallstreet's post office in 1921.[72]

Gold Hill saw the only mining of substance in the district during the 1910s. Around 1915, the Gold Hill Mining Company acquired most of the formerly rich producers on Gold Hill, including the Slide, Bonanza, Prussian, Alamakee, and Cold Spring, then leased some of the properties to small parties of miners. In 1917 Matthew L. McCaslin still owned the Horsfal and employed a small crew of four miners in the workings. George Teal's Gold Hill Concentrating Company may have been Gold Hill's most important operation during the 1910s. In 1916, he built a mill at the Corning Tunnel, but because he was unable to round up enough ore from the mine, he sorted through the waste rock dump for low-grade ore cast off in the past. During the 1910s, only around 50 people lived in Gold Hill, which is why the Postal Service canceled the post office in 1920.[73]

In 1919, what remained of the Gold Hill district's once profitable mining industry faced an issue that would discourage any hope of a future revival. In 1919, the directors of the Colorado & Northwestern Railroad announced that they would junk the system and remove the tracks, and the Public Utility Commission agreed. Regional mine owners, however, offered to buy the railroad, but before they could, a flash flood washed out the tracks in Four Mile Canyon, sealing the railroad's fate. The directors then sold the railroad to the Morse Brothers Machinery & Supply Company, which offered the railroad to local interests at a discount. The money was not forthcoming, so the Morse Brothers dismantled and hauled off nearly everything. Without rail service, the costs of living, mining, and shipping ore went up again, but the introduction of trucks partially mitigated the impact.[74]

[72] Bauer, et al, 1990:127, 148; Cobb, 1999:86; Colorado Mine Inspectors' Reports: Misc. T; Schulz, 1977:1920-6.
[73] Bauer, et al, 1990:63; Colorado Mine Inspectors' Reports: Gold Hill Concentrating Co, Gold Hill Mining Co, Horsfal; Schulz, 1977:1920-6.
[74] Crossen, 1992:260; Fritz, 1933:198; Kemp, 1960:218.

E 4.6.7: The Depression-Era Mining Revival, 1933 - 1942

In 1929, the nation's economy collapsed and plunged the United States into the Great Depression, which reshaped the nation. At that time, thousands of people were thrown out of work, capital necessary for industry evaporated, and many goods and services were curtailed or became no longer available. When the Great Depression crept over Boulder County, it had a devastating effect and caused the failures of banks, personal estates, and companies.

The county's mining industry, which had been in decline since the early 1920s, was hit particularly hard. Many mines closed because their operators were unable to pay for operating costs, new equipment, and, most importantly, the exploration for new ore reserves. In their place arose what was tantamount to a small cottage industry in which unemployed people, primarily miners, returned to idle gold producers to eke out a subsistence-level income. A return to the nearly forgotten labor-intensive practices was a hallmark of the cottage industry movement because most individuals and partnerships were unable to afford machinery. These miners expected only to get by, their needs were very simple, and most individuals were satisfied with several dollars' worth of ore per day. In addition to working underground, subsistence miners favored two other sources of gold that required no investment beyond hand tools. One was working old placer mines thought to be exhausted. Like the Chinese who worked Four Mile Creek during the 1880s and 1890s, Depression-era subsistence miners found that the original placer outfits were sloppy and actually left just enough gold dust to be profitable. The other favored source of gold was low-grade ore that past operators of the formerly productive hardrock mines cast off as uneconomical waste. Subsistence miners found this material in the waste rock dumps and collected it by sorting through the surface material.

The cottage industry movement was most noticeable in the county's formerly most productive districts, including Gold Hill. Between 1929 and 1933, subsistence miners prospected approximately fifteen old producers and generated small batches of ore in approximately five small mines in the Gold Hill area. Four Mile Canyon saw miners enjoy more production and conduct less prospecting, and they operated around eight small mines and sought ore in as many historic properties.[75]

The Great Depression fostered an economic environment that encouraged mining investors to repeat what was becoming a pattern regarding gold producers. Specifically, they sought economic solace in gold, which held a constant value of around $20.70 per ounce. By contrast, the depression rendered financial investments uncertain and caused the value of other metals to collapse. While mining investors certainly had little capital to work with, they cautiously provided promising partnerships with just enough money to imitate the subsistence miners, only on a slightly larger scale. These partnerships tended to be small, they usually leased formerly productive mines, the partnerships often employed small crews who were happy to have jobs, and they focused all efforts on existing gleaning ore. As a result, few mines stayed open for more than several years at a time before being exhausted. Rare was the company that

[75] The number of active mines was estimated from a survey of Colorado Mine Inspectors' Reports.

possessed enough capital to own and improve a property, and to pay miners to explore for new ore reserves.

The Belle Mine, located near Summerville, is an excellent example of a typical Depression-era operation. Between 1934 and 1936, the St. Joe Mining & Milling Company employed a crew of three miners who gathered together ore that past operators left only because they thought it uneconomical. The crew sorted through the Belle's waste rock dump, which was not only a source of low-grade ore, but also engendered almost no operating costs. The miners then went underground and shoveled out the waste rock fill that the past operators dumped into the old and exhausted stopes. The fill material often offered a little low-grade ore, although the operators of the past considered it waste and dumped in into the old stopes to avoid having to haul it out of the mine. The last principal source of ore that the St. Joe miners sought was the pillars of natural rock that the past operators left in place to support the stope walls. The process, known as "robbing the pillars," was dangerous and rendered the old stopes unstable, but often resulted in small lots of rich ore. Once these sources of ore were exhausted at the Belle, the St. Joe company sent its crew to do the same tasks at other mines.[76]

The residents of each town in the Gold Hill district felt fortunate that their area hosted at least one company that weathered the first years of the Great Depression and provided jobs and income. In Four Mile Canyon, the activity was enough to maintain the population at around 125 individuals. At first, the Mountain Plains Mining Company, organized by John G. Clark (see Tungsten Mining District), was Wallstreet's principal operation. The company purchased the Wood Mountain Mine in 1928 and, flush with capital, employed a crew of 19 that drove exploratory workings, produced ore, and concentrated it in the Wood Mill. Clark tried to keep the operation going through 1929, but conditions force him to lay off the crew and lease the mine out, but only temporarily. Some of the idle miners may have found jobs at the Colby Placer, which Albert More purchased. More, who went on to lease hardrock mines a few years later, mechanized the Colby Placer to maximize production, although most of the equipment was second-hand and probably well-worn. A steam shovel scooped gravel from Four Mile Creek and dumped it into a trommel screen, which rotated and classified by material by size. The fine, gold-bearing gravel passed through the screen and dropped into sluices, where workers recovered the precious metal. The operation was a great success and was large enough to require a crew of eight and support facilities such as a shop.[77]

C.P. Pherson can be credited with creating conditions in Salina that fostered the development of one of the Gold Hill district's most important operations. In 1930, he leased the Tambourine Mine from owner Boulder National Bank, and proved the existence of viable ore. The following year, Ted C. Moran, who would go on lease mines in Summit County, took an interest in the Tambourine and may have offered the bank a larger lease than what Pherson could provide. The mine, in fact, offered so much ore that Moran approached Thomas Sullivan and Theodore J. Swisher for operating capital, they organized the Equity Reduction Company in

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[76] Colorado Mine Inspectors' Reports: Bell Mine.
[77] Colorado Mine Inspectors' Reports: Colby Placer, Wood Mountain; *Minerals Yearbook*, 1932:153; *Minerals Yearbook*, 1938:262; Pettem, 1980:102

1931, and not only leased the Tambourine, but also the Black Swan Mill to concentrate the ore. To pay for some of the operating costs, Moran concentrated custom orders from other companies, thereby providing a highly important service. By accepting ore, Moran and the Black Swan helped the local mining industry to survive through the first years of the Great Depression because they were able to produce ore that was too low of a grade to ship without treatment.[78]

George D. Sparks operated Salina's other important operation. In 1931, he leased the idle Ingram Mine and assessed the old stopes. Once he felt that he identified enough ore, Sparks organized the Ingram Mine Company, hired a crew of five miners, and set them to work sorting the mine's waste rock dump and the fill material in the old stopes.[79]

The idle mines in the Gold Hill area provided an opportunity for Andrew A. Zangara to organize one of the most important Depression-era mining companies in the entire county. In 1932, both the Boulder Ore Sampler and Zangara's mining interests were in financial trouble. The Boulder Ore Sampler was a cooperative among the county's principal mining companies, and it bought ore and provided partial treatment prior to shipping payrock to a smelter. With the mining industry at a standstill, Zangara struck a deal with the owners of the sampler. He would provide the sampler with ore, and the owners would provide him with discount treatment and capital to lease as many idle mines as possible. In 1932, the parties agreed and formed the St. Joe Mining & Milling Company, with Zangara as president and his wife Josephine as secretary and treasurer. Ironically, working the St. Joe Mine proper was not among the company's early ambitions, and Zangara instead leased the Cold Spring Mine. To provide immediate income, Zangara's miners began sorting the waste rock dump, and planning for the future, miners also repaired the Cold Spring Mill and began rehabilitating the tunnel. The reason why Zangara seized upon the Cold Spring was that the Gold Hill Mining Company consolidated the property with a large collection of formerly rich claims on Gold Hill and developed them at depth through the tunnel. A cave in blocked the tunnel by 1932, which required costly reconditioning before miners could bring out even a single car-load of fresh ore.[80]

In the same year that Zangara, Ted Moran, and other miners struggled to keep their new companies solvent, a disenfranchised nation elected Franklin Delano Roosevelt as president. He and advisors immediately began developing a variety of programs to revive the dismal economy, including a plan intended to simultaneously devalue the dollar while stimulating metals mining on a broad scale. As part of the plan, the dollar was taken off the gold standard and the Federal Reserve bought gold at inflated prices. The plan worked well and stimulated gold mining as expected, proven by an increase in the volume of gold that flowed into the treasury. In 1934, satisfied with the test, Roosevelt signed into law the Gold Reserve and Silver Purchase acts in hopes that they would resuscitate mining. The Gold Reserve Act raised the minimum price of

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78 Colorado Mine Inspectors' Reports: Tambourine; *Minerals Yearbook*, 1932:152.
79 Colorado Mine Inspectors' Reports: Ingram.
80 Colorado Mine Inspectors' Reports: Cold Springs; *Minerals Yearbook*, 1934:172; *Mountaineer-Mineral Age* April, 1936:11.

gold from around $20.67 to $35 per ounce and the Silver Purchase Act raised the value of silver from around $.40 to $.70 per ounce.[81]

Roosevelt's plan combined with widespread destitution, a lack of employment, and an initiation of a raft of recovery programs spelled a Depression-era revival of mining across the West. With mineral resources now offering a greater potential for income than in the past years, both subsistence miners individuals interested in large-scale production returned to those properties that they thought may still possess ore. What enhanced the environment for company operations was that mining investors were more interested in gold than ever, inexperienced laborers formed a workforce necessary for their mining operations, and advances in milling technologies rendered previously uneconomical ores profitable. While the revival was minor compared to mining operations of decades past, Boulder County, and especially the Gold Hill district, witnessed a return to the old mines on a scale not seen since the 1900s.

In this climate, the Gold Hill district saw a wave of company operations. Gold Hill's population increased to around 125 and that of the Salina area was as much as around 190. Further, much to the delight of the residents, enough people lived in the district to support several businesses at Gold Hill.[82]

One of the principal demographic groups that moved back to the towns was miners, who may have found work with one of several successful and substantial companies. Zangara's St. Joe Mining & Milling Company grew following the increase in the values of silver and gold. By 1934, the company leased an impressive 27 claims in the Gold Hill district, 21 properties including the New Age Mine in the Central Mining District, and the Republican Mine in the Sugar Loaf district. The Cold Spring Tunnel continued to serve as the hub of operations, in part because the company had the Cold Spring Mill working by this time. Between 1934 and 1935, Zangara finally managed to lease the St. Joe Mine, where the company began the practice of actually exploring for then producing fresh ore. By 1936, the company's production of around 75 tons of ore per day overwhelmed the little Cold Spring Mine, so Zangara tapped his growing coffers and built a central state-of-the-art flotation mill. Repeating the strategy employed by Samuel B. Dick and C.W. Culbertson during the later 1890s, Zangara sited his new mill on Valmont Butte, although instead of rail service, wagons and trucks delivered ore from the mountains. The Valmont Mill, also known as the St. Joe Mill, was finished in 1936 and immediately began taking ore from independent miners and the Boulder Ore Sampler. The impact of the Valmont Mill was similar to and larger in scale than Ted Moran's Black Swan operation. Specifically, by accepting custom orders, the mill allowed miners to produce lower grades of ore than were otherwise profitable. Through the St. Joe company, and its mills and leased mines, Zangara accomplished what most mining investors only dreamed of. He managed to build a small and profitable empire during one the nation's most difficult periods of time.[83]

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[81] McElvaine, 1993:164; Saxon, 1959:7, 8, 12, 14, 16.
[82] Schulz, 1977:1940-9; *Vertical Files: Ward.*
[83] Cobb, 1999:116; Colorado Mine Inspectors' Reports: Acme, Bell, Chancellor, Cold Springs, Gray Eagle; *Minerals Yearbook*, 1934:172; *Mountaineer-Mineral Age* April, 1936:11.

J.F. Little, and Ward and E.R. Terry, came close to empire in 1933. In response to Roosevelt's initial increase in the value of gold, the above three investors organized Slide Mines, Incorporated to purchase and rehabilitate the Slide group of properties previously owned by Willard Teller and fellow elite. The company prioritized its capital on building a new mill below the tunnel then had a substantial crew of miners sort through the waste rock dump for low-grade ore. Once the company had money flowing in, it sent miners into the Corning Tunnel to rehabilitate the underground workings there. When this was finished, the company enjoyed what most outfits had little access to, which was fresh ore. The Corning Tunnel penetrated at least six veins before it struck the Slide ore body, and because some of the six veins offered primarily low-grade ore, the previous operations left them alone.[84]

Figure E 4.6.6. Around 1934, Slide Mines built a new mill at the mouth of the Corning Tunnel. The operation was one of Gold Hill's most profitable and a significant employer, both of which were important in the climate of the Great Depression. The tunnel is right and out of view. Source: Boulder Carnegie Library, 219-8-9b.

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[84] *Boulder Camera* 3/2/34; *Minerals Yearbook*, 1934:172; *Minerals Yearbook*, 1935:212; *Mountaineer-Mineral Age* April, 1936:11.

Summerville saw several significant companies reopen some of its historic properties in the wake of Roosevelt's legislation. In 1934, Henry Meyring's son E.G. leased the Cash Mine and employed a crew of two, and T.J. Sullivan's Equity Reduction Company brought the formerly rich Goldsmith Maid Mine back into production. The following year, E.K. Henderson, W.J. McKenzie, Thomas M. Walsh, and W.H. Cowdery, who operated tungsten mines during the 1910s, remembered that no one had worked the Grant Mine on Hoosier Hill in decades and decided to lease the property. They organized the Grant Mining Company and employed a crew of four for several years. When tungsten became economical again during the late 1930s, these men reopened a number of mines around Nederland. In 1935, Robert F. Clark leased the Scotia Mine and employed a crew of six who produced five tons of ore per day through 1936. The increased ore production from these and other mines created a demand for milling that several investors tried to capture. In particular, a firm named Boulder Mill, Incorporated built a new mill on the site of the failed Black Cloud facility. Perhaps the site was cursed because the new concentration mill, like its predecessor, proved ineffective.[85]

Ray W. Brown and C.W. Lowe organized Summerville's most important company in 1935. Brown and Lowe already owned several historic producers that were scattered throughout the county, and their most important ones were the Big Horn and Homestake mines above Summerville. To obtain capital to bring these and the Ward Rose Shaft, at Ward, into production, Brown and Lowe formed the Homestake Gold Corporation. Within several years, Brown and Lowe's suspicions about the presence of fresh ore in their Summerville properties were confirmed by the production of $73,500.[86]

In Salina, a combination of low-cost treatment offered by the Black Swan Mill and the increase in gold prices stimulated a small revival of mining. The Ingram Mine resumed its role as one of Salina's most important producers and employers, and its operator, the Mines Development Company, trucked the ore to the Black Swan Mill. In 1934, McAnally Mines, Incorporated brought the Little Johnnie Mine back into production with a crew of around fifteen workers, who treated the ore in the Little Johnnie Mill. After an impressive production of 25 to 50 tons of ore per day, the miners exhausted the stopes by 1937. The Gold Hill Development Company owned the Fairfax and resumed the production of 10 to 50 tons per week from 1934 to 1937.[87]

John G. Clark was one of the first individuals with capital at Wallstreet to respond to Roosevelt's gold program. In 1933, his Mountain Plains Company resumed production in the Wood Mountain Mine and hired a crew of eight miners. Amusingly, the local mine inspector admonished the workers for using a gasoline locomotive for hauling ore cars out of the underground workings due to the noxious exhaust that the engine generated. In 1934, Clark consolidated his disparate mining interests into the Gold, Silver & Tungsten Production

[85] Colorado Mine Inspectors' Reports: Cash, Gold Smith Maid, Grant, Scotia.
[86] Colorado Mine Inspectors' Reports: Misc. H; *Stock Prospectus: Homestake Gold Corporation.*
[87] Colorado Mine Inspectors' Reports: Fairfax, Ingram, Little Johnnie; *Minerals Yearbook*, 1935:212.

Company, which assumed the Wood Mountain Mine. With gold now fixed at $35.00 per ounce, Clark expanded operations by employing six in the mill and four more underground.[88]

Leamon Vaughn, and R.B. and Albert B. More, paralleled John G. Clark's Wood Mountain venture. In 1933, they organized the More Minerals Mining & Milling Corporation to reopen the Orphan Boy Mine, located at Copper Rock. Numerous fine ore stringers kept miners busy producing an impressive 35 tons per day and milling it in a new facility until 1939.[89]

In 1941, the nation's entry into World War II set in motion a series of events that brought an end to the Gold Hill district's now thriving mining industry. President Roosevelt, whose legislation revived gold mining, assembled several federal agencies that reversed nine years of hard-won progress. Under Roosevelt, the Federal Government initiated a series of programs that organized and administered to economic, material, and labor resources as part of the war mobilization effort. With domestic mineral and metal resources suddenly of supreme importance, the government naturally passed several pieces of legislation that emphasized mining. War Production Board Ruling L-208 was among the legislation and, much to the dismay of Depression-era miners throughout Boulder County and across Colorado, it mandated the immediate suspension of gold mining by the end of 1942 on the grounds that gold was not of strategic importance.

Reliant primarily on gold ore, nearly all the mines in the Gold Hill district had to close, which brought to an end the fourth Period of Significance. During this Period, the Gold Hill district enjoyed its last revival, and while production was limited and people were glad merely to hold jobs, the mining industry may have been better off than any other time following 1905. The reason was that the Federal Government supported increases in the values of both gold and silver, which stimulated a wave of mining. Between 1933 and 1936, the Gold Hill area residents worked in 15 small mines and approximately 5 medium-sized operations, and Four Mile miners worked in 5 small mines and as many medium-sized operations. As miners exhausted the ore in these properties, their numbers declined after 1936. In parallel with the above figures, ore production increased from approximately 1,100 tons per year during the late 1920s to an impressive 72,500 tons per year by 1939. It should be noted that one miner generated around 300 tons of crude ore per year. Production decreased to 24,000 tons per year by 1942, then reverted to a low level after the War Production Board passed L-208 in 1942.[90]

Historic resources with integrity relative to the fourth Period of Significance may have participated in several important trends. The first is that the Gold Hill district saw its most significant period of production since the late 1890s revival. This was particularly timely because without mining, the residents probably would have abandoned the district since they had no other source of income. In addition, the Gold Hill district contributed more to the economy of

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[88] Cobb, 1999:87; Colorado Mine Inspectors' Reports: Wood Mountain; *Minerals Yearbook*, 1935:212; *Mountaineer-Mineral Age* April, 1936:11.
[89] Colorado Mine Inspectors' Reports: Orphan Boy.
[90] The number of active mines was determined from a survey of Colorado Mine Inspectors' Reports, and production figures came from a survey of *Mineral Resources of the United States*.

Boulder County than any other mining district at a time when money was dear. In addition, the companies maintained a workforce and aspects of the original cultural geography in the mountains, helped some investors amass capital that they reinvested in other ventures, and contributed elements of infrastructure, such as mills, which furthered mining. Overall, the Gold Hill district's industry was an important and contributing element of a Depression-era revival that swept Boulder County and greater Colorado.

E 4.6.8: An End to Mining, 1942-1980

When the War Production Board passed L-208 in 1942, it forced an end to the Gold Hill district's mining industry. From 1943 until 1945, a handful of companies were able to remain open, and then only by petitioning the War Production Board. It seems that the Yacola Mining Company, which leased the Winona, Aaron Stromberg who worked the Little Johnnie, and other individuals convinced the Board that even though the ore in their mines carried a high proportion of gold, the ore met the Board's criteria for industrial metals.

When the War Production Board lifted L-208, the Gold Hill district's mining industry had decayed beyond the point of recovery. Most of the mines required costly rehabilitation, very little economical ore remained, few experienced miners with the necessary resources still lived in the district, and, in general, the nation's attention turned from mining to business. In 1946, several partnerships tried reopening mines, and most failed. During the late 1940s, only around five operations of note generated ore, which ascended from a small 2,500 tons in 1946 to 6,100 tons the following year and fell to a negligible amount by 1950. At this time, only 171 people lived in the entire district and they stayed not for the mining but out of familiarity. As a sign of the district's regression, the Postal Service canceled the district's last post office, located in Gold Hill, in 1953. The remaining residents held out some hope for a revival of mining through the next decade and watched their small towns slowly shrink and become primarily bedroom communities for Boulder.[91]

[91] Schulz, 1977:1950-8; number of active mines was determined from a survey of Colorado Mine Inspectors' Reports, and production figures came from a survey of *Mineral Resources of the United States*.

E 4.7: The History of the Sunshine Mining District

E 4.7.1: Discovery and Boom, 1873 - 1885

The Sunshine Mining District was a product of the telluride gold rush that swept Boulder County during the mid-1870s. Ironically, prospectors unknowingly trampled countless times over the Sunshine district's rich veins prior to the recognition of telluride ore. It can be argued that Thomas Aikens and party crossed through the Sunshine area on their way to the fateful discovery of placer gold at Gold Run, and other prospectors certainly traversed the area during the early 1860s in search of hardrock ore. In addition, one of the first roads graded to Gold Hill probably ascended out of Fourmile Canyon (not to be confused with Four Mile Canyon, south of Gold Hill), crossed the Sunshine area, and went over Big Horn Mountain.

Almost fifteen years passed before anyone recognized Sunshine's rich telluride gold veins. In 1872, miners working only two miles to the west, at Gold Hill, realized that a mineralized material initially thought worthless was actually telluride gold ore, and this recognition incited a wave of prospecting throughout the mountainous portion of the county (see Gold Hill Mining District for history). Sunshine lay only several miles to the east of the discovery site, and it was the first location outside of the Gold Hill Mining District where prospectors found more telluride gold.

According to some archival sources, D.C. Patterson apparently found the first vein in 1873, which he named the Little Miami Lode, then discovered the second and called it the Sunshine. Patterson's find drew interest primarily among seasoned prospectors who came because they understood that the Sunshine area had not been heavily examined in the past and presented great opportunity. As soon as the working season of 1874 broke, which was relatively early in the spring, a rush for the Sunshine area developed.[92]

Prospectors pitched their tents at the head of Fourmile Canyon and quickly discovered a number of rich telluride veins in quick succession. They unearthed the Paymaster, Monongahela, White Crow, Grand View, Inter Ocean and other veins, then either developed the properties or sold them. As a rush developed, D.C. Patterson, Taswell A. and brother Peter Turner, and other early prospectors organized the Sunshine Mining District, which the Turners named after Patterson's discovery.[93]

Like Boulder County's other mineral rushes, prospectors, miners, and investors willing to brave primitive conditions worked side-by-side finding and developing telluride veins. Some claims were developed into simple but productive mines almost as quickly as prospectors staked them, and investors began to acquire the most promising properties. In addition to the above-named claims, which partnerships developed into mines, the Sunshine district saw the American, Charcoal, Nil Desperandum, Osceola, and Sheridan properties go into production.[94]

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[92] Bixby, 1880:431; *Colorado Mining Directory*, 1879:118; Howard, 2000:8; Wolle, 1995:493.
[93] Canfield, 1893:116; *Colorado Mining Directory*, 1879:72, 90, 104, 109; Fossett, 1879:82; Wolle, 1991:493.
[94] Fossett, 1876:397; Fossett, 1879:81.

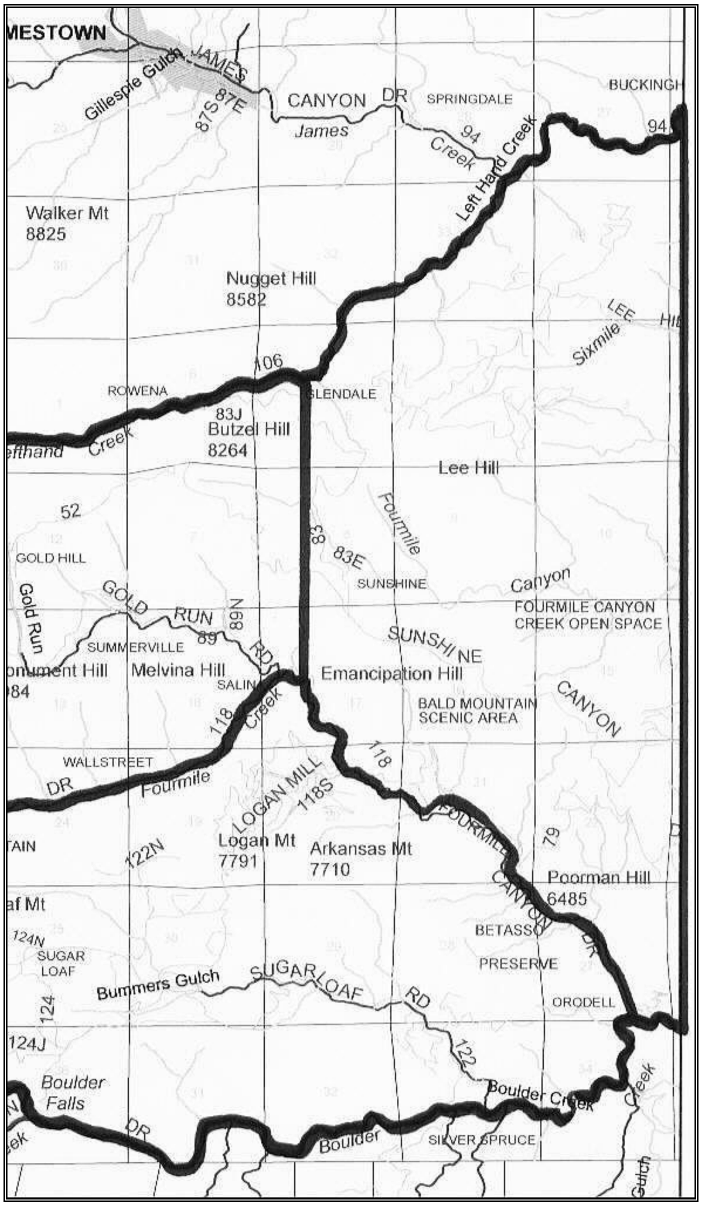

Figure E 4.7.1. The irregular form at right is the Sunshine Mining District. The Gold Hill and Sugar Loaf districts extend left. The boundaries are approximate. Base map provided by Boulder County Land Use Dept.

The American in particular, which Hiram Fullen and George Jackson discovered, may have been the district's best mine. Fullen was an excellent prospector and found at least three highly profitable telluride veins in the county (see Gold Hill Mining District history), and Jackson was none other than the man who made Colorado's first mountain gold discovery at Idaho Springs in 1858. Together, Fullen and Jackson took out $17,500 from the American during 1874 and possibly 1875, and they figured that the vein would surely pinch out after only a little more work. Arnett and Jackson suspended operations and decided to sell the property while the vein still had a sound showing of ore. In accordance with a buyer-be-ware philosophy, Fullen and Jackson hoped to pass off the uncertainty to other investors. Hiram Hitchcock, who owned the Fifth Avenue Hotel in New York City, materialized as the buyer, and Fullen and Jackson gladly sold the American to him for $17,500. The joke, however, was on Fullen and Jackson because the vein continued at depth, the American became one of Sunshine's richest producers, and Hitchcock's investment was repaid many times over.[95]

At the head of Fourmile Canyon, the original prospectors' camp naturally grew into a small town that was concentrated primarily on the south side of the drainage. The residents called the camp Sunshine after the names of the mining district and D.C. Patterson's claim. Sunshine's growth was so explosive that one chronicler noted: "Hundreds of people flocked to the place, and scores of frame buildings went up as if by magic, and soon well built streets, stores, hotels, school and church might be seen where one year before stood the lone cabin of the pioneer ranchman."[96]

At first, Sunshine's population was around 200, and the residents supported the usual assemblages of businesses. Mercantiles, restaurants, and saloons provided daily necessities, and visiting investors could stay in the Grand View Hotel, the Miner's Hotel, the Howard House, the Minneapolis House, or the American House, and keep their teams in a livery. Three blacksmiths conducted metalwork, and an assayer tested prospectors' ore samples. In 1875, the Postal Service officially recognized Sunshine with a post office, and the Sunshine *Courier* was published in the same year. By 1876, the district population increased to as many as 1,500 individuals.[97]

During the late 1870s, a productive mining industry evolved out of the boom, which still continued at a brisk pace. Investors of local- and statewide importance acquired the most promising properties, and the mines that partnerships developed in 1874 became the principal producers. Hiram Hitchcock hired engineer and geologist J. Alden Smith (see Gold Hill district history) to develop the American Mine, then sold the property to H.G. Angle and C. Goddard, who organized the American Consolidated Gold & Silver Mining Company in 1877. Angle was a member of Denver's mining elite and Walter S. Cheesman's mining investment syndicate. Angle retained Smith as manager, and Smith sank the shaft to an impressive 400 feet, making it one of the deepest at the time outside of Ward and Caribou. Also in 1877, C.C. Enright & Company purchased the Emancipation and developed the mine into a profitable producer. Around the same time, Henry A. Barrows developed the Paymaster into a shallow and moderate producer, Thomas Danford worked the Sunshine, and J.H. Clemmer, W.P. Howell, and Cornelius Howell founded the Grand View Mining Company to operate the Grand View Mine. All the above investors lived in Colorado except for Clemmer and the Howells, who were from Ohio.[98]

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[95] Bixby, 1880:431; Pettem, 1980:42; Smith, 1981:54; Wolle, 1995:493.
[96] Fossett, 1876:397.
[97] Bauer, et al, 1990:137; Bixby, 1880:431; Howard, 2000:8, 9; Pettem, 1980:43; Wolle, 1991:493, 494.
[98] *Colorado Mining Directory*, 1879:72, 104, 109, 118; *Colorado Mining Directory*, 1883:54.

Like some of Boulder County's other telluride mining areas, the Sunshine district featured very rich ore but only in limited quantities. Except for in the American Mine, most of the veins were relatively shallow and the rich ore was confined to narrow bands, which miners exhausted more quickly than they hoped for. As a result, many of the marginal mines went bust, prospecting decreased, and, by 1880, the Sunshine district's mining industry contracted around a scattered assemblage of productive mines. A decrease in Sunshine's population and the numbers of active mines reflect the trend of contraction. In 1874 and 1875, prospectors were at work in approximately 15 deep exploratory operations and developed 5 profitable mines. Between 1875 and 1880, these numbers jumped to at least 25 deep prospects, almost 15 small mines, and 1 large operation. After 1880, the numbers of prospects and small mines decreased to less than half, but the district now had 2 medium-sized operations and 1 large mine.[99]

Figure E 4.7.2. In 1874, shortly after discovery, the American Mine was primitive and typical of many frontier shaft operations. A hoist and shop occupied the log building at left, and a headframe stood under the tall peak. One of the individuals is discoverer Hiram Fullen. Source: Boulder Carnegie Library, 219-1-8.

[99] The numbers of active mines were estimated from a survey of 1879 and 1883 *Colorado Mining Directories* and other archival sources.

Figure E 4.7.3. New York City capitalist Hiram Hitchcock purchased the American Mine in 1876, invested in a substantial steam plant, and sank the shaft deeper. Hitchcock was amply rewarded for his expense, and the American became one of Sunshine's most important mines. The structure at left enclosed the shaft and hoisting system, and the shed at right was an ore sorting house. Source: Boulder Carnegie Library, 219-1-9.

The implosion of mining by 1885, at the latest, marks the end of the Sunshine district's first Period of Significance. The Period began in 1873 with D.C. Patterson's discoveries and saw the typical early stages that most precious metals district's underwent, including discovery, a wave of prospecting, initial settlement, the development of a primitive mining industry, permanent settlement, the arrival of capital, the movement of consolidation and investment, then decline due to the exhaustion of shallow ore.

During the first Period, the district participated in several trends that were important primarily on a local level and to a lesser degree on a national level. On a local level, the discovery and development of the district, its mines, and the town of Sunshine contributed to Boulder County's communication, commercial, and financial systems, and the social geography. The wealth that the miners produced and the expenditures by the capitalists flowed into the county's economy. Some of the capitalists who were fortunate enough to be rewarded with profits reinvested portions of their income back into the county's mining industry. Hiram Fullen, who lived in Boulder and invested in the Magnolia and Gold Hill districts, is one example. On a national level, the discovery and development of the Sunshine district contributed to the expansion of Boulder County's telluride mining movement, which held implications for mineralogy, geology, metallurgy, ore treatment, and mining (see Gold Hill Mining District for a full explanation).

E 4.7.2: The Quiet Years, 1885 - 1897

The Sunshine district was relatively quiet for a long period of time after the boom collapsed. A few outfits, however, thought that they could overcome the problems that led to the district's decline. One was to find continuations of the various ore veins, and the other was to somehow profit from the low-grade and complex material that the early companies left underground as unworkable. In terms of the former issue, a total of five small mines were in production at any given time between 1885 and 1890, and the number increased slightly after 1890. During this timeframe, the companies conducted some underground exploration in the Emancipation, Sunshine, Inter-Ocean, and White Crow mines on an intermittent basis. Because little rich ore was forthcoming, the companies produced low-grade material, also intermittently. By the 1880s, many of the mills in Four Mile and Left Hand canyons improved their concentration methods enough to render some low-grade ores economical to mine.

The mining industry was slow during the early 1890s and only around 300 people lived in Sunshine. When the Silver Crash wrecked Colorado's mining industry and caused a nation-wide depression at the end of 1893, Sunshine grew even more quiet than before and the residents struggled to get by. It remains uncertain whether any businesses remained in the town, and it seems likely that some of the remaining miners departed. Thomas R. Mann, Boulder capitalist and Colorado & Northwestern Railroad investor, used the depression to his advantage and purchased the American Mine. He employed a crew of 25 through the mid-1890s.[100]

E 4.7.3: The Late 1890s Mining Revival, 1897 – 1905

The mining revival of the late 1890s brought relief for those individuals in the Sunshine district who persevered through hard times. A number of factors such as an overall economic recovery, available capital, and general optimism stimulated a revival that began to sweep Boulder County and the rest of Colorado by around 1897 (see Ward and Gold Hill mining district histories for full account). A keen interest in gold as a stable form of investment among mining capitalists also played a large role in the revival, which individuals in the Sunshine district experienced firsthand.

Between 1897 and 1900, the Sunshine district's mining industry awoke from a deep slumber, but activity was nowhere near the boom years. Partnerships and investors with capital

[100] *Colorado Mining Directory*, 1896:87; Howard, 2000:8; Schulz, 1977:1890-2.

brought most of the historic mines back into production, developed low-grade ore reserves, and conducted underground exploration at depth. During this time, various outfits brought ore out of around five small mines, four medium-sized operations, and one large producer, and prospectors searched the fringes of the district for new veins. In 1899, Lloyd Snively was one of the fortunate few to find a new vein, which he developed as the Pilot Mine. The revival of mining drew slightly more than 100 people to Sunshine, most of whom were miners, and it seems likely that a few businessmen opened their doors in town to supply the greater population with the necessities of life.[101]

During the late 1890s revival, most of the activity occurred immediately around the town of Sunshine. J.P. Larimer operated the Monongahela, W.J. Williams worked the White Crow, Thomas R. Mann kept the American in production, and other investors mined the Nil Desperandum, Inter-Ocean, and Osceola. To the south, on Emancipation Hill, Edward Temple, who owned other productive mines at Salina, operated the Emancipation. Nearly all the above mines were mechanized, around 500 feet deep, and employed a considerable workforce.[102]

The late 1890s boom continued into the early 1900s, although within a few years, miners began to exhaust the ore formations. Between 1900 and 1905, the marginal and small mines closed one by one, leaving the Inter Ocean, the Emancipation, and the American mines as the principal operations, then they too suspended activity. By 1908, Sunshine descended back into a depression and around one-half of the population left.[103]

By around 1905, Sunshine's revival ended, bringing the district's second Period of Significance to a close. The reasons were similar to the problems that caused the first boom to collapse around twenty years earlier. Miners simply exhausted most of the profitable ore, even though it was lower grade than the material extracted in the past. Underground exploration confirmed that most of the telluride veins were, in fact, shallow and limited. A few veins, however, showed signs of promise, and some low-grade ore remained, but it was not particularly attractive.

The Sunshine district's second Period of Significance began in 1897, and at this time, the district had enough mining, investment, and development to draw a 25 percent population increase. Overall, the district's mines contributed to Boulder County's wealth, social geography, and the funds of capitalists, some of whom reinvested the money back into industry. The district's mines also drew investment that in turn disseminated into the local economy.

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[101] Schulz, 1977:1900-4; the number of active mines was estimated from a survey of the 1898 *Colorado Mining Directory* and other archival sources.
[102] *Colorado Mining Directory*, 1898:117; Howard, 2000:9.
[103] Howard, 2000:9; the number of active mines was estimated from a survey of the 1902 *Colorado Mining Directory* and other archival sources.

E 4.7.4: The Decline of Mining, 1905 - 1929

Nearly all of the Sunshine district's companies and partnerships suspended work during the latter half of the 1900s and the region reverted to ranchland. In 1913, the Postal Service revoked the post office, and from this time until 1929, only a handful of miners secreted out small ore chutes in the formerly productive mines. Some mining experts, however, assumed that Sunshine's revival went bust because no one spent the time or money to thoroughly explore the ground around the White Crow and Inter-Ocean mines. As a result, low-grade ore reserves were almost certainly present, and there was a possibility that stringers of high-grade ore remained, as well.

M.S. Brandt was one such expert, and in 1925, he interested investors in his suppositions, and they organized the United Empire Mines Company. At first, the company purchased the Monongahela and Inter-Ocean mines and dispatched a crew of miners to rehabilitate the Monongahela Tunnel. Sunshine residents were thrilled because not only was this the first mining operation of note in almost two decades, but also it could stimulate another revival should Brandt prove correct. During the next several years, Brandt acquired and consolidated the White Crow, Osceola, and other mines, and used the Monongahela Tunnel as a platform for development. Just as United Empire was making headway, events in 1929 brought the optimism to a halt.[104]

E 4.7.5: Mining During the Great Depression, 1929 - 1942

In 1929, the Great Depression descended on Boulder County and caused banks, personal estates, and companies to fail. The county's mining industry, which had been in decline since the early 1920s, was hit particularly hard, and many mines closed because they lacked the funds necessary to pay their operating costs. Brandt's United Empire was among these, but he apparently convinced his investors that, with a little more capital, his miners would shortly encounter ore. They hesitantly provided enough funds to keep a small crew busy continuing Brandt's exploration efforts until 1932, when the miners vindicated Brandt with the discovery of profitable but low-grade ore. Brandt's miners extracted enough material to impress the investors, who contemplated Brandt's recommendation of building a mill to concentrate the ore.[105]

United Empire was not the only outfit to attempt some semblance of ore production during the depths of the Great Depression. In 1931, the Emancipation Gold Mining & Milling Company reopened the Emancipation after building a mill at Salina in 1928, only to be stopped

[104] Colorado Mine Inspectors' Reports: United Empire.
[105] Colorado Mine Inspectors' Reports: United Empire.

by the depression. The company unwatered the upper levels of the mine, worked them, then sold the property.[106]

While the Emancipation and United Empire companies had the greatest likelihood of meaningful production, a handful of Sunshine miners returned to idle gold producers to garner a subsistence-level income. Because these miners expected only to get by, their needs were very simple, and several dollars' worth of ore per day was sufficient. Between 1928 and 1933, Sunshine's subsistence miners sorted through old waste rock dumps for low-grade ore cast off in the past as uneconomical, and gleaned ore in approximately five small operations. At this time, only forty people lived in Sunshine.[107]

In 1933, President Franklin Roosevelt launched a pilot program intended to simultaneously devalue the dollar while stimulating metals mining. As part of the plan, the dollar was taken off the gold standard and the Federal Reserve bought gold at inflated prices. Satisfied with the test by 1934, Roosevelt signed into law the Gold Reserve Act, which raised the minimum price of gold from around $20.67 to $35.00 per ounce. This increase in value stimulated a small revival in the Sunshine district that reinforced the growing interest in the handful of properties known to possess ore.

The increase in the value of gold encouraged Brandt's investors to part with the money necessary to build a mill at the Monongahela Tunnel. No sooner than work began on the facility, miners encountered a vein of high-grade ore in the White Crow and Monongahela properties, which further validated Brandt's claims. In 1935, the company finished the mill and invested heavily in the surface plant by installing an electric locomotive, a new shop, a sawmill, and an air compressor. The next year, Brandt finally saw the mine begin heavy production. A crew of 25 miners produced an impressive 75 to 100 tons of ore per day, which they treated in the mill.[108]

In 1937, the hopes of Sunshine residents were dashed when debt and a failure to pay income taxes caught up with United Empire. Brandt tried to keep the mine open, but, after waiting years for real production, the investors were unwilling to provide any more money for expenses even as basic as taxes. The mill was suspended and Brandt had no choice but to lease the complex workings out to small parties. Except for the United Empire property, the Sunshine district had only a handful of other mines of substance. In 1935, George D. Sparks, who operated mines in the Gold Hill district, leased the Sunshine Mine and produced small volumes of ore until 1938, then sold to the Mines Development Corporation, which carried on for several more years. Another party leased the Emancipation from around 1936 until 1942, when the War Production Board passed order L-208, which ordered the suspension of gold mining. Sunshine lost its last operation of note.[109]

Since 1942, the Sunshine district saw almost no mining activity. In 1965, Marlin Bruesburg and a crew of three began driving exploratory workings in the Buckskin Joe No.1 and

[106] Colorado Mine Inspectors' Reports: Emancipation.
[107] Schulz, 1977:1930-7.
[108] Colorado Mine Inspectors' Reports: United Empire; *Mountaineer-Mineral Age* April, 1936:11.
[109] Colorado Mine Inspectors' Reports: Emancipation, Sunshine, United Empire.

struck ore, which they produced on a weekend basis through much of the 1970s. Tom Hendricks, who currently operates the Cross Mine at Caribou (2006), produced small volumes of ore from the Buckskin Joe then closed the mine in 1981, and in so doing, was the last person to mine in the Sunshine district.[110]

E 4.8: The History of the Sugar Loaf Mining District

E 4.8.1: Discovery and Boom, 1873 - 1885

During Boulder County's initial gold rush of the early 1860s, prospectors discovered placer gold in the principal drainages that descended from Sugar Loaf Mountain and surrounding hills. Experienced individuals also found a few veins of gold ore and worked them on a small scale. Once the miners exhausted the easily won placer deposits and free-gold ore, most of the individuals abandoned the Sugar Loaf district. The gold, however, was not completely gone. It was merely in a form that no one recognized until 1873. During the previous year, several miners at Gold Hill had samples of highly mineralized rock that appeared to be ore assayed, and reports indicated that the material was actually high-grade telluride gold. The recognition of this new type of ore incited a wave of prospecting (see Gold Hill Mining District for history) that rippled outward from Gold Hill and ushered in a mining boom throughout much of the mountainous portion of the county.

Within a year, prospectors examined the Sugar Loaf district with a new perspective on its mineral wealth. Archival sources claim that telluride ore was first recognized in the Forest Mine during 1873, which would have confirmed for prospectors that telluride certainly existed in the district. Frank C. Messenger, William E. McKnight, Gardner P. Wood, James L. Wilson, and Van R. Elliot were among the first to respond to the telluride discovery, and Messenger and Wood apparently found at least one profitable vein each. Their interest drew other prospectors in 1874, and a few of these individuals found some of Boulder County's richest ore bodies. They established several tent camps, one of which was known as Camp Tellurium, and they used the settlement of Sugar Loaf (Wallstreet) in Four Mile Canyon as a base of residence.[111]

The prospectors had much ground to cover in the broad district, which is why they made important discoveries not all at once, but instead over the course of 1874 and 1875. John A. Logan discovered the Logan Mine in 1874, Pierre Francois Ardourel discovered the Grand Republic in the same area, and other prospectors unearthed the Croesus, Little Annie, Paymaster, Washington Avenue, and Yellow Pine properties. Few prospectors were as fortunate as George R. Williamson, who discovered not one important vein like the individuals noted above, but instead encountered three ore formations at various locations in the district. In 1875, he

[110] Colorado Mine Inspectors' Reports: Buckskin Joe No.1.
[111] Bixby, 1880:432.

discovered the Vucleus, Gray Copper, and Duroc lodes, and wisely developed them on a pay-as-you-go basis instead of selling at the discounted rates typical of prospectors.[112]

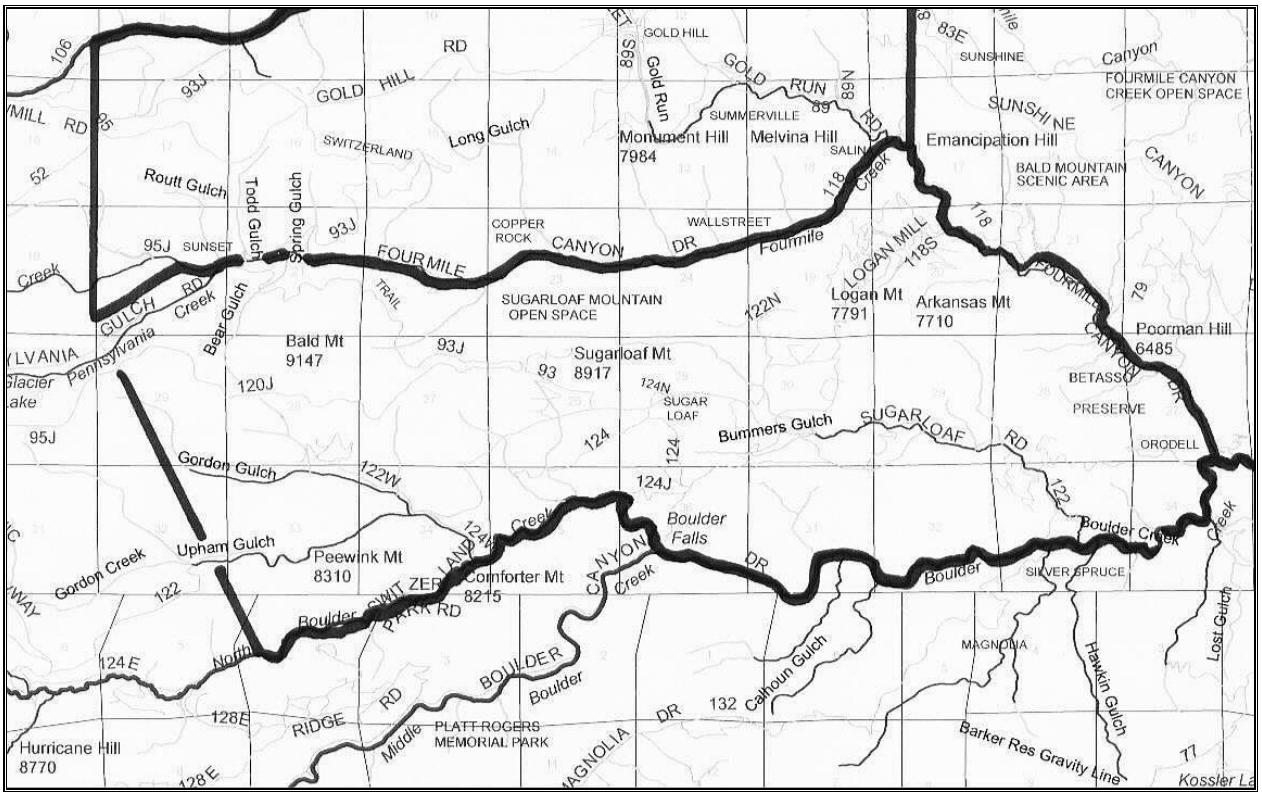

Figure E 4.8.1. The map illustrates the boundaries of the Sugar Loaf Mining District, center, and they are approximate. The Gold Hill Mining District extends north. The town of Crisman, not labeled, was in Four Mile Canyon on the Sugar Loaf district's northeast boundary, near the number "118." The label of "Logan Mill" marks the Logan Mine and Sunbeam Gulch. The settlement of Wheelman, also known as Eagle Rock, was located on the south boundary where Calhoun Gulch meets Boulder Creek. Base map provided by Boulder County Land use Department.

The reason for Williamson's success and unwillingness to sell came from his first-hand observations in the Front Range's various mining districts. Williamson was born in Mercer County, Pennsylvania in 1824, son of a farmer. Interested in a profession other than farming, Williamson left at age 18 and was given a job by an uncle as superintendent of the Davidson Coal Banks in Beaver County. In 1855, Williamson struck out west for Nebraska, settled in Decatur County, bought a tract of land, and was elected sheriff in 1856. Williamson was well-situated geographically to be among the first to respond to the Pikes Peak Gold Rush, so when

[112] Boulder County Metal Miners' Association, 1910:37; *Colorado Mining Directory*, 1879:98, 100, 109; Pettem, 1980:45; Smith, 1981:56; Wolle, 1995:487.

word of the discoveries spread in 1858, he departed across the plains. Williamson ascended to Gilpin County and staked several profitable placer claims on South Boulder Creek and in Spring Gulch in 1859, and joined the rush to California Gulch (Leadville) in 1860. He was not successful in the deep mountains and returned to the Front Range, where he somehow became involved with H.C Norton in 1861. Norton persuaded Williamson to help build the Bear Creek Toll Road, which ascended through Boulder's famed Flat Irons. The road was washed out shortly after, they invested more capital repairing it, and it was washed out again. During his initial years in pursuit of gold, Williamson learned much of what a successful prospector had to know, which he then employed in Gilpin and Boulder counties. In 1874, Williamson responded to the discovery of telluride gold in Boulder County and focused on the Sugar Loaf area. In 1875, he found not one but three ore veins. After working his mines for fifteen years, Williamson moved down from the Sugar Loaf district in 1889 to Boulder and invested heavily in the community. He established a farm, speculated in Boulder real estate, and built several business blocks in town. In 1883, Williamson helped organize the Boulder National Bank, and when he moved to Boulder, he served as president. Williamson also was involved with the Boulder Electric Light Company and invested in the Boulder Elevator & Milling Company.[113]

The first years of prospecting and claim development in the Sugar Loaf district did not cause an intense rush like at Gold Hill and Sunshine, but instead preceded a gradual but constant evolution toward substantial mining. One of the reasons lay with the geography of the Sugar Loaf district. Unlike other important districts in the county, Sugar Loaf lacked mines in the concentrations that inspired and excited investors. Black Tiger and Sunbeam gulches featured enough mines to present the type of visual impact that investors and promoters responded to, although even these were not great. Black Tiger Gulch was on the southwest side and Sunbeam Gulch, in which the Logan, Grand Republic, Yellow Pine, and Gray Copper mines were located, was on the district's east side. Outside of these areas, a number of productive if not overlooked mines were disbursed throughout the rest of the district.

Two important movements during the late 1870s helped Sugar Loaf move away from prospecting and simple claim development toward mining. One factor, although limited and slow to develop, was investment and the acquisition of promising properties by capitalists of means. One group of investors purchased the Washington Avenue Mine and spent a considerable sum on property improvements. Aaron Kellogg and partners purchased the Logan and Croesus, and Williamson, who was growing in importance, used some of his profits to buy and develop the Yellow Pine Mine. Around 1880, M.W. Wilcox and other out-of-state investors organized the Hastings Consolidated Tunnel, Mining & Milling Company to develop a group of claims. At the same time, Benjamin F. Smith and W.B. Daniels, who were of local importance, solicited capitalists from New York City to purchase the Dime and other claims in Sunbeam Gulch. Smith, Daniels, and investors organized the Home Mining Company to do so. R.S. McClellan and T.F. Hendershot, both prospectors turned investors, worked the small Pine Shade on Sugar Loaf Mountain in 1883.[114]

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[113] Byers, 1901:257; Hall, 1895, V.4:617; *History of Boulder and Clear Creek Valleys*, 1880:698; Smiley, 1913:281.
[114] Fossett, 1879:89; *Colorado Mining Directory*, 1879:100; *Colorado Mining Directory*, 1883:53, 60, 71, 100.

Another factor that became an important foundation for profitable mining during the late 1870s was a wave of mill building. When the various partnerships and companies brought their mines into production during this time, their ore constituted a market for millmen. In keeping with the bulk of the county's milling industry, the millmen and metallurgists who served the Sugar Loaf district had no intention of generating gold and silver bullion, and instead sought to concentrate the ore into a density that was profitable to ship to the smelters. Also in keeping with the county's milling industry, a high percentage of the mills were failures.

Obed Crisman can be credited with building the first mill that served the Sugar Loaf district. Crisman was born in Maryland in 1817 and moved with family to Buffalo Creek, Virginia, where he learned the mechanic's trade. He moved to Iowa in 1855, to Missouri in 1858, and joined the Pikes Peak Gold Rush three years later. After no success of note prospecting in Gilpin County, Crisman established a farm in Jefferson County. His mechanical experience resulted in a job running a flour mill at Golden during the mid-1860s, and he stayed for three years. In 1871, Crisman struck out on his own and built the Star Mills in Denver. Seeing opportunity in Boulder County's telluride boom, in 1874, Crisman headed up Four Mile Canyon toward Gold Hill but stopped short. Down-gradient from Sunbeam Gulch, on the east edge of the Sugar Loaf district, Crisman built a concentration mill at what is believed to be Camp Tellurium.[115]

William Graves, may have built the district's second mill as a dedicated facility for the Washington Avenue Mine. The metallurgist who designed the facility apparently had some understanding of telluride ore because he made no attempt to try amalgamation. Instead, he used a battery of stamps to crush the ore, a Bruckner roasting cylinder (a type of rotating furnace) to drive off sulphur and oxidize the ore, and equipment to leach out the gold. Telluride ore responded well to such treatment and it seems likely that Graves' mill was at least partially successful. In 1876, Carvell's Mill operated on the south side of Boulder Creek near the mouth of Bummers Gulch and was a small facility probably intended to concentrate the area's pyretic gold ore. The facility burned in 1877 and was not heavily missed.[116]

Formal settlements were few in the Sugar Loaf district because the mining industry and its workers were disbursed over a wide area. One settlement, located on the north edge of the district in Four Mile Canyon, was Sugar Loaf (Wallstreet), which was actually more important to the Gold Hill area. Another was Eagle Rock, located on the south edge of the district at the mouth of Black Tiger Gulch, and this settlement also served the Magnolia area. Eagle Rock was a milling center, a crossroads to Magnolia, the Sugar Loaf high country, and Nederland, and probably featured at least a stage stop and a mercantile. Someone applied for a post office, which the Postal Service granted in 1876, and by 1880, 130 people lived in and around the settlement. But because Eagle Rock failed to meet the Postal Service's minimum size, the post office was repealed in 1877.[117]

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[115] Bailey, 1982:11; Hall, 1895, V.4:414.
[116] *Banner* 9/20/77; *Boulder County Herald* 4/9/84; *Boulder County News* 2/18/76; Fossett, 1879:89.
[117] Bauer, et al, 1990:48; Schulz, 1977:1880-5.

Figure E 4.8.2. The hamlet of Crisman grew around Obed Crisman's modest mill in 1874, and it served the Sugar Loaf Mining District's eastern portion. Clear-cutting the forest for firewood opened an otherwise dark section of Four Mile Canyon around the business district, which consisted of several small buildings. Source: Boulder Carnegie Library, 219-1-8.

The Sugar Loaf district' third principal settlement was Crisman, which grew around Crisman's mill in Four Mile Canyon southwest of Sunbeam Gulch. G.A. Kelly was as responsible for the settlement as Obed Crisman because it was Kelley's mercantile, built in 1874 at the same time as the mill, which lent legitimacy to the place. George Williamson, John A. Logan, and other mine owners also played a role because they hired crews that settled in Crisman, and through 1876, Crisman's population steadily climbed from 35 individuals to 150 people, including families. The town's original name may have been Camp Tellurium, but the Postal Service commissioned a post office under the name of Crisman in 1876. Like many of Boulder County's legitimate mining towns, Crisman featured a hotel for visitors, several other businesses, and a school for children. Obed Crisman's mill was not the only concentration facility in town, and S.A. Elliot ran a tiny facility in connection with his Golden Rule Mine. Elliot apparently did not understand the nature of telluride ore, because his mill consisted of a chipmunk crusher (a small jaw crusher), a grinder, and an amalgamation furnace, which could treat only several hundred pounds per day. The amalgamation technique was not effective with telluride ore, which required roasting, and only recovered one-half of the gold content in Elliot's ore.[118]

Some of the owners of the rich mines in Sunbeam Gulch wanted to remain near their operations and lived in Crisman. While Williamson, who actually resided at the Yellow Pine, was well-liked, not all the owners were, according to archival sources. "One of Crisman's most prominent citizens was Pierre Ardourel, a mine owner. Not all of the town's residents thought highly of Pierre. A good number called him 'that tricky little fat Frenchman.'"[119] Legend has it that Ardourel built a handsome wine cellar for his large and fine house in Crisman, both of which were ruined when workers graded the Greeley, Salt Lake & Pacific Railroad through town.

During the latter half of the 1880s, the Sugar Loaf district entered a transition that, while gradual, saw an overall decline in activity. The transition was not as sudden, dramatic, and well-defined as in the county's other districts such as Ward, Gold Hill, and Sunshine. During the first few years following the discovery of telluride ore, prospectors developed approximately ten deep exploratory efforts. Between 1876 and 1880, these tripled in number. At the same time, partnerships worked around fifteen small mines, and companies brought at least one significant property into operation. Between 1880 and 1885, the number of deep prospects changed little, but the number of active mines decreased by half. By 1885, prospecting finally decreased, as well. These trends reflect a movement away from prospecting and the operation of small mines toward the acquisition of the promising properties by noted capitalists, the consolidation of disparate claims, the exhaustion of shallow ore formations, and an overall contraction.[120]

This trend ended the Sugar Loaf district's first Period of Significance, which began with the recognition of telluride ore in 1873. During the first Period, prospectors swept through the district in search of hardrock ore, discovered the principal ore formations, and initiated a mining industry. Milling, permanent settlement, and the development of a crude transportation infrastructure followed, and the cumulative aspects had local and national significance. On a local level, the discovery and growth of the Sugar Loaf district contributed to Boulder County's communication, commercial, and financial systems, and the county's social geography. The wealth that miners produced contributed to the county's economy and the financial reserves of investors, some of whom put the money back into the county's mining industry. On a national level, the discovery and development of telluride gold ore in the district contributed to the telluride mining movement, which is discussed in detail under the Gold Hill district.

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[118] Bailey, 1982:11; Bixby, 1880:432; *Colorado State Business Directory and Annual Register*, 1878; *Vertical Files: Crisman*; Wolle, 1995:487.
[119] *Vertical Files: Crisman.*
[120] The number of active mines was estimated from surveys of 1879 and 1883 *Colorado Mining Directories* and other archival sources.

E 4.8.2: The Years of Stagnation, 1885 - 1897

Portions of the Sugar Loaf district grew quiet after 1885, but mining was by no means over. While the numbers of prospects and mines decreased between 1885 and 1890, the active mines more than doubled during the next three years. Between 1890 and 1893, limited outfits worked around ten small producers, and formal companies operated at least five medium-sized mines and as many mills. The Livingston and Amalgam Thief mines, developed during the mid-1880s on the southeast and southwest sides of Sugar Loaf Mountain, respectively, were among the district's largest and best producers. To treat their own ores, both companies built concentration mills. At the Amalgam Thief, John E. Rothwell built a chlorination mill adjoining the shaft house in 1887. A year later, John T. Herrick and George Teal planned a more ambitious and functional mill on North Boulder Creek near the Recluse Mine. Herrick was an experienced individual who operated several productive mines in Park County and probably supplied the capital, and Teal would go on to lease numerous mines throughout Boulder County into the 1940s. Herrick and Teal's plan was to treat ore primarily from the Livingston and Recluse mines and accept custom orders during slow times. The principal obstacle that these investors and millmen underestimated was the difficulty of treating telluride payrock. As a result, both mills ran into trouble. Meanwhile, mining companies sent their ore to other facilities such as the Crisman Mill at Crisman and Ira Monnell's successful concentrator at Sugar Loaf.[121]

The fact that the Recluse Mill had to be refitted left a vacuum in the Sugar Loaf district's milling industry. To fill the void, the Eagle Rock Reduction Company obtained rights to a mysterious treatment method known as the Cochran Process then built the Cochran Mill at the mouth of Black Tiger Gulch in 1891. The Eagle Rock company hoped to secure plenty of custom work to fill time between shipments from its own mines, which failed to actually yield. In 1891, the mill started on ore from the Livingston Mine then ceased. The Cochran Process proved to be a failure.[122]

The Livingston company sent its ore to the Cochran Mill while the company finished a new mill at the head of Bummers Gulch to replace the Recluse. The manager chose the McArthur-Forrest Process because it had been demonstrated to be effective in Ward and even on telluride ore hauled out of the Prussian Tunnel near Gold Hill. Unfortunately, the Livingston owners neglected to test batches of ore in those mills already equipped with the McArthur-Forrest Process to make sure that the process actually worked for them. Had the owners done this, they could have avoided what became another costly failure. The process was ineffective on most, but not all, of the Livingston ore. The only time that mill recovered gold as expected was during the first several months of operation during the spring of 1892. In 1893, William Mehollin built the next mill to fill the existing treatment void and used his own Mehollin Electric

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[121] *Boulder County Herald* 10/10/88; *Boulder County Herald* 5/1/89; Cobb, 1999:100.
[122] *Boulder County Herald* 7/2/90; *Boulder County Herald* 4/22/91; Cobb, 1999:95.

Process. Mehollin did what the previous series of metallurgists could not, which was to open a truly effective facility for the mines at Sugar Loaf Mountain.[123]

Figure E 4.8.3. The Livingston Mine was one of the Sugar Loaf Mining District's principal producers during the late 1880s and early 1890s. The view is northward toward Sugar Loaf Mountain, in the background. The mine typifies Boulder County's modestly successful shaft operations, and the left portion of the shaft house enclosed a hoist and boiler while the peak stood over a headframe. Source: Boulder Carnegie Library, 219-5-13.

When the Silver Crash wrecked the overall mining industry and caused a nation-wide depression at the end of 1893, mining slowed in the Sugar Loaf district but the district maintained enough production to foster the construction of several more mills. Unlike other portions of the county, he Sugar Loaf district's mining industry did not collapse because of the depression, and the reasons were similar to those that kept the Ward and Gold Hill areas alive during the dismal economic conditions. In general, most capitalists saw their various

[123] *Boulder County Herald* 5/11/92; *Boulder County Herald* 11/9/92; *Boulder County Herald* 10/3/93; *Boulder County Herald* 510/18/93; *Boulder News* 9/15/92.

investments evaporate after the Silver Crash, but a few financially adept individuals sought economic solace in gold because its value remained a constant $20.70 per ounce. After the worst of the depression passed by 1895, these capitalists fomented a limited but noticeable wave of interest in gold's source – the mines and mills.

E 4.8.3: The Late 1890s Mining Revival, 1897 – 1905

A sudden turn-around of conditions during the late 1890s brought relief for those individuals in the Sugar Loaf district who persevered through the depression that followed the Silver Crash. A number of factors such as an overall economic recovery, the availability of capital, and general optimism stimulated a revival that began to sweep Boulder County and the rest of Colorado by around 1897 (see Ward and Gold Hill mining district histories for full account). A keen interest in gold as a stable form of investment among mining capitalists also played a large role in the revival, which individuals in the Sugar Loaf district experienced firsthand.

Between 1897 and 1900, the Sugar Loaf district boomed with a level of energy no one in the area had seen in twenty years. Prospectors returned to the field in search of new ore bodies, and small outfits and investors with capital worked together to conduct underground exploration and begin new projects of substance. During this time, various outfits brought ore out of around fifteen small mines, four medium-sized operations, and one large producer, and they sent ore to one of around four mills. The settlement at the south base of Sugar Loaf Mountain, now known as Sugar Loaf, was home to 183 people alone, while more individuals lived in Eagle Rock and Crisman.[124]

Those mines and companies that were the most important during the 1890s boomed during the revival, and Sunbeam Gulch became a hotspot of grand production. The Kenna brothers developed the Dime Mine, which featured 750 feet of workings, and George Williamson maintained production the Yellow Pine and Gray Copper properties. E.J. McCormick, who belonged to a British investment syndicate, simultaneously operated the Logan and Croesus mines, and other investors reopened the Trojan and Pine Shade claims. Around Sugar Loaf Mountain, H.E. Townsend's Amalgam Thief Mining & Milling Company worked the Amalgam Thief, and Harlan P. Walker, who owned the rich Golden Age Mine and Mill at Jamestown, oversaw the construction of a new chlorination mill at the shaft. The Amalgam Thief Mill proved effective, as did the Gilman cyanide mill, which began operations at the mouth of Bummer Gulch in 1895.[125]

The late 1890s boom continued into the early 1900s, and more investors and their companies arrived in the Sugar Loaf district. The number of mines and mills literally doubled

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[124] Schulz, 1977:1900-4; the number of active mines was estimated from a survey of the 1898 *Colorado Mining Directory* and other archival sources.
[125] *Boulder Camera* 3/1/95; *Boulder Camera* 9/22/98; *Boulder Camera* 12/20/98; Cobb, 1999:100; *Colorado Mining Directory*, 1898:112, 116.

between 1900 and 1905, and the climate was so positive that some of the deep exploration efforts were brought into production. As the mines in the Black Tiger Gulch area drew miners, the population of Eagle Rock grew and someone requested a post office, which the Postal Service granted in 1900 under the name of Wheelman.[126]

The cluster of mines around Sunset came to the fore during the revival, and while the media described them as within the Sugar Loaf district, they were actually local to Sunset. The Forest Mining & Milling Company employed ten in the Forest Mine, the Sunset Gold Mining Company worked the Free Coinage at the mouth of Penn Gulch with a crew of eight, and the St. Anthony Mining & Milling Company leased the Dolly Varden and employed a crew of 12. These companies had to send their ore to one of the mills in Wallstreet or Salina for treatment, and the companies enjoyed decreased freight rates due to the railroad in Four Mile Canyon.[127]

Both Crisman and Salina housed the considerable workforce employed by the district's crown jewel mines in Sunbeam Gulch. Surprisingly, the owners of two of the best producers put their properties up for sale. During 1903 or 1904, W.B. Teters either purchased or leased the Dime, which may have been idle due to litigation. In 1905, he employed a crew of miners to drive a haulageway to undercut the ore system at depth. In 1900 or 1901, McCormick sold the Logan to Clinton M. Tyler and Thomas R. Mann, who certainly had to involve other investors in order to gather enough money together. Tyler arrived in Colorado at the end of the Pikes Peak Gold Rush and joined other pioneer investors in establishing several sawmills and key toll roads in Gilpin and Boulder counties. Only late in life did he venture into mining. Mann was one of the capitalists who built the Colorado & Northwestern Railroad in 1897, and he probably saw the Logan both as a source of profits for his own pockets and as a source of ore for the railroad. To enhance the mine's profitability, Tyler and Mann built a concentration mill in Sunbeam Gulch shortly after the purchase.[128]

Several events stimulated excitement around Sugar Loaf Mountain during the revival. In 1902, a farmer who was plowing a potato crop near the Livingston Mine noticed chunks of gold ore in his field, so he abandoned his plow and used his team to scrape off the topsoil. As the scraper overturned the earth, the farmer followed the team and picked up $77.00 worth of samples. Further investigation revealed a vein that was supposedly an extension of the Logan, and so the farmer sold the property to the Livingston Gold Mining Company. The Potato Patch discovery stimulated a small rush to Sugar Loaf Mountain, but little new came of the event. Miners then sank what they called the Potato Patch Shaft and discovered that the vein widened. Besides this fortunate find, the Livingston company not only enjoyed excellent production from its principal workings, but also finally had a mill in which to concentrate ore. Specifically, the company's metallurgist puzzled out the problems with the Recluse Mill by 1900 and treated both Livingston ore and material from other mines on a custom basis. The success of the Recluse Mill improved the situation for mining companies in the area because they now had a local

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[126] Bauer, et al, 1990:151; the number of active mines was estimated from a survey of the 1902 *Colorado Mining Directory* and other archival sources.
[127] *Colorado Mining Directory*, 1902:10, 12.
[128] *Colorado Mining Directory*, 1902:18; *Denver Times* 6/3/01, p14, c2; *Sugarloaf Mines and Mining*.

treatment facility that reduced the costs of freighting ore. As a result, these companies were able to produce lower grades of ore than what might have otherwise been economical.[129]

Curiously, the owners of the Livingston Mine sold the property to the United States Gold Corporation around 1905, despite the Potato Patch discovery and the functional Recluse Mill. At the same time, the Good Luck Mining & Milling Company purchased and consolidated a number of claims. These two companies, along with those operating the Logan, Gray Copper, and Dime mines in Sunbeam Gulch, were the principal producers in the Sugar Loaf district for the rest of the 1900s. Tyler may have retained his interest in the Logan, provided he was still living, but Mann shot himself over financial difficulties in 1902.[130]

The demand for ore treatment remained high after 1905, although many of the small mines began to close when miners exhausted the veins, most of which were shallow in depth and short in length. In 1906, U.S. Gold planned a massive mill at the Livingston Mine to replace the Recluse facility, and instead of ordering new machinery, which would have been very costly, the company bought the failed Wallstreet chlorination mill when it was auctioned off by the sheriff in 1907. Workers disassembled the mechanical components, shipped them by rail up to Sugar Loaf Mountain, and moved them to the new site at the mine. At the same time, the Good Luck company built a cyanide mill both for the company's own ore and that from other mines.[131]

Before the mills were finished, U.S. Gold and the Good Luck company perpetrated an event signaling that all was not well in the Sugar Loaf district. In 1908, both companies tried cutting mill workers' wages from $3.00 to $2.50 as the companies prepared for operations. Miners and other workers in the Sugar Loaf district went on a sympathy strike out of fear that their wages could be cut next. Local residents complained as the mining industry slowed, but the companies relented and upheld the original wage rate so that the mill workers could finish their projects. By 1909, the Good Luck Mill operated, but with difficulty, and the Livingston Mill was a long way from being finished.[132]

The hidden issue reflected by the strike was that the Sugar Loaf district's mining industry was in decline and profits decreased. This atmosphere drove U.S. Gold and the Good Luck company to cut workers' wages in an attempt to reduce operating costs. The small mines continued to close and some of the substantial companies leased out their properties in blocks to independent parties, which was usually a sign that a property's best days were over.

The trend of decline marks the end of the Sugar Loaf district's second Period of Significance. The Period began in 1897 when the late 1890s revival created the conditions for a boom that rivaled the original excitement of the early 1880s. The reasons for the decline around 1910 were similar to the problems experienced in the rest of the telluride-bearing mining districts. Specifically, miners exhausted most of the profitable ore, even though it was lower

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[129] *Boulder Camera* 4/10/03; Boulder County Metal Miners' Association, 1910:32; *Colorado Mining Directory*, 1902:18; Pettem, 1980:64; *Vertical Files: Sugar Loaf*; Wolle, 1995:490.
[130] "Obituary" *Mining Reporter* 11/20/02 p424.
[131] *Boulder Camera* 7/29/09; *Boulder County Miner* 8/22/07; *Boulder County Miner* 12/10/08; Cobb, 1988:98-99; *Sugarloaf Mines and Mining; Mineral Resources of the United States*, 1908:372.
[132] *Sugarloaf Mines and Mining.*

grade than the material extracted in the past. Underground exploration confirmed that most of the telluride veins were, in fact, shallow and limited. A number of veins, however, held value at depth as exemplified the relatively high number of significant mines and profitable companies that continued to operate through most of the 1900s. It is interesting to note that, because serious mining began in the Sugar Loaf district approximately five years later than many of the county's other telluride-bearing districts, the decline also materialized five years later.

During the second Period of Significance, the Sugar Loaf district saw as much if not more mining, investment, and development than during the original boom. While production figures remain uncertain, it seems likely that mining companies generated a greater tonnage of ore, although not necessarily ounces of gold, during the Period than at any other time. During the Period, the district also enjoyed the installation of more mining and milling equipment than in the past. Overall, the district's mines contributed to Boulder County's wealth, social geography, and the funds of capitalists, some of whom reinvested the money back into industry. The district's mines also drew investment that in turn disseminated into the local economy.

E 4.8.4: The Decline of Mining, 1910 - 1929

Most of the Sugar Loaf district's companies and partnerships suspended work during the 1910s and the region reverted to ranchland. The largest mines, however, continued to yield ore, but production was irregular and the ore low in grade. If this was not enough of a sign of a growing distress, companies increasingly turned their properties over to parties of lessees in an effort to maintain income while avoiding the operating costs. For example, the Yellow Pine Mines & Reduction Company owned the Yellow Pine Mine but did not work the property and instead leased it to around 35 different groups. Similarly, the Logan Metals Company leased the Logan in at least six blocks from 1916 to 1925.[133]

The Good Luck complex and the Livingston Mine were the two principal company-run operations in the district during the 1910s, and they were not in the best condition. The Good Luck company had trouble securing enough ore from its own property as well as from other mines to run the Good Luck Mill on a continuous basis. The ore mined from depth proved troublesome to treat so the company refitted the mill several times, which greatly eroded the company's profitability. After working on the massive Livingston Mill for almost five years, U.S. Gold finally treated a trial run of ore in 1912 then stopped. It seemed that the mill was still not ready. When the investors finally grew tired of the interminable delays and the newspapers claimed that the operation was a fraud, John R. Wolff, who was manager, started up the mill again in 1917 and proved that it functioned correctly. He then worked the mine at capacity through 1918 then suspended operations. The fact that the company consumed ten years

[133] Bauer, et al, 1990:92; Colorado Mine Inspectors' Reports: Senator Hill.

tinkering with the mill suggests that the Livingston was exhausted and that the operation may have been an investment fraud after all.[134]

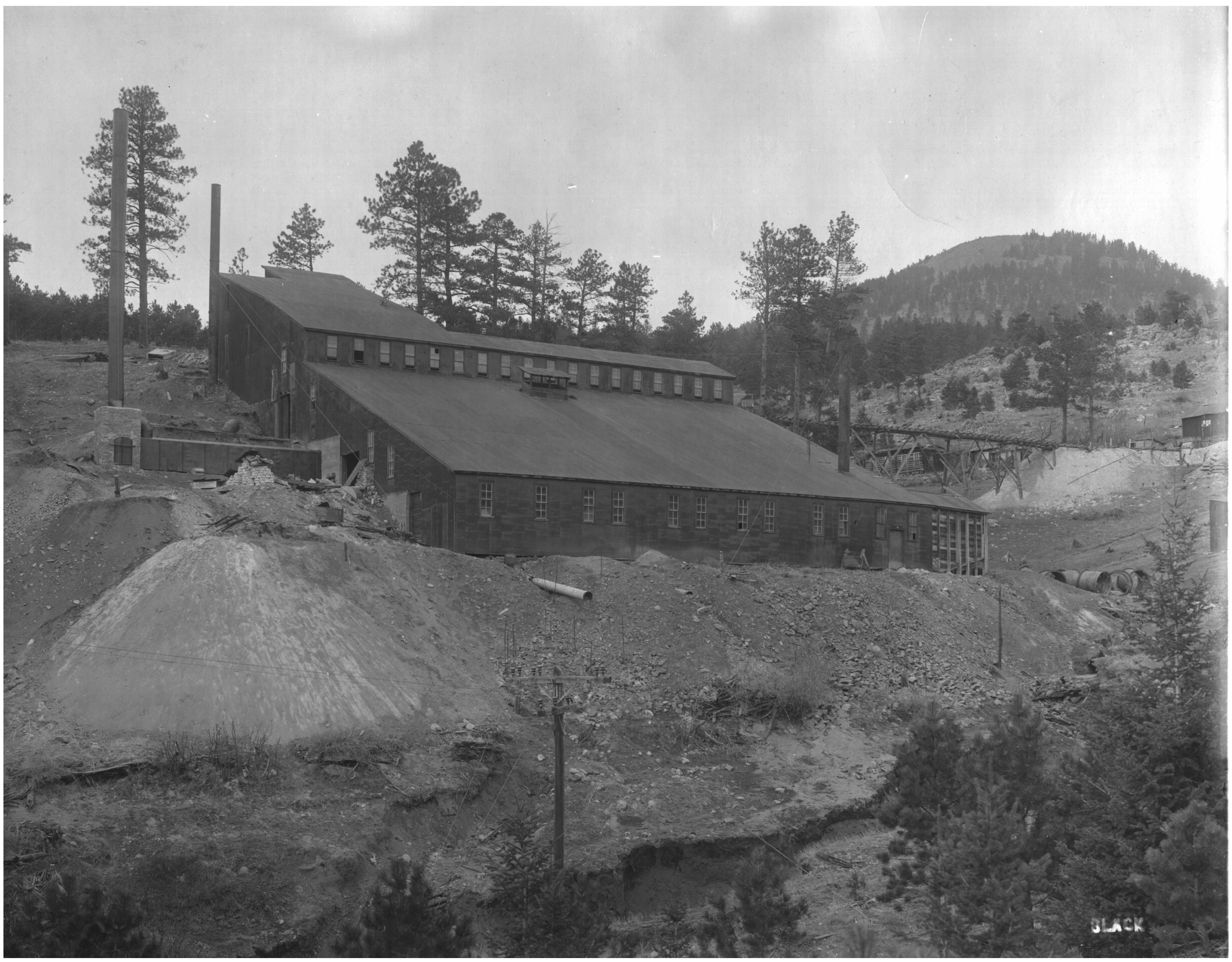

Figure E 4.8.4. The United States Gold Corporation tinkered with the massive and costly Livingston Mill for around ten years but never ran it at capacity. Intermittent operations, changes in ownership, and lack of production between 1907 and 1918 roused suspicions that the mill was a fraud. Source: Boulder Carnegie Library, 219-5-14.

As the 1910s progressed, signs of decline were everywhere and the mining industry dissipated. Only eighty people lived in Sugar Loaf and fewer resided in Crisman, which is why the Postal Service cancelled the post office there in 1918. Between 1915 and 1920, only around

[134] *Boulder County Miner* 10/24/12; *Boulder County Miner* 92/26/13; Colorado Mine Inspectors' Reports: Livingston Mine; *Vertical Files: Sugar Loaf.*

five small mines, several medium-sized operations, and one large producer were active in the district. Ore production fluctuated wildly and declined from approximately 5,000 tons in 1910 down to 800 tons in 1912, then up to 15,500 tons in 1916 and back down to 2,000 tons 1919.[135]

Mining almost came to an end in the Sugar Loaf district during the 1920s. Between 1920 and 1925, prospectors knocked around on five claims and partnerships eked out an income from as many small mines. The Logan and Yellow Pine mines were the only operations of note, at least until even the small parties of lessees could no longer find ore in the either property and closed them in 1926. In general, only a handful of miners produced less than 1,000 tons of crude ore per year for the rest of the decade, and with no opportunity for income, all but the most stalwart people left.[136]

E 4.8.5: Mining During the Great Depression, 1929 - 1942

In 1929, the difficult times of the Great Depression descended onto Boulder County. Banks failed, personal estates evaporated, businesses closed, and many types of goods and services were no longer available. Hundreds of individuals were thrown out of work and were forced to exercise creativity to earn income. The county's mining industry, which had been in decline since the early 1920s, was hit particularly hard. Many mines closed because the companies and partnerships no longer could afford to pay even the smallest of operating costs. In their place rose what was tantamount to a small cottage mining industry in which unemployed people, primarily miners, returned to idle gold producers to garner a subsistence-level income.

Because these miners expected only to get by, their needs were very simple and several dollars' worth of ore per day was sufficient. A return to ages-old hand labor was a hallmark of subsistence mining, and while it guaranteed only limited production, hand mining required no capital beyond tools and muscle. As an example of how primitive some operations were, in 1930 statisticians observed subsistence miners in the Sugar Loaf district pounding ore in hand-mortars and panning the crushed material for the gold.[137]

Subsistence mining was most noticeable between 1929 and 1933 in what had been the county's most productive districts. Sugar Loaf drew a number of subsistence miners who prospected approximately fifteen properties and generated small batches of ore in half as many small mines. The district's historic producers also interested several partnerships that had enough capital to at least attempt production. In 1932, C.H. Craig kept several miners busy in the Yellow Jacket near Sugar Loaf in hopes of gleaning any gold ore than remained. Confident that they would find ore, he built the Craig Mill but had to accept custom orders because the

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[135] Bauer, et al, 1990:40; *Boulder County Post Offices*; Schulz, 1977:1920-6; the number of active mines was estimated from a survey of Colorado Mine Inspectors' Reports, and production was summarized from *Mineral Resources of the United States*.

[136] Colorado Mine Inspectors' Reports: Logan, Yellow Pine; the number of active mines was estimated from a survey of Colorado Mine Inspectors' Reports, and production was summarized from *Mineral Resources of the United States*.

[137] *Mineral Resources of the United States*, 1930:1058.

Yellow Jacket proved to be barren. During the 1920s, John G. Clark, who ran a small tungsten empire, branched out into gold and purchased the idle Dime Mine, located in Sunbeam Gulch. In 1930, he paid several miners to scour the old workings in search of low-grade ore that previous operators left as uneconomical.[138]

In 1933, when the depression was at its nadir, President Franklin Roosevelt launched a pilot program intended to simultaneously devalue the dollar while stimulating metals mining. The dollar was taken off the gold standard and the Federal Reserve bought gold at inflated prices. Satisfied with the test, in 1934, Roosevelt signed into law the Gold Reserve Act, which raised the minimum price of gold from around $20.67 to $35.00 per ounce. This increase in value stimulated a small revival in the Sugar Loaf district that drew, in addition to the subsistence miners, companies with the small amounts capital typical of the Great Depression.

None of the mining operations were grand, but they allowed investors and employees to earn needed income. In 1934, R.E. Martin and A.W. Thurston brought the Milan Mine at the head of Black Tiger Gulch into production, and other lessees reopened the Croesus and Logan mines. In 1935, the Livingston Mining Company reopened the Livingston Mine then leased it to George Jump's Highland Mining Company, Incorporated. Jump started in the Sugar Loaf district by leasing tungsten mines, became president of the Boulder County Metal Miners' Association, and finished his lengthy career by leasing more tungsten mines. In 1939, John R. Wolff bought the Livingston back and continued production until 1942.[139]

John G. Clark and the St. Joe Mining & Milling Company ran the largest operations in the district after 1934. In addition to buying the Dime, Clark purchased most of the other principal mines in Sunbeam Gulch, including the Grand Republic. In 1934, he leased the mine to the St. Joe Mining & Milling Company, which was one of the Gold Hill district's most important Depression-era outfits (see Gold Hill Mining District). St. Joe began operations with a crew of 20 that produced 100 tons of low-grade ore per day. The situation was so bright that the company doubled the workforce to 40 in 1936. At first, St. Joe trucked the ore to its mill at the Cold Spring Tunnel near Gold Hill, then to the Valmont Mill after the facility was finished in 1936. St. Joe's Grand Republic operation was the largest in the county in 1935 and 1936, and the company closed the mine in 1939.[140]

In 1936, John G. Clark brought his Empress Mine into production through a 900 foot tunnel, which was costly to rehabilitate. He hired a crew of seven that generated low-grade ore then started a sinking a new incline shaft to develop a new ore body. Such development was uncommon during the capital-scarce times of the Great Depression, and it reflects Clark's willingness to spend capital when needed. Clark closed the mine in 1942.[141]

In 1939, J.F. McConky and other investors organized the Logan Mining & Milling Company to lease the Logan Mine on a large scale. John R. Wolff, who was part owner of the

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[138] Colorado Mine Inspectors' Reports: Cash, Kekeonga; the number of active mines was estimated from a survey of Colorado Mine Inspectors' Reports.
[139] Colorado Mine Inspectors' Reports: Croesus, Livingston, Logan, Milan.
[140] Colorado Mine Inspectors' Reports: Grand Republic; *Minerals Yearbook*, 1935:212; *Minerals Yearbook*, 1937:317; *Minerals Yearbook*, 1938:262.
[141] Colorado Mine Inspectors' Reports: Empress.

property, agreed to the lease because he felt that McConky's operation would produce ore in economies of scale, which meant more income than could be realized from the small and disparate parties that worked the mine up to that time. McConky then hired a crew of twenty miners, built the Logan Mill, and began heavy production.[142]

The Great Depression was not an easy time for Sugar Loaf district residents, but it fostered a revival that provided jobs and maintained the population at a relatively steady eighty people. Due in part to investors, and especially those with enough capital for meaningful operations such as John G. Clark, the production of crude ore jumped from 438 tons in 1931 to 2,900 tons in 1932, then skyrocketed to 19,200 tons in 1934 after Roosevelt signed the Gold Reserve Act into law. The following year saw miners generate an impressive 37,600 tons of ore, which was second in the county only to Gold Hill. From this time until 1942, production steadily declined to 3,300 tons per year. Between 1933 and 1936, partnerships and companies reopened at least twenty mines and worked them on a limited scale, and investors financed several medium-sized operations as well. Paralleling the decline in production, the numbers of active mines fell until the fateful year of 1942.

In 1941, the nation's entry into World War II set in motion a series of events that deeply impacted the Sugar Loaf district. Under President Roosevelt, the Federal Government initiated a series of programs to organize and administer to economic, material, and labor resources as part of the war mobilization effort. With domestic mineral and metal resources suddenly of supreme importance, the government naturally passed several pieces of legislation that emphasized mining. War Production Board Ruling L-208 was among the legislation and, much to the dismay of Depression-era miners throughout Boulder County, it mandated the immediate suspension of gold mining by the end of 1942 on the grounds that gold was not of strategic importance. Reliant on gold ore, all the mines in the Sugar Loaf district closed except those with tungsten ore (see Boulder Tungsten District history), which brought to an end to anything more than occasional exploration efforts.

War Production Board Ruling L-208 ushered in the Sugar Loaf district's third and last Period of Significance. The Period began in 1929 when subsistence miners gleaned ore on a small scale and ended when the Federal Government suspended gold mining. During this Period, the Sugar Loaf district enjoyed its last revival, and while production was limited and people were glad merely to hold jobs, the mining industry may have been better off than any other time following 1905. The reason was that the Federal Government supported increases in the values of both gold and silver, which stimulated a wave of mining. Historic resources with integrity relative to the fourth Period of Significance may have participated in several important trends. The first is that the Sugar Loaf district saw its most significant period of production since the late 1890s revival. This was particularly timely because without mining, most residents probably would have abandoned the district since they had no other source of income. In addition, the Sugar Loaf district contributed more to the economy of Boulder County than any

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[142] Cobb, 1999:73; Colorado Mine Inspectors' Reports: Logan; *Minerals Yearbook*, 1940:293.

other mining district except Gold Hill at a time when money was dear. In addition, the companies maintained a workforce and aspects of the original cultural geography in the mountains, helped some investors amass capital that they reinvested in other ventures, and contributed elements of infrastructure, such as mills, which furthered mining. Overall, the Sugar Loaf district's industry was an important and contributing element of a Depression-era revival that swept Boulder County and greater Colorado.

E 4.9: The History of the Central Mining District

E 4.9.1: Discovery and the Rise of Hardrock Mining, 1860 - 1868

When Boulder County's first gold rush peaked during the early 1860s, prospectors radiated outward from Gold Hill, which was the epicenter of discovery, and searched the nearby canyons and hills for not only placer gold, but also for hardrock ore. When the boom collapsed, Gold Hill was first to fall and the trend of decline then abandonment spread to the county's other centers of mining by the mid-1860s. In contrast to the general portrayal of history, however, two mining districts actually saw explosions of activity during this period of general decline. One was the Ward district, located at the head of Left Hand Canyon, and the other was the Central district, which encompassed placer mines and several very important hardrock discoveries on James Creek north of Gold Hill.

As noted in the discussion of the county's first gold rush, placer miners claimed much of James and Little James creeks, and their tributaries, and established a camp at the confluence of the two creeks. Following the discovery of hardrock free-gold ore at Gold Hill, experienced prospectors examined the James Creek area from a new perspective. In addition to searching for pockets of soil bearing placer gold, they also searched for mineralized veins. In either 1863 or 1864, depending on the source, Joseph Hutchinson and James Smith apparently were the first to discovery ore, although it was not gold. Instead, they found veins of galena, which was a lustrous blend of silver, lead, and other industrial metals. It seems likely that the veins also offered stringers of gold in enough volume to be tantalizing.[1]

The following year, Hutchinson and Smith returned with other prospectors who may have been more experienced to confirm the find. With a little effort, the prospectors defined the vein and conducted some development, then spread the word of the discovery. With the rest of the county falling into decline, the idle and unsuccessful individuals were a ready audience and responded at once. By 1866, at least 600 people rushed to James Creek and congregated around the original camp at the confluence of James and Little James creeks. Someone staked a townsite claim in advance and named it Elysian Park after the valley's park-like natural beauty. There was nothing serene about the new camp, however, in which people frenetically scrambled for the best lots, fought with each other over properties, and jumped claims.[2]

As the rush intensified and prospectors began to search an extensive area for hardrock ore, it became apparent that the original laws and geographic area defined by the Utilla district were obsolete. To better define laws applicable to hardrock mining and to recognize a broader area, the James Creek prospectors reorganized the Utilla district as the Central district. In later years, it would also be known as the Jamestown district.

[1] Bixby, 1880:429; Hall, 1895:307; *Boulder County Herald* 10/7/91.
[2] Bixby, 1880:430; *Boulder County Herald* 10/7/91; Eberhart, 1987:97; Fritz, 1933:164.

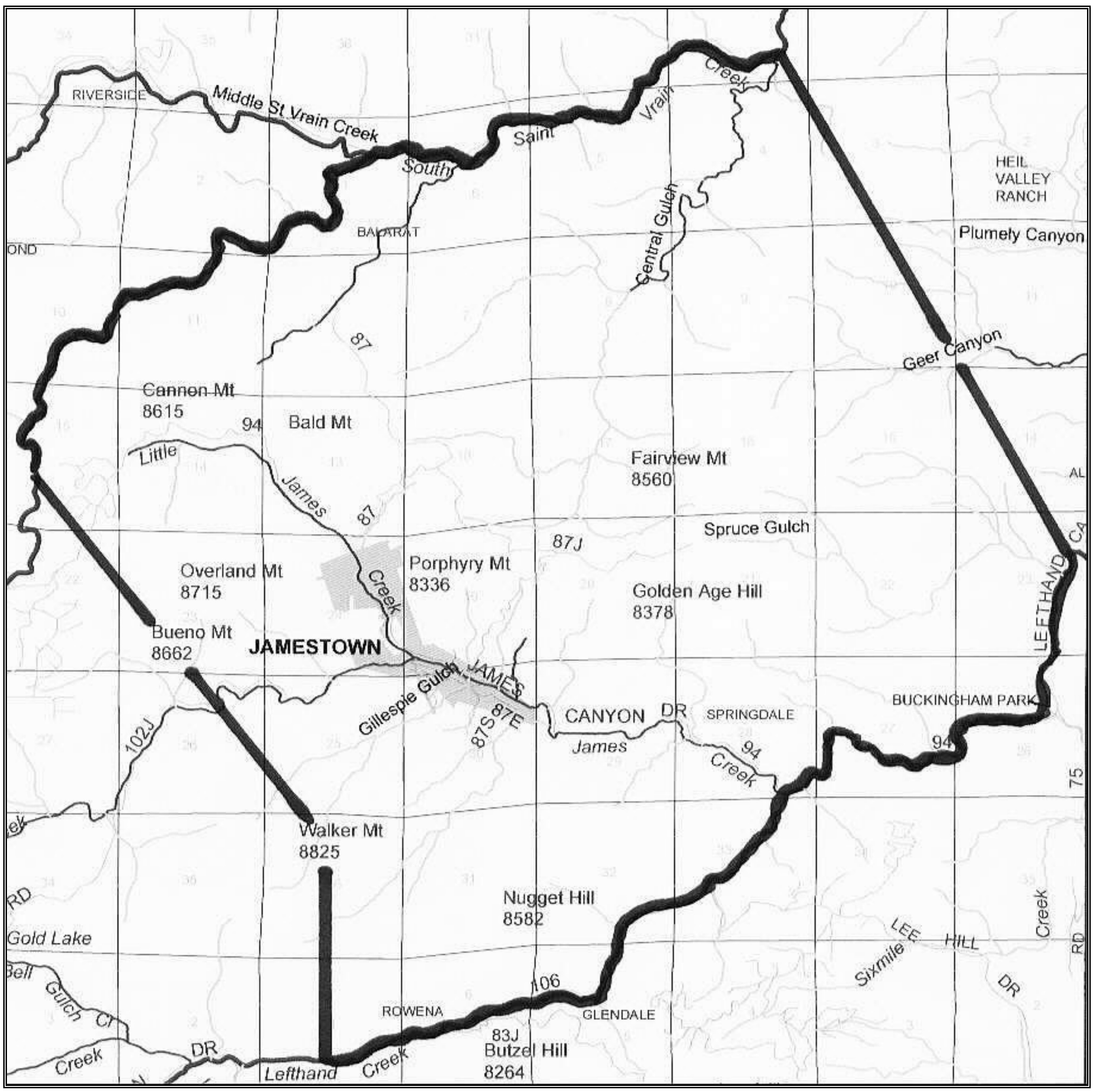

Figure E 4.9.1. The map illustrates the Central Mining District, also known as the Jamestown Mining District. The Gold Hill district extends south, the Sunshine district lies southeast, and the Gold Lake district is adjacent and west. The boundaries are approximate. Base map provided by Boulder County Land Use Department.

Elysian Park was out of control during 1866 because everyone wanted to erect buildings before the weather turned. Prospectors in the area developed the Big Thing and the Buck Horn, one of which may have been Hutchinson and Smith's discovery, and someone found the Argo, which confirmed that Elysian Park was center to gold in addition to silver. This was important because Colorado lacked smelters capable of treating silver ore, and so silver discoveries almost became an afterthought when compared to gold. Like the original Gold Hill rush, prospectors-turned-miners constructed several arrastras along James Creek to amalgamate the gold ore, and some entrepreneurs saw the opportunity to build superior stamp mills. Mark F. Bebee and George A. Patten, millmen from Central City, built the first stamp mill in 1866 on Little Jim Creek probably to be near the known gold discoveries. In 1867, E.W. Cobb built the second mill directly in the new settlement, and to facilitate the shipment of ore to the mills, someone graded a road from Left Hand Canyon.[3]

Cobb, Patten, and Bebee hoped that some of the approximately 100 claims being developed would provide their mills with ore. Around 200 to 300 prospectors searched the hills around Elysian Park while community activists were at work trying to convert the wild settlement into a town. By 1867, residents and entrepreneurs constructed between 100 and 200 buildings, and three sawmills supplied them with the needed lumber. At the same time, someone applied for a post office under the name of Jimtown, but the formal and stuffy Postal Service insisted on recognizing the community as Jamestown. Z.A. Willard of Boston built Jamestown's third mill, which may have been designed to smelt the area's silver ore.[4]

By 1869, the Willard Mill failed, heralding the overall course that the Jamestown boom followed. Repeating the pattern that began at Gold Hill, the miners around Jamestown exhausted the easily extracted and milled free-gold ore, leaving the complex, pyretic material that assayed well but would not amalgamate. The silver ore offered no relief because smelters capable of freeing the metal did not yet exist, and so the galena would have to wait.

In 1869, the Central Mining District's first Period of Significance came to an end. The Period began in 1863 when prospectors discovered hardrock ore in the form of galena, which incited a rush that was significant on a local level. Within a short time, prospectors found hardrock gold ore in addition to silver, reorganized the Utilla Mining District as the Central district, and began mining. The participants of the rush established Jamestown, which grew into a significant but unstable settlement that contracted abruptly when the rush collapsed around 1869.

The Central district's first Period of Significance was important for economical, industrial and geographic reasons. In terms of industry and economics, the Central district experienced its rush at a time when Boulder County was in decline due to the collapse of mining around Gold Hill. This was an important overlap because the Central district helped the county's

[3] Bixby, 1880:430; *Boulder County Herald* 10/7/91; Cobb, 1999:52; *Colorado Mining Directory*, 1879:74, 76; *Colorado Mining Directory*, 1883:42.
[4] Bauer, et al, 1990:79; Bixby, 1880:430; *Boulder County Herald* 10/7/91; Cobb, 1999:54; Hollister, 1867:271; *Vertical Files: Jamestown*.

economy and psyche weather a local depression until around 1870, when the Caribou boom became important. The Central district's initial boom also drew some investment to the area, which then made its way into the rest of the county's economy. In response to the boom, mining companies and individuals contributed to the development of a transportation infrastructure to and within the Central district, which helped later activities. In terms of geography, the boom established the foundation for a lasting social geography that was modified in later decades.

E 4.9.2: The Telluride Boom, 1875 - 1885

When the first boom collapsed, the Central district was almost abandoned. Only a few prospectors and loggers remained, but the population was enough to keep the Jamestown post office open. In 1872, events at Gold Hill, located only around four miles to the south, became a foundation for a major revival. Several miners who were working the Alamakee at Gold Hill were curious about highly mineralized rock that showed no gold but appeared to be some type of metal ore. They had Boulder metallurgist J. Alden Smith (see Gold Hill district history) assay their samples, and he confirmed the material to be telluride gold, which incited a wave of prospecting throughout the mountainous portion of the county. During the next several years, prospectors worked their way outward from Gold Hill, proving telluride gold as far south as Magnolia and as far north as South St. Vrain Creek. It seems curious that three years passed before anyone seriously examined the Central district for telluride ore.

Repeating the boom of ten years earlier, a series of rich discoveries in 1875 incited a telluride rush to Jamestown. During the year, prospectors traced pieces of float (ore samples that natural weathering broke off a vein) up to the Golden Age and Bueno lodes, east and west of Jamestown, respectively. Local residents referred to the Bueno as the Wano after its phonetic pronunciation in Spanish, which suggests that Hispanic prospectors may have been involved in the discovery. Benjamin F. Smith and a local native named Louis Wallace, also known as Indian Jack, found the Golden Age, and Smith bought Wallace's share. Smith immediately developed the vein and invested some of the profits in other telluride mines. The Golden Age discovery fueled the rush, and prospectors found a number of other veins including the Golden Era, the Grant, the Ella, the Hecla, and the Louis. J. Alden Smith apparently searched the area and staked the J. Alden Smith lode, and Benjamin Smith also found a vein that he named after himself.[5]

Prospectors accurately perceived the Central district as rife with potential, and its broad area, dozens of hills, and deep gulches provided plenty of area for an army of wealth-seekers. Jamestown boomed and drew the typical rush participants and businesses. Some archival sources claim that as many as 10,000 people crowded the district, although this seems exaggerated when compared against the county's entire population of approximately 9,700. Reflecting the boom atmosphere, Jamestown featured as many as 33 saloons, dancehalls, and parlor houses, and only one church. Other businesses catered to everyday life, and they included

[5] *Colorado Mining Directory*, 1879:89; Fossett, 1879:85; Fritz, 1933:23, 175; Jenkins, 1979:3; Southworth, 1999:54; Wolle, 1995:509.

the typical mercantiles, restaurants, butchers, and bakeries. Hotels received guests, liveries took care of their animals, and community activists provided a meeting hall and a school. Like most rushes, young men greatly outnumbered the families, although this would change in later decades.[6]

The boom continued through the late 1870s, and two industries took form. On the legitimate side, investors began to acquire the proven properties and use their capital to develop them into actual mines. On the shady side, speculators and promoters purchased the unproven claims and tried to sell them as if they would yield a bonanza. In 1875, Harlan P. Walker started down the road to riches when he purchased the Golden Age from Benjamin Smith, then built the Golden Age Mill in Jamestown in 1877 to treat primarily his ore and that from other mines. Around 1880, Walker interested Chicago investors Eugene and Daniel H. Pike in the mine for development capital, and they organized the Golden Age Mining Company. By 1883, the property yielded an impressive $130,000. In 1880, Philadelphia capitalists Thomas H. Gill, D.R. Patterson, and H.E. Eggleson pooled their capital, chartered the Buena Gold Mining Company, and purchased the Bueno Mine and built the Bueno Mill near the mine. Another group of Philadelphia investors organized the Governor Group Gold Mining Company during early 1880s to acquire an extensive collection of claims southwest of Jamestown. The company peppered the claims with shafts, drove a 600 foot tunnel, and built a mill at Jamestown. R.R. Newkirk, A.H. Russell and others organized the Invincible Mining Company to explore and develop the Invincible Vein northwest of Jamestown. Capitalists mostly local in importance brought the Argo, Bondholder, Cincinnati, Golden Era, Grand Central, and other mines into production.[7]

J.D. Alkire proposed one of the most ambitious and costly projects in the districts, which was also perhaps premature given that many of the veins had not been thoroughly explored. Specifically, Alkire assumed that a deep haulageway driven into the base of Golden Age Mountain would be richly rewarded not only by charging other companies a fee to use the passageway, but also by penetrating as-yet undiscovered veins. In 1883, he organized the Jamestown Milling & Tunnel Company and began the tunnel.[8]

Some investors were interested in the Central district's original form of mineral wealth, which was placer gold. In 1882, A.B. Ingols, J.W. Barbee and G.W. Cummings, who also held interests in Gold Hill, organized the Central Gulch Ditch & Mining Company to work a group of placer claims on James Creek. By consolidating claims, employing a workforce, and building lengthy sluices, they were able to profit from the gold dust that original placer miners failed to recover.[9]

Repeating a pattern that developed in Boulder County's other mining districts, the actual production of ore created a demand for milling, which various interests tried to satisfy. In the Central district, it appears that most metallurgists understood that the telluride ore would not

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[6] *Boulder County Herald* 10/7/91; Eberhart, 1987:97; Southworth, 1999:55; *Vertical Files: Jamestown*; Wolle, 1995:509.
[7] *Colorado Mining Directory*, 1883:42, 45, 47, 51, 57, 58, 62, 76, 82.
[8] *Colorado Mining Directory*, 1883:62.
[9] *Colorado Mining Directory*, 1883:48.

amalgamate unless roasted first and instead required concentration. In 1877, Silas T. Tumbleson developed the Bonanza into a minor producer, or so it seemed, then sold the property to Connecticut capitalists in 1880. They organized the Crocker Process Ore Reduction Company and hired a capable metallurgist who built an effective roasting and amalgamation facility at Jamestown. The problem with the operation, however, was that the Bonanza offered little ore, forcing the company to treat custom orders in the mill to pay for the expenses. By this time, the Cincinnati and the tiny Simpson mills in town also accepted custom orders. Someone built Brett's Mill in Left Hand Canyon near its confluence with James Creek around 1877 to process ores that they expected to come from the Central district's south portion. The mill was the nucleus of the hamlet of Glendale, where H.S. Goff opened an assay shop.[10]

Figure E 4.9.2. The sudden growth of Jamestown during the late 1870s was fueled as much by unfounded speculation as legitimate mining. Unlike most of Boulder County's mining settlements, Jamestown was rowdy, loud, and a destination for cliché mining rush participants such as gamblers. This north view depicts Jamestown's main street, which lined the floor of James Creek. Note the extensive placer tailings along the creek. Source: Boulder Carnegie Library, 219-5-13.

[10] *Colorado Mining Directory*, 1879:125; *Colorado Mining Directory*, 1883:51, 76.

Like most rushes, Jamestown drew many more prospectors than there were ore veins, which forced late arrivals to spread out into the surrounding hills and search for undiscovered telluride deposits. Archibald Van Deren and Edward Fuller were two such prospectors, and they led a small party of others from Central City to Boulder County in hopes of finding telluride ore. Van Deren was born in Bourbon County, Kentucky in 1831 and went with family to Sangamon, Illinois at age five to start a homestead. Within weeks, however, his father died, leaving Van Deren and brothers to run the farm until they were adults. After having his fill of farm life, Van Deren left at age 22 and found a job in a mercantile in Springfield. He apparently became a partner and lasted until the Pikes Peak Gold Rush drew him to Colorado in 1859. Van Deren joined the excitement in Gilpin County and, after placer mining a short time, ran one of Colorado's first stamp mills, located at the head of Nevada Gulch. Successful, Van Deren was appointed to the first Gilpin County Commission by Governor Gilpin in 1861, then served in the Territorial Legislature in 1863. Van Deren was loyal to Central City but took time away in 1875 to try his luck in the Central district.[11]

His party prospected its way west up James Creek past Bueno Mountain and found extremely rich ore on the drainage's north side. They claimed the telluride vein as the John Jay, developed it, and saw a small rush develop around their find. Prospectors pitched tents and built several small cabins on a wide spot on the drainage floor, and Van Deren named the growing camp Providence because he felt that the hand of the Divine guided his party to the discovery. By the late 1870s, Van Deren hired a small crew of miners who sank a shaft, installed a steam hoist, and constructed a simple mill. The John Jay Mine contributed to Van Deren's coffers through the early 1880s.[12]

Charles Mullen, William A. Christian, and William H. Lessig were three other late prospectors who had to search the outskirts of the Central district. They ventured north into Long Gulch where placer miners worked the drainage floor during the original boom, and perhaps the trio understood that placer gold was a sign that hardrock veins must be nearby. The trio was certainly experienced. Mullen had been prospecting for years and Christian was involved in several mining ventures in Park County. In 1876, the trio found what it sought, which was a massive telluride vein on the drainage's northwest side. Mullen et al claimed the vein as the Smuggler, and the discovery drew other prospectors who unearthed the Ballarat, Bendigo, Careless Boy, and Eldorado lodes nearby.[13]

Mullen and partners pitched a camp on a wide spot in Long Gulch adjacent to the Smuggler along with several other parties of prospectors, who developed their properties. After gouging out wonderfully rich ore through 1876, Mullen somehow came in contact with Benjamin Eaton, a farming and irrigation magnate who was one of northern Colorado's most influential politicians, and he offered to buy the Smuggler. Mullin sold in 1876 followed by

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[11] Hall, 1895, V.3:412; *History of Boulder and Clear Creek Valleys*, 1880:692.
[12] Cobb, 1999:56; *Colorado Mining Directory*, 1879:95; *Colorado Mining Directory*, 1883:63; Eberhart, 1987:98; Fossett, 1876:403.
[13] *Colorado Mining Directory*, 1879:73, 74, 77, 84; Fossett, 1876:404; Fossett, 1879:86; Pettem, 1980:47; Wolle, 1995:511.

Christian, but Lessig retained his interest. Eaton then drew in investors who organized the Smuggler Mining Company. Charles G. Van Fleet was a member of the company, and he financed the Van Fleet Mill as a separate venture to treat the vein's low-grade ore.[14]

Van Fleet was born at Fleetville, Pennsylvania during 1847 to a merchant and farming family of means that founded the town. At age 12, Van Fleet enrolled in the Wyoming Seminary and Commercial College, matriculated to the Clinton Liberal Institute, then studied law under several prominent lawyers. Around 24 years old, Van Fleet passed the bar and established a partnership with his brother-in-law M.J. Wilson in Scranton, Pennsylvania. There, he also speculated in real estate, constructed a number of buildings, and invested in coal mines. With his health declining, Van Fleet quit his practice in 1875 and struck west for California in hopes of recuperating. He went as far as Colorado and found that the territory offered an excellent climate and ample business opportunities, and he decided to stay in Boulder. There, Van Fleet opened a law practice and began investing in mining.[15]

Figure E 4.9.3. Ballarat was Boulder County's northern-most mining settlement, and in its first years, the hamlet was home to miners employed at several operations. The small operations closed within a short time and Ballarat became a company town for the Smuggler Mine, one of Boulder County's richest producers, visible at upper left. Flashfloods washed much of the town away after 1900. Source: Boulder Carnegie Library, 219-5-13.

[14] Fossett, 1876:404; Fossett, 1879:86-87; *History of Boulder and Clear Creek Valleys*, 1880:695; Pettem, 1980:47.
[15] *History of Boulder and Clear Creek Valleys*, 1880:696.

The prospectors' camp on the floor of Long Gulch assumed the form of an established settlement. By 1878, the population exceeded eighty residents, most of whom were either among the Smuggler company's crew of fifty or miners employed at the handful of surrounding operations. Someone named the settlement Ballarat after both the mine in Long Gulch and the Australian gold mining town, and the Postal Service recognized the new entity with a post office in 1879. Because the gulch was narrow, much of the town manifested as two rows of buildings strung out along both sides of the floor. The population was enough to support a mercantile and several boardinghouses, and visiting guests stayed in a hotel.[16]

During the late 1870s, Ballarat became a company town as the Smuggler company quickly subsumed the profitable claims that surrounded the Smuggler Mine. The company purchased the Bendigo, Careless Boy, Eldorado, Little Eddie, and Waumega mines. Freed from the burden of owning the Smuggler claim, William Christian, brother Charles J., and James D. Smith, who started the Jamestown rush with his 1864 galena discovery, found another telluride vein that they claimed as the Longfellow in 1877. During the late 1870s, miners worked this, the Charter Oak, the Rattler (named after the snake), and the Ballarat mines. Around 1880, prospectors found yet another vein that they claimed as the Colfax Group, developed it, and built a ten stamp mill for the ore, and W.H. Gifford reworked the gulch floor as the Bendigo Placer. Despite the activity, miners exhausted most of the veins because, like elsewhere in the county, the ore bodies were short in length and shallow in depth. As a result, Ballarat began to decline as quickly as it boomed, and without enough people, the Postal Service revoked the post office in 1881.[17]

Springdale, located where Castle Gulch emptied into James Creek, was one of Jamestown's most important satellite settlements. The confluence offered three qualities that naturally attracted prospectors in 1874. One was broad, flat, sunny ground. Another was a proximity to a number of claims being developed in Castle Gulch, and the most unusual was a mineral spring. While the claims interested the prospectors, the spring drew developers who envisioned its resort potential, and these factors established Springdale's dual role. In 1875, an entrepreneur built the Seltzer House Hotel as a tourist destination, and prospectors and miners made up a considerable proportion of the settlement's population of 300. While tourists bathed in the mineral waters, miners commuted up to the King William, Grand Central, Big Blossom, Gladiator, Rip Van Dam, and Copper Blush mines in the surrounding hills. In 1880, C. Edgar Smith of New York City bought the resort, secured a post office, and built summer cottages, a bowling alley, and a bath house. Someone else ran a bottling works, and guests kept their draft animals in a livery.[18]

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[16] Bauer, et al, 1990:16; *Colorado State Business Directory and Annual Register*, 1878; Fritz, 1933:175; Wolle, 1995:511-512.
[17] Bauer, et al, 1990:16; Bixby, 1880:430; *Colorado Mining Directory*, 1879:100; *Colorado Mining Directory*, 1883:44, 49, 50; Wolle, 1995:511-512.
[18] Bauer, et al, 1990:135; Bixby, 1880:430; Fossett, 1876:404; Fossett, 1879:85; *Vertical Files: Springdale.*

Cumulatively, the Central district's deep prospects, productive mines, and mills, effective or not, constituted a nascent mining industry. The investors, especially those with capital reserves, lent legitimacy to the district, and they financed the introduction of machinery at a relatively early time. It appeared to Jamestown residents as if their mining industry was propelling the district in the direction of greatness, like Gold Hill.

It seems, however, that the speculators and promoters had as much influence as the well-meaning miners and investors over the Central district's future. While promoters and speculators lurked on the fringes of every mining boom in Colorado, they were apparently particularly egregious in Jamestown. Speculators and promoters forced real estate prices in town to spiral upward, they misrepresented questionable claims, less-than-honest individuals exaggerated the effectiveness of some of the mills, and a few even went so far as to bilk and scam profit-hungry and inexperienced investors. This coupled with simpler forms of greed tarnished the Central district's boom for quite some time.

Over-promotion did not cause the boom to collapse. Instead, the shallow and inconsistent telluride veins typical of Boulder County were the main cause because miners quickly exhausted the easily won ore. Over-promotion, however, soured the willingness of capitalists to invest and left a black mark on the Central district, despite the large reserves of low-grade ore that remained. The effect moved a local Boulder newspaper editor to assert:

> "Until within the past couple of years mining has fallen into an unsavory repute. The snide Jamestown boom several years ago killed that prosperous mining town and buried its many rich gold and silver lodes in oblivion. The name of Jimtown was a stench and its mines something to be dreaded and shunned by capitalists. Yet through no fault of legitimate owners of mining claims, but rather by being pushed and bommed by unscrupulous and designing mining sharks."[19]

The Central district's second Period of Significance began with discovery of telluride ore in 1875 and ended with the collapse of profitable mining around 1885. The second Period saw an intense wave of prospecting followed by the development of a truly viable mining industry. Between 1875 and 1880, partnerships and companies developed around fifty deep prospects, and extracted ore in approximately ten small mines and half as many medium-sized operations. Between 1880 and 1885, the number of deep prospects increased slightly while at least five more small mines were brought into production. These figures plummeted when the boom collapsed.[20]

During the second Period, the district experienced several trends that were important on local and national levels. On a local level, the district enjoyed an energetic boom almost equal with that at Gold Hill, which was the center of the county's telluride mining industry. The second Period saw the development of a profitable mining industry and the establishment of the

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[19] *Boulder County Herald* 7/10/89.

[20] The numbers of active mines were estimated from surveys of 1879 and 1883 *Colorado Mining Directories* and other archival sources.

permanent settlements of Jamestown, Springdale, Camp Providence, Ballarat, and Glendale. These became a part of Boulder County's communication, commercial, and financial systems. The wealth that miners produced contributed to the county's economy and the financial reserves of investors, some of whom put the money back into the county's mining industry. The district's boom also drew investment from the outside to the county, and some of the money made its way into the local economy. On a national level, the Central district's mines and mills contributed to the expansion of Boulder County's telluride mining movement, which is discussed in detail in the history of the Gold Hill district. Historic resources that retain integrity today relative to the second Period of Significance may be important when associated with some of the above trends.

E 4.9.3: The Quiet Years, 1885 - 1893

The Central district was relatively quiet for a long period of time after the boom collapsed. A few outfits attempted to overcome the geological problems that led to the district's decline. One was to find continuations of the ore veins, and the other was to somehow profit from the low-grade and complex material that the early companies left underground as unworkable. In terms of the former issue, a handful of small- and medium-sized mines were in production at any given time between 1885 and 1890. In terms of the latter issue, local investors found that the low-grade as produced was uneconomical, but if someone could concentrate the material, the low-grade ore might pay. The principal obstacle that the investors underestimated, however, was the difficulty of treating telluride payrock. To this end, a newspaper editor in Boulder lamented: "Jimtown has huge veins and immense mineral deposits, but must have a cheap process to treat the low grade ore in the camp."[21]

By the early 1890s, some of the Central district's mining companies found at least partial solutions to their principal problems. Almost as many mines and mills were active between 1890 and 1893 as they were during the last years of the boom. In addition, the buoyant national economy and an interest in mining helped. Jamestown was certainly a fraction of what it was during the boom, but the town still retained a core business district. A population of 212 people and families lived in town, although the demography evolved from mostly young men and opportunists to workers and their families. An additional 529 people were scattered throughout the rest of the district, mostly in the satellite camps and at those mines located too far from Jamestown for a reasonable commute by foot. Because most of the mines in Castle Gulch were active and tourists still visited the mineral springs on James Creek, Springdale was as busy as ever. Glendale retained a few residents who worked in the mill and catered to traffic on the Left Hand Canyon road. Camp Providence, however, contracted to the small crew that worked in the John Jay Mine, and Ballarat was almost deserted.[22]

[21] *Boulder County Herald* 10/7/91.
[22] Schulz, 1977:1890-2; the number of active mines was estimated from a survey of archival sources.

E 4.9.4: The Silver Crash, 1893 – 1897

The Central district entered a particularly difficult time at the end of 1893. A collision of factors caused the value of silver to tumble from around $.88 to $.63 per ounce, which had a major impact that engulfed Colorado, the West, and the rest of the nation. At $.88 per ounce, most grades of silver ore were barely profitable to mine, and when the price fell, they became uneconomical. Mines across the West suspended operations, thousands of workers suddenly found themselves jobless, and a financial panic known as the Silver Crash of 1893 first swept the West then rippled out to the rest of the nation, ushering in a depression that lasted through much of the 1890s. Colorado, which relied to a great degree on silver, was devastated, and the effects trickled down to the Central district, where they resulted in two important trends. (For a full explanation of the Silver Crash of 1893, see Caribou Mining District history).[23]

The first and most immediate trend was that many of the mining companies in the Central district either reduced operations or shut down altogether. One reason was that some of the ore bodies around Jamestown offered a blend of gold and silver, which was only profitable to mine when the gold content was high enough to offset the silver. The other principal reason was that, given the dismal economic climate, investors were unwilling or simply unable to spend their money on anything other than the production of the highest grades of payrock, most of which had been exhausted years ago. Without funds flowing into the Central district's mines, ore was unable to flow out. To make matters worse for the district, sixty hours of rain during the already wet spring of 1894 caused the creeks to rise at first, then flood. Much of Ballarat and Camp Providence were washed away, buildings all along James Creek were knocked over or undermined, and the system of roads was destroyed. The result set the region back. Many out-of-work people and troubled businesses lacked the funds to rebuild and so left, mining companies could not ship their ore, and repairs taxed already drained funds.[24]

The second trend began to take form after 1895 and gave those residents who remained in the district a reason for hope. In general, most capitalists saw their various investments evaporate after the Silver Crash, but a few financially adept individuals sought economic solace in gold because its value remained a constant $20.70 per ounce. After the worst of the depression passed by 1895, these capitalists fomented a limited but noticeable wave of interest in gold mines.[25]

Under these conditions, the reports of several new gold strikes around Cannon Mountain, located at the head of Little James Creek, created a small excitement. Prospectors flocked to the area and established the camp of Gresham. Expecting the camp to develop into a town, community builders requested the post office of Gresham, which the Postal Service granted in 1895. During this time, investors financed at least ten deep prospects, but no mines of

[23] *Report of the Director of the Mint*, 1894:20; Saxon, 1959:7, 8, 14, 16.
[24] Eberhart, 1987:97, 98; Southworth, 1999:55; *Vertical Files: Springdale*; Wolle, 1995:509.
[25] Saxon, 1959:78, 14, 16.

significance came of the event and so Gresham withered. Apart from Gresham, several of the proven producers in the district fitfully generated ore.[26]

E 4.9.5: The Late 1890s Mining Revival, 1897 – 1905

As the decade of the 1890s waned, a variety of factors came together to spell a revival of mining throughout Boulder County and greater Colorado. First, the economy finally rebounded from the depression, investors were again willing to risk capital, financing could be found for businesses, and goods and services were readily available. Second, mine owners were more than willing to extend themselves to bring their idle properties back into production or sell them to investors to avoid sustained financial losses. Third, advances in mining technology and engineering decreased the costs of production, and improvements in milling methods permitted ores of greater complexity and lower grades to be profitably concentrated than before. Last, a keen interest in gold as a stable form of investment among mining capitalists also played a large role in the revival.

The Central district enjoyed a wave of mining and prospecting not seen since the early 1880s. Between 1897 and 1900, partnerships and companies worked around 20 small mines, 3 medium-sized operations, and 4 large producers. Prospectors responded to the strong interest in gold by returning to the hills in search of veins that somehow had been overlooked, and these wealth-seekers developed around 25 deep prospects, which was most since the telluride boom. The late 1890s revival saw two general trends develop in the district's mining industry. One was a steady movement of consolidation and interest among powerful capitalists, and the other was a return of small partnerships and companies, which the above figures reflect.

Most of the district's historic producers were reopened and some changed hands for high prices. The Livingston Mining Company, which also owned the rich Livingston Mine at Sugar Loaf, operated the Longfellow Mine on Golden Age Hill. The mine was a modest producer with a 450 foot tunnel, several shafts, and a crew of seven. L.N. Denison was hired to manage the Nugget Mine, which was a moderate producer on Nugget Mountain. Denison also owned Gold Hill's historic Alamakee Mine and managed the Slide, which was one of the county's best. The American Star Mining Company operated the American Star, which had a 230 foot shaft and yielded $200,000. Under H.H. Barbee, the Gold Ledge Mining Company developed the Cashier Mine with a crew of 12 miners. The Standard Mining Company developed the Standard and built a mill to treat its ore. Because the names of many of the above mines are new, it appears that some of the historic producers were re-titled probably by the investors who purchased them.[27]

Among Jamestown's profitable mines, the Golden Age reigned supreme. By the late 1890s, the mine already yielded almost $1 million and consisted of an 800 foot shaft, two long tunnels, at least 10,000 feet of workings. Out-of-state investors G.R. Nelson and D.H. Pike

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[26] Bauer, et al, 1990:67; *Boulder County Post Offices.*
[27] Cobb, 1999:50; *Colorado Mining Directory*, 1898:114; *Colorado Mining Directory*, 1902:2, 6, 18, 22

owned the mine by the late 1890s, and they employed a crew of 30. During the 1900s, the Golden Age shaft house burned and, despite a sound record of production, the company decided against rebuilding it and instead closed the mine. The Bueno was the other principal operation, and it yielded $200,000 from an 800 foot long tunnel and a shaft. The Woody Mining Company purchased the property and refitted the mill with cyanide equipment, which was proven to work on telluride ore. The Woody company, however, sold the Bueno in 1906 to the Monarch Consolidated Gold & Copper Mining & Smelting Company, which refitted the mill again. Had anyone closely considered the events at the Bueno and Golden Age mines, they might have questioned just how long the late 1890s revival would last. The relatively quick turnover of the Bueno and the need to refit the mill again spoke poorly of the mine's future and suggested that, perhaps, the best ore was gone. The fact that the Golden Age was not reopened reflects a similar trend. If rich ore remained underground, then the company would have justified the expenses required to repair the shaft.[28]

At Camp Providence, the John Jay and several small mines were in full production. Judge John A. Bentley owned the John Jay by the late 1890s, and as a sign that the best and most easily treated ore was gone, he commissioned a new mill equipped with a roasting furnace, which drove off sulphur and oxidized the ore for better treatment. A crew of 16 operated both the mine and mill. In his old age, Benjamin Eaton sold the Smuggler at Ballarat during the late 1890s, and the new owners apparently reopened the mine, which yielded up to $400,000, and operated it with a crew of 12 miners. By this time, Ballarat was largely gone, although miners employed at the Longfellow and several other operations inhabited the few remaining cabins. Springdale increasingly had to rely on its tourist trade because the surrounding mines there were becoming exhausted.[29]

The Golden Age and Bueno mines were bellwethers for the state of the Central district's mining industry, although miners may not have perceived this. When these properties ran into trouble during the latter half of the 1900s, they were figureheads for a decline that swept the rest of the district at this time. The district's decline became pronounced by 1905, and it marks an end to the third Period of Significance. The third Period began in 1897 with a major and abrupt revival of mining. Between 1900 and 1905, the number of active mines decreased to 10 deep prospects, less than 15 small operations several medium-sized operations, and 1 large producer. After 1905, many of these closed, and the population of the district fell. A core 157 people lived in Jamestown while only 223 workers inhabited the rest of the district. The reason for the decline was the common trend experienced throughout the county, which was that miners simply exhausted most of the profitable ore, even though it was lower grade than the material extracted in the past. Further, underground exploration confirmed that most of the telluride veins were, in fact, shallow and limited.[30]

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[28] Cobb, 1999:57; *Colorado Mining Directory*, 1898:114; *Colorado Mining Directory*, 1902:5, 14, Jenkins, 1979:3; *Mineral Resources of the United States*, 1906:208.
[29] Cobb, 1999:56; *Colorado Mining Directory*, 1898:114; *Colorado Mining Directory*, 1902:16, 27.
[30] Schulz, 1977:1910-9; production figures were derived from a survey of *Mineral Resources of the United States.*

In general, the Central district experienced several important trends during the third Period of Significance. First, in terms of industry, the district saw significant levels of investment, ore production, promotion, and overall development. During the Period, the mines contributed heavily to local- and countywide economies, and the mining companies consumed a considerable amount of machinery and supplies. The vibrant mining industry also drew investment from distant capitalists, which made its way into the county's economy. This strengthened the district's involvement with commerce, banking, finance, and communication. In terms of society and culture, the district's population reached its peak and increased the sizes of Jamestown and Springdale. The large population fostered cultural institutions, communication systems, and commerce for non-industrial goods and services. Further, by consuming fresh foods, the population contributed to the growth of Boulder County's agricultural industry. Historic resources that retain integrity relative to the third Period of Significance may be important if associated with the above trends.

E 4.9.6: The World War I Fluorspar Boom, 1915 - 1922

Most of the Central district's companies and partnerships suspended work during the latter half of the 1900s and the region fell into depression. Those who remained in the district after the collapse, however, were ultimately rewarded for their patience. Political instability in Europe interested Jamestown miners in a type of ore that no one seriously considered during the booms. When World War I began in 1914, manufacturing industries in Europe mobilized to meet a heavy wartime demand, and as the war progressed and devastated Europe's economy, governments there turned to American manufacturers for their needs. Armaments and the principal material to make armaments – steel – became an important commodity, and Jamestown possessed fluorspar, which was one of the key mineral resources used for smelting steel.

Fluorspar was a calcium di-fluoride ($CaFl_2$), compound that occurred as a hardrock ore. Mineralogists and industrialists recognized three grades of fluorspar and each was an important material for manufacturing. Metallurgical fluorspar, also known as metspar, was used as a flux primarily for smelting steel and to a lesser degree other forms of industrial metal ores. When introduced into furnaces, metallurgical fluorspar melted quickly and coated the more resilient ores, and in so doing, helped them to soften then liquefy. Metallurgical fluorspar also hastened the separation of molten metals from the waste that workers threw out as slag, and increased the fluidity of the slag so it could be easily drained from smelting furnaces. By definition, metallurgical fluorspar had to contain at least 60 percent $CaFl_2$, and metallurgists chose specific purities according to the type of ore being smelted. Acid fluorspar, also known as acid spar, saw demand for a variety of industrial uses and by definition had to contain 97 to 98 percent $CaFl_2$ and less than 1 percent silica dioxide (SiO_2). Chemical companies depended on acid fluorspar to manufacture hydrofluoric acid, which was used to etch glass, pickle metal products, and mill ore. During the late twentieth century the acid became important for refrigeration, electroplating, and refining high-octane gasoline. Beginning in the mid-1930s, hydrofluoric acid also became a crucial chemical for manufacturing aluminum goods. Ceramic fluorspar was used for making flint glass and enamels, which grew in popularity during the twentieth century. By definition ceramic fluorspar had to consist of 80 to 95 percent $CaFl_2$ and not more than 3 percent SiO_2, and be free of metal impurities such as lead and zinc.[31]

Miners recognized fluorspar in some of the mines around Jamestown during the initial boom but thought little of the material. In 1874, someone sent several shipments to the Boyd Smelter as a flux, and Anthony Arnett did the same thing during the early 1880s, but James Boyd, who ran the smelter, was unwilling to pay enough to make mining the bluish ore profitable. The Pueblo steel mill created a small demand after 1900, but the price was still too low to justify shipping anything but the highest grades of ore.[32]

As steel and other materials came under demand during World War I, so did fluorspar, which many Jamestown miners threw out as waste rock in the past because it was so plentiful. Some of the miners now paused to remember those underground workings where they saw the fluorspar ore in hopes of leasing the properties. By 1916, fluorspar miners began a noticeable wave of activity, and much to their delight, the value of and demand for the industrial mineral slowly rose then shot upward as the war dragged on.

The fluorspar movement was important to Jamestown because it maintained a community and lifestyle that was threatened with extinction after the turn-of-the-century boom came to an end. During the late 1910s, the population of Jamestown remained fairly static instead of declining like the county's other mining districts. Comparatively, the fluorspar movement granted the Central district a sense of victory over the forces that were deconstructing the surround areas. As in the past, workers and their families continued to dominate the demography of Jamestown.

One of the first areas where miners remembered seeing fluorspar ore was to the north of Jamestown. Louis Markt and Thomas Mohr considered the area as early as 1915 and apparently purchased the idle Alice Mine the following year under the name of Louis Markt & Company. They leased the Alice Shaft out to the Fluorite Mining Company, which then began substantial production from the underground workings. At the same time, Hoffman & Company leased the waste rock dump and sorted out the fluorspar cast off during the past. The Alice was apparently a gateway into fluorspar mining for Markt and Mohr. In 1916, they leased the Emmitt Mine and what had been renamed the Fluorite Group for promotional purposes, and both were located on the west side of Little James Creek northwest of Jamestown. Neither of these properties saw much development until the fluorspar boom. The partnership of Olson & Semke leased the Argo Mine, located in the same vicinity, and other lessees were at work elsewhere.[33]

By 1917, the fluorspar boom interested not only small parties of lessees, but also investors with capital and mining companies that were more than eager to bring their idle properties back into production. J.F. Barnhill and J.H. Hardy concluded that plenty of fluorspar remained in the old Golden Age workings that could still be accessed through the two main

[31] Davis, 1943; Ladoo, 1923; Roskill, 1971:2; Roskill, 1976:1-2; Roskill, 1990:2.
[32] *Colorado Mining Directory*, 1883:44; Fritz, 1933:180; Goddard, 1946:9; Kelly and Goddard, 1969:18.
[33] Colorado Mine Inspectors' Reports: Alice, Emmitt.

tunnels, and they leased the property from George Nelson's widow. After minor exploration proved that plenty of ore existed, in 1918, Barnhill and Hardy formed the Golden Age Mining & Milling Company then began heavy production. At the same time, E.J. Chissell realized that his idle Bueno (Wano) Mine offered fluorspar. He revived the Wano Mining & Milling Company and reopened the venerable producer. Markt wanted to expand what was becoming a small fluorspar empire in the Jamestown, and so formed a partnership with C.A. Atkinson. In 1918, they leased the Blue Jay and Emmitt mines and, unable to work all of both properties, leased some portions out to H.S. Vickery.

Already, the fidgety metallurgists in Jamestown were forming a symbiotic relationship with the fluorspar miners. The metallurgists possessed idle mills that could be used to concentrate the fluorspar ore, and the miners generated ore that could keep the district's metallurgists busy. By concentrating the ore, miners were able to produce lower grades than were otherwise profitable, which benefited everyone in the district. The problem that the metallurgists faced was that because Jamestown was one of the centers of fluorspar mining in the West, there were few templates for processing that they could follow. The best that they could do was to imitate some of the methods that companies in Kentucky and other fluorspar districts in the Southeast and Midwest tried.

It appears that Hoffman & Company was the first organization in the district to attempt to concentrate fluorspar ore when it built a mill on the edge of Jamestown in 1916. When Hoffman's mill proved effective, E.J. Chissell decided to maximize his income and adapted the Wano Mill (Bueno Mill) to fluorspar ore in 1918 then actively solicited Jamestown's mining companies. The following year, J.F. Barnhill and J.H. Hardy reorganized their Golden Age company as the Colorado Pitchblende Company, leased the Argo, and took over the Golden Age Mill to treat fluorspar ore. The company ran custom orders when not processing its own material. It seems interesting to note that the district's metallurgists refitted the mills originally designed to treat romanticized gold ore for mundane fluorspar with ease and without hesitation.[34]

While the declaration of Armistice in 1918 brought a long-awaited end to the ravages of World War I, it created the conditions for a delayed reaction that would erase much of the progress made in the Jamestown area. The economic and political trends of 1919 belied the impending doom. As soon as the war was over, European nations began the costly and protracted process of rebuilding their infrastructures, industries, maritime businesses, and militaries. As a result, the demand for steel only increased after the war, at least for a while.

While no one in the Central district relished the war to end all wars, they certainly welcomed what the cataclysm did for their mining industry. The Jamestown mining companies shipped out a record 23,000 tons of fluorspar ore in 1918. Partnerships developed ten deep prospects and another ten small mines, and they operated five significant producers. In sum, the mining industry approached the level of production that it held during the late 1890s boom, although the workforce was slightly smaller because machines replaced miners for some tasks.[35]

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[34] Goddard, 1946:9; Colorado Mine Inspectors' Reports: Alice, Golden Age, Wano

[35] Goddard, 1946:9; Ladoo, 1923; the numbers of active mines came from a survey of Colorado Mine Inspectors' Reports.

Three major operators came to dominate the fluorspar industry, although there were plenty of small veins and pockets of ore to support an army of independent miners. In 1919, the J. Gillingham Hibbs Ore Company leased the Good Friday, Brown & Brown, Argo, and Emmett mines, and treated the ore in both the Golden Age Mill and the Lehman Mill, located on the south edge of Jamestown. Hibbs specialized in industrial minerals mining and also leased several tungsten mines including the Red Signe in the Sugar Loaf district. E.W. Lehman, the district's second important producer, held several fluorspar interests and formed a partnership with W.B. Clemens and George Evans in 1918 to lease several important properties. In conjunction with this, Lehman either built his own mill or most likely purchased the Hoffman facility, which then became known as the Lehman Mill. However it came to be, the Lehman Mill became a fixture in the fluorspar industry.[36]

The third and largest principal operator was the Climax Spar & Radium Company, which appears to have been an incarnation of J.H. Hardy's Colorado Pitchblende outfit. Hardy and C.V. Mead organized Climax Spar in 1919 to consolidate their interests and acquire additional properties that offered fluorspar. Hardy brought with him the Golden Age and other leases, Mead probably had the Argo lease, and together, they purchased the Brown & Brown, Blue Jay, Buster, Emmitt, Esmeralda, and Violet Ray mines. Climax Spar worked several of the mines itself but leased out most of the properties in blocks and sections to small parties.[37]

The small army of lessees and the three principal entities literally saved the Central district from abandonment during the 1910s. The impending decline that the 1918 Armistice set in motion, however, finally arrived in 1922 and struck the Central district with full force. As normalcy returned to the United States and Europe, the demand for and value of fluorspar slumped. As if this were not enough, a deep, post-war depression crept over the entire United States, bringing with it economic woes of all types. Fluorspar mining halted then collapsed, and with little ore being produced, the three concentration mills, which were the Golden Age, the Lehman, and the Wano, were dismantled by 1923.[38]

The rapid collapse of fluorspar mining during the early 1920s brought an end to the Central district's fourth Period of Significance. The Period, which began in 1915, saw the Central district become involved with trends important on local, state, and national levels. Historic resources that retain integrity relative to the fourth Period of Significance, and can be attributed to fluorspar prospecting, mining, milling, and its general manifestations, may be important through an association with the trends of fluorspar mining. Only fluorspar mining, and its related trends, were important during the fourth Period of Significance, and gold and silver mining was unimportant because of a lack of production and a failure to make an impact during the 1910s. Given this, most gold and silver mining resources that were active during the fourth Period will most likely be insignificant. Further, it should be noted that most of the fluorspar mines in the Central district were concentrated within a three mile area around Jamestown.

[36] Colorado Mine Inspectors' Reports: Argo, Brown & Brown, Emmitt, Good Friday, Misc. H.
[37] Colorado Mine Inspectors' Reports: Argo, Blue Jay, Brown & Brown, Emmitt, Violet Ray.
[38] Ladoo, 1923.

On a local level, the fluorspar industry drew capital to the Jamestown area and was the driving force behind the continuation of mining. This came at a time when, due to the exhaustion of gold and silver ores, the district would have otherwise fallen into decline. The fluorspar industry also became a foundation for Jamestown's mining culture and was the principal employer there when few other types of jobs existed in the area during the 1910s. On a slightly broader level, fluorspar mining contributed to Boulder County's economy through production and the dissemination of the capital invested in the district. In addition, Jamestown miners joined those in the Boulder Tungsten District in helping to diversify the county's mining industry into industrial minerals and away from gold and silver, which were exhausted by the 1910s. In so doing, both districts prevented the county from losing a viable mining industry. Further the fluorspar mines developed during the 1910s provided a foundation for later mining, which proved to be an important source of income when most other types of ore were uneconomical.

At the statewide level, the ore mined in the Jamestown area directly contributed to the growth of Colorado's steel industry. During its first several decades of activity, the ore mined in Jamestown went primarily to the steel mills in Pueblo, which required fluorspar to manufacture steel. Securing fluorspar from regional sources proved important for the success of the steel industry because importing the mineral from distant locations would have been too costly. At the same time, the Jamestown area became one of the West's most important fluorspar regions because of its high level of production. When other mining interests saw the success of the Jamestown mines, they sought then developed other major fluorspar deposits. Given this, Jamestown served as an example and spearhead for a larger fluorspar industry in Colorado and New Mexico.

On a broad scale, the Jamestown mines participated in providing the steel industry with the raw materials necessary for smelting. The steel industry played key roles in mobilizing for World War I and for manufacturing goods, hardware, and machinery during the 1910s and early 1920s.

E 4.9.7: Post War Decline, 1923-1929

As the national economy recovered during the 1920s, manufacturers again demanded fluorspar, but several factors confounded a revival at Jamestown. First, the demand was sluggish and soft. Second, Jamestown now faced severe competition from other mining districts such as Poncha Springs, Salida, and North Gate in Colorado, and Deming and Lordsburg in New Mexico. And even these areas struggled because massive mines in Illinois and Kentucky were able to produce the ore at far lower costs than in the West. Third, Jamestown lacked concentration mills, which rendered low grades of ore uneconomical. Regardless, miners and partnerships with no better sources of income returned to the Jamestown mines in search of economical grades of fluorspar.

Beginning in 1925, H.S. Vickery employed the greatest number of miners in several properties that he leased from the Climax Spar & Radium Company. At the same time, E.W.

Lehman organized the Lehman Fluorspar Company and leased the rest of Climax Spar's mines. Once he expected his miners to generate enough ore, Lehman refitted the Lehman Mill in 1927 and began processing his and Vickery' ore. Unfortunately, the Great Depression crushed the fluorspar industry as it began to show signs of life.[39]

E 4.9.8: Mining During the Great Depression, 1929 - 1942

In 1929, the Nation descended into its worst depression ever. The two industries that the Central district relied on, mining and manufacturing, ground to a halt. The general mining industry was ruined because the companies and partnerships no longer could afford to pay even the smallest of operating costs. The steel industry greatly curtailed production and cut its costs at every opportunity, including the prices paid for raw materials such as fluorspar. These factors were a double blow to the Central district, which came to rely on the little fluorspar mining that it had.

Without the prospect of employment or other sources of income, the Central district reversed the trend that directed the mining industry away from gold mining and toward fluorspar. As in decades past, fluorspar no longer drew the interest that gold did. Gold, however meager the source or amount, fetched a constant $20.70 per ounce and offered local miners some semblance of income. The only resources that they needed to find and produce small lots of ore were time, tools, and knowledge of local geology and mines. When unemployed people, primarily the local miners, returned to idle gold producers to scratch out a living, they formed a small cottage mining industry. Placer mining required less skill than hardrock mining, and because of this, the Central district saw a return to the gulches and valleys where the original Fifty Niners sluiced through gravel. Because these miners expected only to get by, their needs were very simple and several dollars' worth of ore or gold dust per day was sufficient.

The district's historic producers drew particular interest because they usually offered hidden pockets and chutes of ore, low-grade ore left in place as uneconomical by past operations, and similar material thrown out onto the waste rock dumps. Such mines were usually able to support at least several subsistence miners, and when there was enough ore, partnerships with capital attempted some level of formal production. Like most of Boulder County's gold-bearing districts, Central possessed a few historic producers that were capable of supporting company operations.

Harry M. Williamson operated the most significant operation during the first years of the Great Depression, and he settled in Jamestown prepared by several decades of mining and milling. Williamson held several mining ventures in Four Mile Canyon during the late 1890s that proved profitable. He leased the Great Britain Mine above Wallstreet and ran the Scottish-

[39] Colorado Mine Inspectors' Reports: Argo, Blue Jay, Emmitt.

Colorado Mill in Salina. In 1920, Williamson organized the Colorado United Mines Company, which leased a consolidation of four gold mines around Sunset and built an effective mill.[40]

What brought Williamson to Jamestown remains uncertain, although he applied his experience at a time when miners like him were important. In 1929, Williamson and Ralph Jarrett, who owned the Bueno Mine, formed a partnership to bring the property back into production. Jarrett provided the property and some materials, Williamson furnished his expertise, and they organized the Wano Mines & Power Corporation. During the next several years, Williamson employed a small crew of miners who inspected the underground workings in search of missed ore, and other workers who rehabilitated the Wano Mill. Fortunately, the mill retained its most vital equipment, including a hydropower dynamo and a high-volume air compressor. The work was slow in the climate of the Great Depression, and by 1932, Williamson began limited production, much to the accolades of Jamestown, which assumed that the Wano was exhausted.[41]

In 1933, when the depression was at its nadir, President Franklin Roosevelt launched a pilot program intended to simultaneously devalue the dollar while stimulating metals mining. The Federal Reserve took the dollar off the gold standard and bought gold at prices above the traditional $20.70 per ounce. When the program showed positive results by 1934, Roosevelt signed into law the Gold Reserve Act, which raised the minimum price of gold to $35 per ounce, and the Silver Purchase Act, which increased the value of silver from around $.40 to $.70 per ounce.[42]

In the Central district, these increases in value had the effect that Roosevelt intended, which was a small revival among both subsistence miners and companies with capital, who were likely to become employers. Further, the revival began as early as 1933, when the Federal Reserve bought gold above the traditional price. Between 1933 and 1936, miners prospected at least ten exploratory operations, and worked in seven small mines and two medium-sized operations.

None of the mining operations were grand, but they allowed investors and employees to earn needed income. Joe McAnely was among the first to respond to Roosevelt's programs, and he targeted the long-forgotten Smuggler Mine at Ballarat. In 1933, McAnely's Smuggler Mining Company rehabilitated the Smuggler Shaft and built a mill equipped with machinery of his own design. By 1934, with the confidence of high gold prices, McAnely employed a crew of ten miners who produced and concentrated an equal tonnage per day. The operation soured after several years, however. In 1936, the surface plant at the shaft burned, which proved costly, and the mill could not concentrate the material produced from depth. By 1938, McAnely turned the property over to subsistence miners.[43]

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[40] Anderson, 2005:51; Colorado Mine Inspectors' Reports: Colorado United Mines; *Colorado Mining Directory*, 1898:117.
[41] Colorado Mine Inspectors' Reports: Wano.
[42] McElvaine, 1993:164; Saxon, 1959:7, 8, 12, 14, 16.
[43] Colorado Mine Inspectors' Reports: Smuggler; *Mountaineer-Mineral Age* April, 1936:11; *Minerals Yearbook*, 1938:262.

J.H. Gates, S.R. McKelvey, Arthur Kimberling, and J.G. McKenzie also responded quickly to Roosevelt's 1933 gold price experiment. They owned the John Jay Mine at Camp Providence, pooled resources as Associated Metal Mines, Incorporated, then rehabilitated the main tunnel. In 1933, a crew of ten miners began production in the old stopes through the tunnel, and when Roosevelt signed the Gold Reserve Act into law in 1934, they felt confident enough to spend money unwatering the shaft. The partnership used some of the income to build a new mill in 1935, which only enhanced profitability through the rest of the decade.[44]

In Jamestown, Williamson expanded his operations at the Wano in response to the Gold Reserve Act. He employed a crew of ten who produced and milled ten tons per day. Once his miners developed at least one body of low-grade ore by 1938, Williamson then leased blocks of underground workings to more than twenty independent parties.[45]

In 1934, local mine owners L.J. Skinner, S.A. Madrid, and E.O. Kemptner formed the Jamestown Holding Company to bring the Mount Pleasant Mine into production. The mine was located one mile west of Jamestown and featured a short tunnel that saw minimal development. The investors hired a crew of seven miners who lengthened the tunnel then generated ten to twenty tons of ore per week for several years.[46]

While Associated Metals had its own mill at the John Jay and Williamson operated the Wano Mill, enough ore came out the Central district's mines to keep several other facilities open by 1936. H.S. Vickery bought one of the idle mills in Jamestown probably during the 1920s or early 1930s and treated custom ores. The Jamestown Holding Company was one of Vickery's best customers.[47]

As alluded to above, the Great Depression crushed fluorspar mining in the Central district. The price of the mineral dropped to a point where mining was unprofitable, and between this and competition from New Mexico, Jamestown miners generated only 40 to 80 tons of the mineral per year during most of the 1930s. In an attempt to revive manufacturing and to provide electricity at low cost, the Roosevelt Administration began a series of massive hydropower projects in the West. The Administration hoped that the inexpensive power would support a growing aluminum industry, which required electricity and chemicals for refining the metal. Two of those chemicals that came under demand were metallurgical- and acid fluorspar. The Jamestown mines still offered plenty of metallurgical fluorspar, and technological improvements permitted the concentration of this into acid fluorspar, which made the material even more attractive to aluminum manufacturers.

By the late 1930s, the price of and demand for fluorspar finally increased enough to rouse interest in the Jamestown area's former producers. Some of the investors who developed the mines during World War I were still around, and they moved to bring their idle properties back into production. J.H. Hardy, who was president of the early Climax Spar & Radium Company,

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[44] Colorado Mine Inspectors' Reports: John Jay.
[45] Colorado Mine Inspectors' Reports: Wano.
[46] Colorado Mine Inspectors' Reports: Mt. Pleasant.
[47] *Mountaineer-Mineral Age* April, 1936:11.

possessed most of his original properties, and he interested R.T. Bacher and Franck Becraft in opening them back up. These three Colorado investors organized the Boulder Fluorspar & Radium Company in 1936 or 1937 to assume the assets of Climax Spar, which included the Argo, Blue Jay, Emmitt, and Brown & Brown mines. By 1937, the company had small teams of miners at work readying the properties for leasing, and H.S. Vickery was already interested in working the Blue Jay. He then concentrated ore from the Blue Jay and other mines in his Vickery Mill.[48]

At the same time, Charles and R.M. Burger interested Andrew A. Zangara in a venture to reopen the long-idle Alice, Chancellor, and Yellow Girl mines, which they purchased and consolidated. Zangara, who was president of the St. Joe Mining & Milling Company (see Gold Hill district history) was able to supply some capital and the use of his Valmont Mill to concentrate the ore. The party organized the Crystal Fluorspar Company in 1937, rehabilitated the Alice Shaft, and began production.[49]

By 1940, Jamestown residents were pleased to see that fluorspar was back in demand. It was obvious to most that Roosevelt's programs resuscitated steel manufacturing and fostered the new aluminum industry, which consumed much of the fluorspar. What concerned some residents, however, was that much of the manufacturing was actually in support of Allied forces gathering for another world war.

Jamestown's fluorspar commanded the attention of several visionary people in 1940 who probably understood that the mineral would shortly be more important and hence profitable than ever. It may have been D.K. Jefferson who targeted the Jamestown area's fluorspar mines for examination on behalf of the General Chemical Corporation, based in New York City. Jefferson was manager and probably authorized the purchase of the Alice, Burlington, Chancellor, Yellow Girl, and several other mines from the Burgers in 1940. During the next year, General Chemical hired a large workforce, began production, and sent the ore to Zangara's Valmont Mill for concentration.[50]

Harry M. Williamson was also alert to the increasing demand for fluorspar and compared this with his waning gold operation at the Wano Mine. Deciding that there was a better future in fluorspar than low-grade gold ore, he and son Harry B. formed Harry M. Williamson & Son in 1940 and leased the entire Boulder Fluorspar & Radium Company collection of properties. The mines literally surrounded Jamestown. The Argo lay on the east side of Little James Creek and to the north of town, the Emmett was on the west side of the creek opposite the Argo, and the Blue Jay was located in McCorkle to the south of town. It remains unknown where Williamson concentrated the ore in 1940, although it was most likely in the Vickery Mill, which the Boulder Fluorspar company used up that time.[51]

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[48] Colorado Mine Inspectors' Reports: Blue Jay, Brown & Brown, Buckhorn, Emmitt.
[49] Colorado Mine Inspectors' Reports: Alice.
[50] Davis, 1941; Goddard, 1946:9; Jenkins, 1979:4.
[51] Colorado Mine Inspectors' Reports: Emmett; Davis, 1941; Goddard, 1946:9; Jenkins, 1979:4.

When the United States officially entered World War II in 1941, the Roosevelt administration began a mobilization campaign of unprecedented proportions that radically changed mining in the Central district. The manufacture of steel for armaments and aluminum primarily for aircraft caused the demand for fluorspar to reach record levels. At the same time, the War Production Board passed order L-208, which suspended gold mining by the end of 1942 because the Board felt that it was no longer a strategic priority. As a result, nearly all the gold mines in the Central district closed. The cautiously planned operations at the John Jay, the Mount Pleasant, and Harry Williamson's Wano, which were vital during the Great Depression, were forced out of business.

This interesting transition marks the end of the Central district's fifth Period of Significance. The Period began in 1929 when the Great Depression created economic conditions that were so poor, miners returned to old gold producers in hopes of eking out enough income for survival. Passage of the Gold Reserve and Silver Purchase acts in 1934, however, increased the prices of gold and silver enough to lure capitalized companies back to the Central district, where they reopened a number of mines. President Roosevelt's economic programs and European preparation for war ignited a renewed interest in fluorspar mining, as well. The fifth Period ended in 1942 when conditions created by World War II forced the Central district to undergo a major transition.

During the fifth Period, the Central district experienced several important trends. The first is that the Central district saw its most significant period of production of gold and silver since the late 1890s revival. This was particularly timely because without mining, most residents probably would have abandoned the district since they had no other source of income during the Great Depression. Second, the Central district's mines contributed to the economy of Boulder County both through the production of ore and the dissemination of capital that was spent on mining. Third, the companies employed a workforce that maintained a population in the Central district and reinforced the original cultural geography of the mountains. Fourth, some investors amassed capital through mining and milling that they reinvested in other ventures such as elements of infrastructure and mills, which furthered mining. Overall, the Central district's industry was an important and contributing element of a Depression-era revival that swept Boulder County and greater Colorado. Historic resources that currently retain integrity relative to the fifth Period may be important if associated with the above trends. The fifth Period applies to all forms of prospecting, mining, milling, and associated activities.

E 4.9.9: The World War II Fluorspar Boom, 1942 - 1945

When the nation formally entered World War II, the conditions created by the Roosevelt Administration, the minerals market, and the result of sixty years of mining pushed the Central district through a transition from gold and silver to fluorspar. The Central district was more than ready for the change and passed through the transition easily. The high price of and demand for fluorspar was a powerful incentive that drew miners out of the gold mines and into the fluorspar mines, and the migration was natural because after sixty years of mining, profitable grades of gold ore were becoming difficult to find. If these factors were not enough, the War Production Board's order L-208 forced the transition because it mandated that the mining companies close their gold mines.

One of the most important factors that lubricated the transition was the Central district's well-developed infrastructure for mining. At least four serviceable mills were located in Jamestown, many of the companies and partnerships possessed plenty of tools and equipment, a network of roads facilitated easy transportation to Boulder, and local individuals had both capital and intimate knowledge of the mines. Good fortune provided Jamestown miners with an opportunity to adapt their cultural and economic traditions to a modern type of ore. Most of the county's other gold mining districts were not so lucky.

The owners and operators of Jamestown's mines readily converted their shares of the infrastructure from gold to fluorspar in 1942. When order L-208 forced Harry Williamson to close his gold mining efforts at the Wano Mine, he immediately used the mill as a central station for what became a small fluorspar empire that included the Argo, Blue Jay, and Emmitt mines. Williamson refitted the mill to treat fluorspar ore and used the shop to maintain equipment brought from the mines. In addition, workers laid pipelines across the landscape from the powerful compressor at the Wano to the fluorspar properties to convey air for drilling. This was not an easy or inexpensive task and required formal engineering and construction. Williamson, who did business as Harry M. Williamson & Son, also accepted custom ore at the Wano Mill.[52]

Harry M. Williamson & Son was not the only entity to refit now-useless gold mills for fluorspar ore. General Chemical made an offer to Andrew Zangara for the Valmont Mill, which Zangara built in 1936 to process gold ore produced by his St. Joe Mining & Milling Company. Zangara organized St. Joe in 1932, and the company became the largest leaser of gold mines in the central portion of the county during the Great Depression. Without gold ore, however, the mill was merely idle capital, which is why Zangara sold it to General Chemical in 1942.[53]

A few companies in Jamestown had the benefit of using mills that were built specifically for fluorspar ore. Clark H. Clark leased the Nation's Treasure Mine and concentrated fluorspar at the Lehman Mill. Fluorspar apparently drew Clark to Jamestown from the Sugar Loaf district, where he leased several gold mines during the 1930s.[54]

The ready-made mining infrastructure at Jamestown allowed the companies there to generate high volumes of fluorspar with ease. Due in large part to the contributions of Jamestown's companies, Colorado attained the status of being one of the nation's most significant fluorspar producers by 1943, supplying 9 percent of the nation's total. For context, Illinois and Kentucky, which possessed the richest fluorspar deposits, furnished 47 and 26 percent of the nation's total, respectively. By 1945, Colorado's production rose to 14 percent of the nation's total, which was partially a function of improvements to the Jamestown mines and mills. Williamson continued to work the Emmitt, Argo, and Blue Jay mines as a disjointed but

[52] *Boulder Camera* 1/29/42, p6; Cobb, 1999:59; Colorado Mine Inspectors' Reports: Emmett, Wano.
[53] *Boulder Camera* 1/29/42, p6; Colorado Mine Inspectors' Reports: Alice, Misc. E.
[54] Cobb, 1999:54; Colorado Mine Inspectors' Reports: Bonanza.

coordinated operation, and he employed 35 miners and leased blocks of ground to 20 more. General Chemical operated the Alice, Burlington, Chancellor, Invincible, and Yellow Girl mines with a crew of 22 miners, and employed another 20 in the Valmont Mill. The Williamson and General Chemical operations combined with additional lessees generated around 36,000 tons of ore in 1943 alone, which was the highest volume of rock taken out of the ground in decades.[55]

During the mid-1940s, the boom at Jamestown was a function of the wartime demand for fluorspar, which is why the mining industry suddenly faced uncertainty when the war ended in 1945. The Central district was on the brink of another transition, which heralded an end to the district's sixth Period of Significance. The Period began in 1942 when a combination of political and economic factors forced the Central district to change from gold- to fluorspar mining. While the transition was smooth, it reshaped the district's social and industrial geography. Activity contracted from Camp Providence, Ballarat, and other portions of the district to a concentrated area immediately around Jamestown. The transition also allowed Jamestown to thrive at a time when many of Boulder County's other gold mining districts collapsed.

Figure E 4.9.4. In 1940, Harry M. Williamson & Son their small fluorspar empire when they leased the Blue Jay, Emmitt, and Argo mines and operated the properties together. The firm installed similar surface plants at all three mines, and the one at the Blue Jay is currently the best-preserved. Source: Author.

[55] *Boulder Camera* 1/29/42, p6; Colorado Mine Inspectors' Reports: Burlington; Davis, 1943, 1945.

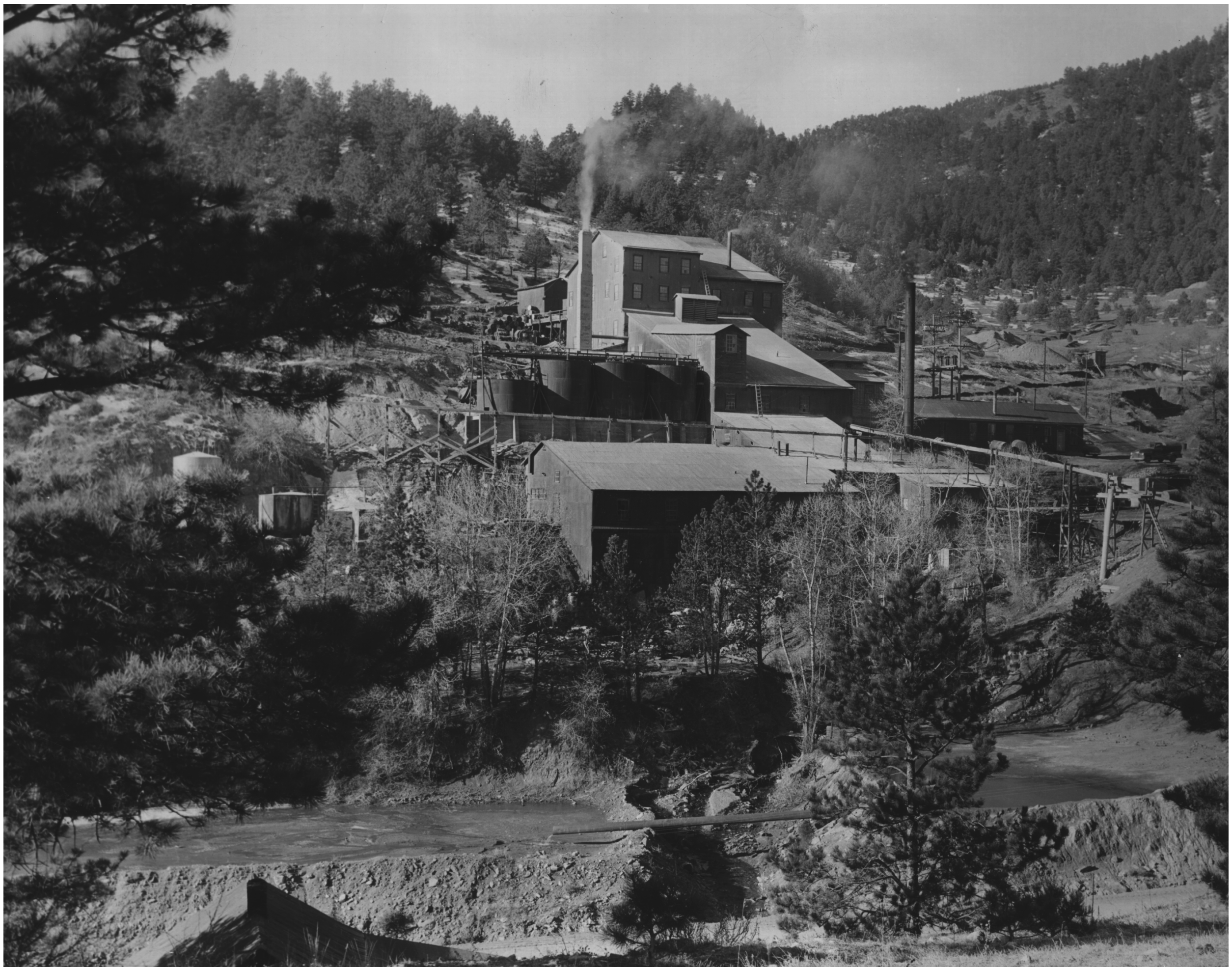

Figure E 4.9.5. The Wano Mill was the hub of Harry M. Williamson & Son's fluorspar empire. The mill featured a massive air compressor, an electric generator, and shop facilities that served the company's three mines. In 1942, when the Federal Government forced the suspension of gold mining, Williamson converted the mill to concentrate fluorspar ore. Williamson ran the mill through World War II, when this photograph was taken. Source: Boulder Carnegie Library, 219-9-12.

A number of trends on local, state-wide, and national levels developed during the sixth Period. Fluorspar mining was the driving engine behind the events and trends, and other forms of mining were not significant at this time. For this reason, only those historic resources that retain integrity relative to fluorspar prospecting, mining, milling, and other activities are likely to be important.

On a local level, mining at Jamestown made economic contributions to the county through ore production and by drawing capital. These contributions were timely because, except for in the Boulder Tungsten District, passage of order L-208 forced most of the county's mines to close. The capital was important because it was invested in the Jamestown area and disseminated to other portions of the county. Jamestown's mining companies contributed heavily to the maintenance of the social geography of the mountainous portion of the county by being major employers and by keeping the tradition of hardrock mining alive.

On a state-wide level, Colorado rose to the status of being one of the nation's important sources of fluorspar, mostly because of the heavy production from the Jamestown mines. This reinforced Colorado's existing reputation as a mineral treasure trove, and contributed to the state's political capital.

On a national level, the Jamestown mines contributed a significant volume of a raw material that was vital to the war effort. Fluorspar was a key ingredient for smelting steel, refining aluminum, and manufacturing other wartime goods. By 1945, Colorado supplied 14 percent of the nation's fluorspar, and Jamestown contributed a major share of this figure.

E 4.9.10: Mining during the Post-War Years, 1946 - 1955

Repeating the economic trend that developed after World War I, a manufacturing recession followed World War II when hostilities ended in 1945. The demand for fluorspar dropped off and, as a result, Colorado's production slumped by thirty percent. This naturally affected mining at Jamestown. With the fluorspar market uncertain, Williamson decided to divest himself of portions of his empire and curtail operations at those aspects he retained. In 1946, Williamson suspended work at the Blue Jay Mine and sold both Argo Mine and the Wano Mill to the Ozark-Mahoning Company, which was an important fluorspar producer in Illinois. General Chemical, by contrast, apparently ceased work in Jamestown all together, opting to focus its efforts at its mines in Poncha Springs and Deming, New Mexico.[56]

Unlike the depression that followed World War I, the recession after World War II was relatively brief and manufacturing quickly rebounded. While Colorado's production continued to decline to half of its wartime yield, Jamestown's principal companies, which were Williamson and General Chemical, resumed mining. During 1947, Williamson employed a full workforce at the Argo, Blue Jay, and Emmitt mines, and leased the Wano Mill from Ozark-Mahoning. General Chemical worked the Burlington and Alice at the same levels as during the war.[57]

The demand for fluorspar was so sound that both companies invested a considerable amount of capital developing their ore bodies. Williamson's miners sank the Argo and Blue Jay shafts, and General Chemical did likewise and improved the surface facilities. General Chemical also engineered an unusual practice for disposing of the thousands of tons of waste rock generated during production. Specifically, when the waste rock was brought to the surface, ore of economical grades was removed, then a worker bulldozed the waste into several small shafts that sent the material back underground. Miners then used draglines to scrape the waste rock back into the exhausted stopes from where it came.[58]

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[56] Colorado Mine Inspectors' Reports: Argo, Blue Jay, Burlington; Davis, 1946, 1948.
[57] Colorado Mine Inspectors' Reports: Argo, Burlington; Davis, 1947; Davis, 1948.
[58] Colorado Mine Inspectors' Reports: Burlington.

The rise of modern consumerism and arming for the Korean War in 1952 ensured a demand for fluorspar through the 1950s. In terms of production, Colorado's contribution of the mineral, much of which came from Jamestown, began to rise, and by 1953, Colorado finally surpassed Kentucky. Yet, at the same time, Jamestown's affair with the mineral permanently ebbed. Three principal factors were responsible. First, the costs of production steadily increased to the point where most grades of ore were uneconomical. Safety and environmental regulations, high wages, and the costs of finding new ore bodies placed a great burden on mining companies. Second, repeating an all-to-common pattern in Boulder County, the easily mined deposits neared exhaustion. Third, in response to the high price of domestic fluorspar, manufacturers turned to sources overseas where the costs of production were low.

In this climate, those companies that remained active around Jamestown after World War II began to curtail production. In 1954, Williamson closed both the Argo and the Blue Jay mines, and the handful of lessees also ceased work. This left Williamson's Emmitt and General Chemical's Burlington as the past principal mines to operate at Jamestown after 1955. Between 1945 and 1950, Jamestown featured six medium-sized operations and one large producer, and four of these closed by 1955. Because the mining industry was Jamestown's principal employer, people left when the mines closed. The town's population decreased from 190 in 1940 down to 118 by 1950 and continued to fall through the decade.[59]

With only three mines in production by 1955, mining as an industry no longer held the same importance for Jamestown that it once did. As a result, Jamestown's seventh Period of Significance came to an end. The Period began in 1946 when Jamestown's fluorspar industry faltered while waiting for industry to make post-war adjustments, then resumed production on a significant scale by 1947.

Several trends on local, state-wide, and national levels mark the seventh Period. Fluorspar mining was the driving engine behind the events and trends that were important during the Period, and other forms of mining were not significant at this time. For this reason, only those historic resources that retain integrity relative to fluorspar mining, milling, and other activities are likely to be important.

On a local level, mining at Jamestown made economic contributions to the county through ore production. This was timely because most of the county's gold mines failed to reopen after the war, leaving the Jamestown area and the Boulder Tungsten District as the county's principal centers of ore production. Jamestown's mining companies contributed heavily to the maintenance of the social geography of the mountainous portion of the county by being major employers and by keeping the tradition of hardrock mining alive.

On a state-wide level, Colorado rose to the status of being one of the nation's important sources of fluorspar, mostly because of the heavy production from the Jamestown mines. This reinforced Colorado's existing reputation as a mineral treasure trove, and contributed to the state's political capital.

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[59] Schulz, 1977:1940-9; Schulz, 1977:1950-8; the number of active mines was estimated from a survey of Colorado Mine Inspectors' Reports.

On a national level, the Jamestown mines contributed a significant volume of a raw material that was vital to arming for the Korean War. Fluorspar was a key ingredient for smelting steel, refining aluminum, and manufacturing other wartime goods. By 1952, Colorado was one of the nation's most important sources of fluorspar, and Jamestown contributed a major share of this figure.

E 4.9.11: An End to Mining, 1956 - 1973

Fluorspar mining continued to decline in the Jamestown area through the 1950s, despite passage of Public Law 733 in 1956, which empowered the Office of Defense Mobilization to acquire and stockpile metallurgical fluorspar as a strategic mineral. Foreign competition and the high costs of production were the principal culprits, but Williamson and General Chemical maintained production at their respective properties.[60]

At the same time, the Central district saw a new type of prospector arrive in search of an ore known to exist in the area since the 1900s. Specifically, prospectors empowered by federal incentives examined the district a new for uranium. That Springdale's mineralized waters carried radium had been proven by the 1900s, although the metal, in demand for its medical uses, was not found in commercial quantities. The Atomic Age prospectors of the 1950s understood that uranium and radium were usually associated with each other, and so they assumed that the Central district held a high potential for uranium. Further, the Federal Government provided special bonuses for the discovery of pitchblende ore, which was igneous in origin.

Between 1955 and 1963, Jamestown hosted a number of these prospectors who engaged in limited claim development. In 1955, the Black Hope Uranium Corporation sank a new shaft two miles north of Jamestown, and the following year, the Mountain States Uranium Corporation leased the Red Spruce Mine and explored for pitchblende uranium. At the same time, the La Salle Mining Company leased the Fair Day Mine, conducted minor exploration, then actually mined a small tonnage of ore between in 1960 and 1963. This was, however, the closest that Jamestown would come to seeing meaningful production.[61]

Meanwhile, General Chemical still operated the Burlington complex and generated around 3,600 tons of ore per month, which was the same amount that some of Boulder County's mining districts produced per year. As the 1950s progressed and miners exhausted the ore, General Chemical reduced operations until 1963, when it let go most of the miners. It was now obvious that the Burlington's days were numbered. However, during the year, General Chemical invested a considerable amount of capital in one last development effort and sank several winzes underground into new ore. This granted the company another ten years of significant production and allowed Jamestown to maintain its ambiance as a mining community. In 1973, General Chemical finally ran out of ore and closed the Burlington, which was the last mine of note in the Jamestown area.

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[60] McDougal and Roberts, 1956.
[61] Colorado Mine Inspectors' Reports: Black Hope No.1, Fair Day, Red Spruce.

E 4.10: The History of the Magnolia Mining District

E 4.10.1: Discovery and Boom, 1875 - 1885

When prospectors fanned out through Boulder County's hills in search of hardrock ore during the gold rush of the early 1860s, they almost certainly ascended southwest up Keystone Gulch and examined what became known as Magnolia Hill. Keystone Gulch drained into Boulder Creek's south side, opposite Bummers Gulch where placer miners were already at work. At the time, prospectors were attuned to free-gold ore and did not yet recognize telluride gold, which was the Magnolia area's principal type of payrock. Ironically, Clinton P. Tyler's workers graded the Boulder Valley & Central City Wagon Road Company nearly across Magnolia Hill in 1864, oblivious to the riches around them.

The history of mining in the Magnolia district began not on Magnolia Hill where veins of ore lay, but instead at Gold Hill in 1872. There, several miners were curious about highly mineralized rock that showed no gold but possessed some characteristics of metal ore. Assays confirmed the material to be telluride gold, which incited a wave of prospecting throughout the mountainous portion of the county (see Gold Hill Mining District for history). During the next several years, prospectors worked their way outward from Gold Hill, proving telluride gold as far north and Jamestown and as far south as Sugar Loaf.

Several parties of prospectors reasoned that if telluride gold could be found at Sugar Loaf, there was every reason to believe that the system of veins should continue into the hills south of Boulder Creek, opposite Sugar Loaf. It remains uncertain who initially ascended Magnolia Hill in search of riches, but C.A. Hammill was the first to find telluride gold, or any economic ore for that matter, which he claimed as the Downs Lode in 1875. A few days later, Hiram Fullen and partner made the second strike and claimed it as the Magnolia. When news of the finds wafted through the hills of the county, a number of prospectors immediately responded and established a camp in Keystone Gulch where water was available. At this time, they organized the Magnolia Mining District to govern the growing claim activity.[62]

During the working season of 1875, prospectors blanketed Magnolia Hill with a quiltwork of claims and made a quick succession of seemingly rich strikes. Almost from right underneath the grass roots, prospectors proved ore on a number of claims and developed them as the Ben C. Lowell, Keystone, Lady Franklin, Little Maud, Mountain Lion, Rebecca, and the Sac& Fox. Because Magnolia Hill tended to be dry, the prospectors-turned miners were able to work late into the fall, when winter finally forced most of them down for the season.[63]

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[62] Fossett, 1876:405; Fritz, 1933:174; Southworth, 1999:62; Wilkerson, 1939; Wolle, 1995:492.
[63] Bixby, 1880:432; *Colorado Mining Directory*, 1879:105, 112, 113; Fossett, 1879:89; Southworth, 1999:62; Wolle, 1995:492.

Magnolia joined the ranks of Boulder County's telluride boom camps during 1876, and prospectors worked side-by-side with mining companies engaged in formal claim development. In the beginning, all the mines were simple, labor-intensive affairs, but the production of ore from the shallow workings fueled claim speculation and drew the interest of investors. The evolution of the original prospectors' camp into a formal settlement lent legitimacy to growing importance of the mining district. During 1876, a few entrepreneurs established a mercantile and several service businesses, and residents expecting longevity secured a post office under the name of Magnolia. Visually, the settlement imparted anything but longevity. Most of the 300 inhabitants lived in log cabins and wall tents, while the businesses occupied a handful of frame buildings. Regardless, Magnolia attracted enough people to justify daily stage service.[64]

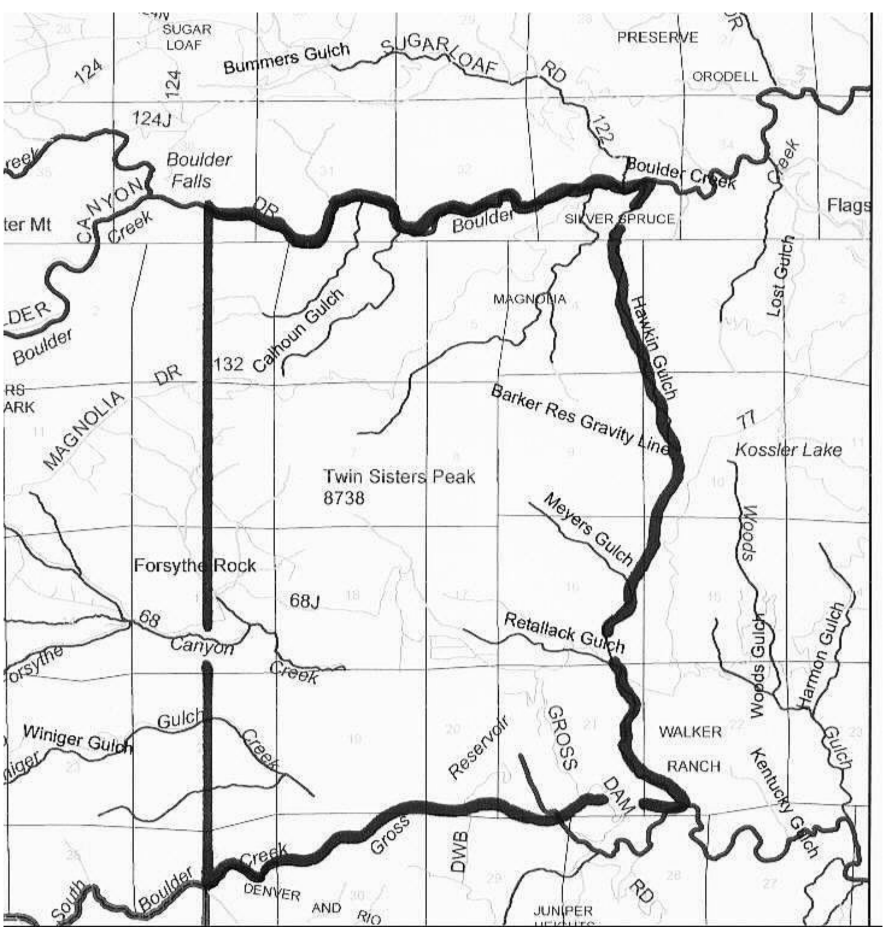

Figure E 4.10.1. The map illustrates the Magnolia Mining District, whose boundaries are approximate. The Sugar Loaf Mining District extends north. Base map provided by Boulder County Land Use Department.

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64 Bauer, et al, 1990:92; Fritz, 1933:173.

Figure E 4.10.2. The Magnolia Mining District was the scene of a frenetic rush during the late 1870s. This south view depicts the principal concentration of mines in 1876 or 1877, when they were in states of development. Many failed and were abandoned in primitive states. The town, which remained small, extends right and out of view. Source: Boulder Carnegie Library, 219-8-66.

By 1878, an actual mining industry began to emerge from the scattered prospects, and investors, mostly of limited means, acquired the most promising properties. In 1876, Jacob Carvell and William Hardenbrook organized the Keystone Mining Company to develop the Keystone, and within two years, a crew of at least ten miners sank the main shaft to a depth of 250 feet and produced ore from several other shallow shafts. Frederick Luce and Augustus Paddock owned the Mountain Lion, and their crew of at least ten more miners sank the shaft to the 200 foot-level. Henry C. Thompson, and William T. and Joseph Grout owned and worked the Rebecca. Charles G. Buckingham and C.A. Stuart bought the Magnolia, and they may have been the most noteworthy of the new investors (see Gold Hill Mining District history for Buckingham).[65]

Magnolia's mining industry continued production but it began to change during the early 1880s. The days of frenzied prospecting ended, and the number of deep prospects being developed decreased from at least 25 around 1876 to approximately 18 during the early 1880s. The number of mines, all of which were small in scale, decreased as well. During the height of

[65] *Colorado Mining Directory*, 1879:96, 101, 105, 112; Fossett, 1879:89-90.

the boom, partnerships had at least 10 properties in production, and by the early 1880s, organized companies worked around 6. What happened was that, over the course of around 8 years, the prospectors and miners revealed an alarming geological trend. In the Magnolia district, like the Gold Hill District whose ore veins were similar, most of what appeared to be veins were actually barren reefs and dykes of igneous rock, and nearly all the veins that carried ore were only several hundred feet long and as deep. Simply put, miners exhausted the ore in little time and were unable to find much more during underground exploration.[66]

During the early 1880s, most what had been perceived as the Magnolia district's most promising properties either were consolidated with neighboring properties or fell silent. The fringes of the district, however, had not been thoroughly developed and still offered potentially rich ore bodies. At least this probably what local mining investors W.L. Seely, Thomas N. Shanks, and Phil Lonergan thought when they organized the Seeley Mining Company in 1880 to develop the odd Kekionga Vein. Located around one mile southwest of Magnolia, geologists were able to trace Kekionga Vein for 6,000 linear feet, although only a portion featured ore. The Seeley company, or course, was interested in the vein's ore-bearing section and began work by 1881. The company realized some ore for its troubles over the course of several years, but like the Magnolia's other veins, the Kekionga's ore chutes proved to be limited, erratic, and worse, troublesome to mill. As a result, the operation ceased.[67]

The Magnolia district's first Period of Significance began with discovery of ore in 1875 and ended with the collapse of profitable mining around 1885. During the Period, the district experienced an energetic boom, the development of a profitable mining industry, the establishment of the permanent settlement of Magnolia, and ties to Boulder County's communication, commercial, and financial systems. The discovery and development of the Magnolia district contributed to the expansion of Boulder County's telluride mining movement and social geography. The wealth that miners produced contributed to the county's economy and the financial reserves of investors, some of whom put the money back into the county's mining industry.

E 4.10.2: The Quiet Years, 1885 - 1897

The Magnolia district was relatively quiet for a long period of time after the boom collapsed. A few outfits, however, thought that they could overcome the problems that led to the district's decline. One was to find continuations of Magnolia's ore veins, and the other was to somehow profit from the low-grade and complex material that the early companies left underground as unworkable. In terms of the former issue, a total of five small mines were in production at any given time between 1885 and 1893. In terms of the latter issue, local investors found that the low-grade as produced was uneconomical, but if they could concentrate it

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[66] Wilkerson, 1939; the number of active mines came from a survey of 1879 and 1883 *Colorado Mining Directories*.
[67] *Colorado Mining Directory*, 1883:75.

themselves instead of paying an independent mill to do so, the low-grade ore might pay. The principal obstacle that the investors underestimated, however, was the difficulty of treating the telluride payrock.

A man named Colonel Parker acquired the American and American Eagle mines after the boom ended and decided to invest in a concentration mill. During 1888, workers erected what was known as the Parker Mill on Boulder Creek at the mouth of Keystone Gulch. By 1889, the mill began to operate, and the lack of further mention in archival records suggests that the facility failed. At the same time, the partnership of Hartong & Company leased the Kekionga Mine and treated ore in the Wolf Mill at Magnolia. The operation was brief. During the early 1890s, J.A. Teagarden, who had considerable experience operating mines in the Sugar Loaf district, worked the Keystone Mine and thought that he could solve the concentration problem. In 1893, Teagarden built an experimental bromide leaching mill to treat the ore, and when this process failed, he converted the mill to chlorination, which worked with Gold Hill's telluride ores. The process was, unfortunately, only marginally successful with Keystone ore, so he closed the mill within several years.[68]

Despite the above failures, the handful of active mines maintained some semblance of life on and around Magnolia Hill during the early 1890s. In addition to working the Keystone and Kekionga mines, partnerships pulled ore from the Senator Hill, the Mountain Lion, and the Magnolia properties. It remains uncertain whether any businesses remained in the town of Magnolia, but a population of 79 people lived in the town and among the surrounding ranches. When the Silver Crash wrecked the mining industry and caused a nation-wide depression at the end of 1893, it seems likely that most of the remaining miners departed, leaving Magnolia on the brink of becoming a ghost town.[69]

E 4.10.3: The Late 1890s Mining Revival, 1897 – 1905

The great mining revival of the late 1890s brought relief for those individuals in the Magnolia district who persevered through hard times. A number of factors such as an overall economic recovery, available capital, and general optimism stimulated a revival that began to sweep Boulder County and the rest of Colorado by around 1897 (see Ward and Gold Hill mining district histories for full account). A keen interest in gold as a stable form of investment among mining capitalists also played a large role in the revival, which individuals in the Magnolia district experienced firsthand.

Between 1897 and 1900, the Magnolia district boomed with a level of energy no one had seen in the area in twenty years. Partnerships, small outfits, and investors with capital all worked side-by-side rehabilitating old mines, conducting a little underground exploration, and beginning new projects of substance. During this time, various outfits brought ore out of around 15 small

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[68] *Boulder Camera* 12/18/93; *Boulder County Herald* 12/5/88; *Boulder County Herald* 7/10/89; *Boulder County Herald* 5/1/89; Cobb, 1999:102.
[69] *Boulder News* 12/21/93; Schulz, 1977:1890-2.

mines and 2 medium-sized operations, and Magnolia's population more than doubled from past numbers to 183 people. It seems likely that a few businessmen opened their doors in town to supply such a population with the necessities of life.[70]

Companies brought most of the formerly rich producers back into production, such as the Rebecca, Magnolia, American, and Washington (formerly Downs Lode) mines. The Senator Hill was one of the largest operations with 1,500 feet of workings and Pickwick was second with a 400 foot-deep shaft. Charles Davis, an important local investor (see Gold Hill Mining District), expressed his confidence in the boom by acquiring the Mountain Lion, and hardware magnate Robert Seaman purchased the Keystone and Kekionga. These two properties became the foundation for one of the district's significant but ill-fated projects. In 1899, Seaman spent a staggering $100,000 on the Nellie Bly Mill, which was supposed to treat from the mines. The metallurgist incorporated the equipment from Teagarden's Keystone chlorination mill, possibly not realizing that if the process failed once, it might fail again. Within several years, it was painfully obvious that the Nellie Bly Mill did not recover as much gold as expected and was closed.[71]

Some investors and speculators assumed that Magnolia's first boom went bust because only the high-grade ore pinched out several hundred feet in depth, and that plenty of low-grade ore continued downward. Further, the occurrence of the high-grade material could resume below the zones that mining companies penetrated up that time. Given this, several companies began deep haulageways from the south bank of Boulder Creek to undercut portions of the district. While such projects were costly, investors eagerly furnished capital for the Sylvanite, Marchionesse, Graphic, and other tunnels.

The late 1890s boom continued into the early 1900s, and Magnolia residents welcomed more investors and their companies. A few more mines were active between 1900 and 1905 than during the past several years, and the climate was so positive that prospectors began combing the hills again for veins missed in the past. During this time, the district boasted of at least ten deep prospect operations, which approached the exploration efforts of the original boom.[72]

The Buckeye Mining & Milling Company employed a crew of fifteen in the Buckeye, the Lady Franklin Mining Company operated the Lady Franklin with a crew of seven, and M.A. Russell worked the American Mine. The Ben C. Lowell offered great potential because the original company never sank the shaft beyond 100 feet. The Bimetallic Gold Mining & Milling Company, under W.H. Hirshfield, employed eight miners in the Ben C. Lowell. Miners also brought ore out of the Kekionga, Mountain Lion, and other properties. A firm developed the Cash Mine into a substantial producer and constructed a mill equipped with a roasting furnace to oxidize the telluride ore, which was successful. The preponderance of companies that lacked

[70] Schulz, 1977:1900-4; the number of active mines was estimated from a survey of the 1898 *Colorado Mining Directory* and other archival sources.
[71] Cobb, 1999:102; *Colorado Mining Directory*, 1898:115.
[72] The number of active mines was estimated from a survey of the 1902 *Colorado Mining Directory* and other archival sources.

their own mills shipped their ore by wagon to concentration facilities in Boulder and the Gold Hill district, or directly to the smelters in Denver.[73]

By around 1905, Magnolia's second boom ended, bringing the district's second Period of Significance to a close. The reasons were similar to the problems that caused the first boom to collapse around twenty years earlier. Miners simply exhausted most of the profitable ore, even though it was lower grade than the material extracted in the past. Underground exploration confirmed that most of the telluride veins were, in fact, shallow and limited. A few veins, however, showed signs of promise, and some low-grade ore remained, but it was not particularly attractive. Some of the investors who profited during the late 1890s revival must been satisfied, but many lost small fortunes.

The Magnolia district's second Period of Significance began in 1897, and at this time, the district saw more mining, investment, and development than during the original boom. While production figures remain uncertain, it seems likely that mining companies generated a greater tonnage of ore, although not necessarily ounces of gold, during the Period than at any other time. During the Period, the district also enjoyed the installation of more mining and milling equipment than in the past. Overall, the district's mines contributed to Boulder County's wealth, social geography, and the funds of capitalists, some of whom reinvested the money back into industry. The district's mines also drew investment that in turn disseminated into the local economy.

E 4.10.4: The Decline of Mining, 1905 - 1933

Nearly all of the Magnolia district's companies and partnerships suspended work during the latter half of the 1900s and the region reverted to ranchland. Between 1915 and 1920, only a handful of companies secreted out small ore chutes in the formerly productive mines. The Ophir Syndicate's lease on the Senator Hill Mine may have been the largest operation during the 1910s, and it only lasted several years. Without a viable population in town, the Postal Service revoked Magnolia's post office in 1920, forcing local ranchers to travel for their mail.[74]

The 1920s were no different in the Magnolia district than the previous decade. Between 1920 and 1925, prospectors knocked around on four claims and partnerships eked out an income from as many small mines. In general, miners produced less than 1,000 tons of crude ore per year. The Kekionga was the most substantial operation but, like the district's other mines, it was short-lived. In 1923, C.R. Slusser & Company employed a crew of eight, which focused on tungsten ore and produced a little telluride gold as a byproduct. Most of the mine's workings were caved in, and instead of investing in rehabilitation, Slusser suspended work after a year. The Acme Gold Mining Company ran the other noteworthy operation, which lasted only a year longer. The company rehabilitated then produced a small volume of ore from the Acme Tunnel,

[73] Cobb, 1999:104; *Colorado Mining Directory*, 1902:2, 4, 5, 6, 15, 16, 17, 20, 21, 26.
[74] Bauer, et al, 1990:92; Colorado Mine Inspectors' Reports: Senator Hill.

which was one of the haulageways driven from the south side of Boulder Creek during the late 1890s boom.[75]

In 1929, the economic ravages of the Great Depression settled down onto Boulder County. The failures of banks, personal estates, and companies had a devastating effect and hundreds of individuals were thrown out of work. The county's mining industry, which had been in decline since the early 1920s, was hit particularly hard. Many mines closed because they lacked the funds necessary to pay their operating costs. In their place rose what was tantamount to a small cottage mining industry in which unemployed people, primarily miners, returned to idle gold producers to garner a subsistence-level income. Because these miners expected only to get by, their needs were very simple and several dollars' worth of ore per day was sufficient.

This movement was most noticeable between 1929 and 1933 in the county's formerly most productive districts. Magnolia drew a handful of subsistence miners who prospected approximately five properties and generated small batches of ore in as many small mines. Magnolia's historic producers interested several partnerships that had enough capital to at least attempt production. In 1932, the H. & H. Ore & Metals Company began rehabbing the Kekionga in hopes of gleaning any gold ore than remained. The work was slow, dangerous, and expensive because, as noted above, most of the horizontal workings caved in and the shaft was in poor condition. Unable to bear the cost after a year, H. & H. turned the property over to another lessee. At the same time, Elmer Hetzer acquired the Cash Mine and began repairing the shaft. The Cash may have been one of Hetzer's first independent operations. He went on to acquire a number of other mines in the county and ultimately assembled a small tungsten empire during the late 1940s.[76]

E 4.10.5: Mining During the Great Depression, 1933 - 1942

In 1933, President Franklin Roosevelt launched a pilot program intended to simultaneously devalue the dollar while stimulating metals mining. As part of the plan, the dollar was taken off the gold standard and the Federal Reserve bought gold at inflated prices. Satisfied with the test by 1934, Roosevelt signed into law the Gold Reserve Act, which raised the minimum price of gold from around $20.67 to $35 per ounce. This increase in value stimulated a small revival in the Magnolia district that drew, in addition to the subsistence miners, companies by the small amounts capital typical of the Great Depression. None of the mining operations were grand, but they allowed investors and employees to earn needed income.

As can be expected, partnerships and companies returned to the former producers where they were most likely to find low-grade ore left by past operators. In 1935, Carl Egle & Associates unwatered then rehabilitated the Ben C. Lowell shaft and produced ore until 1939.

[75] Colorado Mine Inspectors' Reports: Acme, Kekeonga; the number of active mines was estimated from a survey of Colorado Mine Inspectors' Reports.
[76] Colorado Mine Inspectors' Reports: Cash, Kekeonga; the number of active mines was estimated from a survey of Colorado Mine Inspectors' Reports.

The firm consisted of Carl Egle and Arthur Sorey, who were well-versed with historic producers throughout the region. Hetzer worked the Cash at times and leased it at others between 1933 and 1942. In 1933, R.O. Smith purchased the Kekionga, took advantage of the H. & H. rehabilitation efforts, and employed a small crew through 1939. George Jump reopened the Lady Franklin in 1936 and kept seven miners busy for several years. Jump may have been one of the most experienced lessees in the district. He worked in the tungsten mines during the 1920s, leased a number of mines during the Great Depression, and resumed tungsten mining during the 1940s while also serving as president of the Boulder County Metal Mining Association. In 1936, Clifford Staley reopened the Keystone, built a small mill, and treated both crude ore and material recovered from the waste rock dump.[77]

In total, a population of around fifty people lived in Magnolia and at the surrounding ranches, and miners worked in ten small operations. Production increased from a paltry 425 tons of crude ore in 1932 to as much as 5,100 tons by 1935, then fluctuated between 1,800 and 2,800 during the rest of the decade. For context, one miner produced around one ton of ore per day, or around 300 per year.[78]

In 1941, the nation's entry into World War II set in motion a series of events that deeply impacted what little mining continued in the Magnolia district. Under President Roosevelt, the Federal Government initiated a series of programs to organize and administer to economic, material, and labor resources as part of the war mobilization effort. With domestic mineral and metal resources suddenly of supreme importance, the government naturally passed several pieces of legislation that emphasized mining. War Production Board Ruling L-208 was among the legislation and, much to the dismay of Depression-era miners throughout Boulder County, it mandated the immediate suspension of gold mining by the end of 1942 on the grounds that gold was not of strategic importance. Reliant on gold ore, all the mines in the Magnolia district closed, which brought to an end to anything more than occasional exploration efforts.

War Production Board Ruling L-208 ushered in the Magnolia district's third and last Period of Significance. The Period began in 1929 when subsistence miners gleaned ore on a small scale and ended when the Federal Government suspended gold mining. During the Period, the Magnolia district saw its most significant period of production since the late 1890s revival. This was particularly timely because without mining, Magnolia's few residents probably would have abandoned the district since no other source of income existed. In addition, the district's mines contributed to the economy of Boulder County at a time when money was dear, they maintained a workforce and aspects of the original social geography in the mountains, and helped some investors amass capital that they reinvested in other ventures. Overall, the district's industry was an important and contributing element of a Depression-era revival that swept Boulder County and greater Colorado.

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[77] Colorado Mine Inspectors' Reports: Ben C. Lowell, Cash, Kekeonga, Keystone, Lady Franklin; *Mountaineer-Mineral Age* April, 1936:11.

[78] Schulz, 1977:1940-9; the number of active mines was estimated from a survey of Colorado Mine Inspectors' Reports, and the production figures came from a survey of *Mineral Resources of the United States.*

E 4.11: The History of the Boulder Tungsten District

E 4.11.2: Discovery and Development, 1900 - 1915

As early as the 1870s, the prospectors who searched the hills around Nederland and in the Sugar Loaf Mining District encountered a heavy black mineral that they could not identify. The material appeared to be some sort of ore, but assays proved that it was largely void of gold and silver. The mineral certainly was ore, but like the telluride gold that occurred around Gold Hill, assayers neglected to run the material through full batteries of tests. As a result, prospectors discounted the mineral as “barren silver”, “black iron”, and magnetite.

During the first decade of the twentieth century, three seemingly isolated events came together to make the “barren silver” the focus of one of Colorado’s last major rushes. Archival sources differ as to exactly who first realized that the “barren silver” was actual high-grade wolframite, which was a tungsten compound. Some sources indicate that John H. Knight, a metallurgist by trade, had an assayer test samples of the ore during the late 1890s. Repeating the events that led to the realization of telluride gold at Gold Hill, Knight encountered the ore in a shallow shaft on his Connotton claim near Nederland and was curious about its exact mineral content. Unlike telluride gold, tungsten was more of a novelty than an economic ore because industry had few uses for the metal at the time. One of the reasons for the lack of demand was that tungsten was so rare, few industrialists had enough of the metal for extensive experimentation. European steel manufacturers, primarily the Krupps in Germany, were the closest to rendering the metal truly meaningful by developing a means of using it as an alloy material. Knight understood that tungsten was uncommon and would become important at some point in the future, so he sent specimens to the president of the Colorado School of Mines and displayed the same at the Paris Universal Exposition in 1900. Widespread interest failed to develop, although Hugo Krupp, who had made the most progress wit the metal, approached Knight and came to an agreement for small batches of ore. Knight then began minor production in the Nederland area and sent the crude ore to Germany for treatment.[79]

Other archival sources, including tungsten pioneer William Loach, claimed that Samuel Conger was the first to identify the “barren silver” as tungsten ore. Around the same time when Knight could have been advertising his tungsten ore, Conger, one of the discoverers of silver at Caribou, was prospecting in Oregon and encountered more “barren silver.” Conger had samples assayed out of curiosity and the assayer informed him that the mineral was wolframite. While Conger was in Oregon, Samuel Wannamaker, another Nederland area pioneer, found similar samples of wolframite while prospecting in Arizona. Coincidentally, Conger and Wannamaker met in Denver during their return to Colorado and related their tungsten finds while discussing their adventures. Both men remembered encountering similar minerals north of Nederland while prospecting in Boulder County, so they returned to a claim owned by a prospector named Towner, collected samples, and distributed them among five different assayers in Boulder and

[79] Boulder County Metal Miners' Association, 1910:43; Fritz, 1933:182, 218; Kemp, 1960:120; Loach, 1924:1.

Denver. As soon as two of the assayers reported tungsten, Conger and Wannamaker leased the claim, named the shaft after Conger, and began extracting ore. By this time, Conger and Wannamaker included T.S. Waltemeyer as a partner, and they shipped small batches of ore to the State Ore Sampling Company in Denver, which apparently acted as broker for European interests.[80]

In all likelihood, Knight and Conger came to similar conclusions around the same time and drew attention to the presence of tungsten ore through their promotion and production. Slightly behind the Germans, American and British steel makers developed tungsten-based steel alloys around 1900, and Pennsylvania's Firth Sterling Steel Company and the Primos Chemical Company needed sources of the metal for manufacturing. Both companies learned of the Boulder County discoveries around the same time and made moves to find and secure economical tungsten deposits.

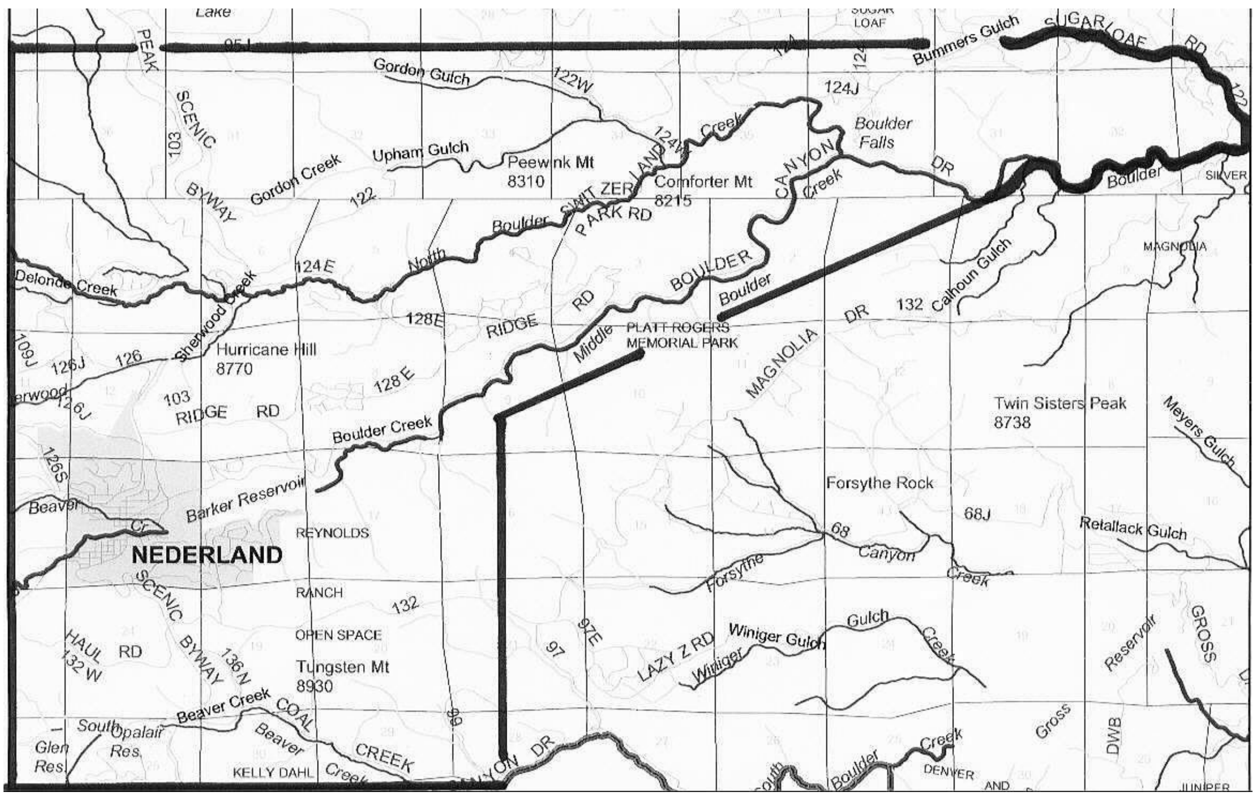

Figure E 4.11.1. The Boulder Tungsten District, illustrated above, was not a formal mining district and instead was a term applied to several concentrations of tungsten ore deposits. The boundaries are approximate, and the entity above is actually superimposed over portions of the Grand Island and Sugar Loaf mining districts. Base map provided by Boulder County Land Use Department.

[80] Fritz, 1933:220; George, 1909:181; Kemp, 1960:121; Warne and Everett, 1953:2.

The Primos Chemical Company may have been the first major interest to make a presence in the county, and the company secured the services of Morris J. Jones in 1900. Jones organized the Great Western Exploration & Reduction Company, found sources of ore in the western reaches of the Sugar Loaf district, and, in 1900, began to build one of America's first tungsten concentration mills in Gordon Gulch. Firth, slightly behind Primos, dispatched its head chemist and metallurgist N.G. McKenna in search of a source of ore in 1901. McKenna examined a vein on the Copeland property on South Boulder Creek and found it rich enough to warrant development. He then dispatched William Loach to serve as Firth's director of field operations, and Loach immediately purchased the Copeland property at a substantial price.[81]

A nascent tungsten mining industry began to take form in Boulder County during the early 1900s and it was driven primarily by the interest that Primos, Firth Sterling, and several other organizations expressed. At first, the industry grew softly and gradually not only because the market for the metal was new and limited, but also there was no precedent for ore extraction and treatment. Any progress made along these lines came about from experimentation, calculation, and trial and error in Boulder County. In terms of the nascent state of the tungsten industry, one mining statistician observed:

> "Although tungsten minerals have been known for a long time, as also the value of this metal for making alloys, it is only within the last few years that there has been any considerable demand for it."[82]

By 1903, three principal tungsten organizations began a noticeable output in the county. Morris J. Jones continued to develop several claims in the western portion of the Sugar Loaf district and completed his concentration mill in Gordon Gulch near the confluence with Upham Gulch. At the same time, McKenna and William Loach organized the Scrooby Mining Company to develop the Copeland property, and Robert M. Bell, a Mr. Barnsdall, and Chauncy F. Lake took over the best property to date, which was Samuel Conger's Conger Mine. When the lease on the Conger came available in 1903, Bell and Lake acquired it for $5,000. Like Conger and Wannamaker, Bell and Lake sent the ore to the Cardinal Mill for concentration. As early as 1900, Conger and Wannamaker sent their payrock to the Cardinal, which was known at the time as the Midget Mill after its operator, the Midget Mining & Milling Company. Through this transaction, Conger and Wannamaker met Chauncy Lake, who managed the mill and was curious enough about tungsten to try and work the ore. Amazingly, Lake and Bell pioneered an effective concentration process in an extremely short time, even though they had few if any examples to follow. With the Conger and Cardinal combination going very well, Lake and Bell targeted other properties for acquisition.[83]

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[81] Fritz, 1933:222-223; Kemp, 1960:122; Loach, 1924:1; *Mineral Resources of the United States*, 1901:262; Tomblin, 1912:1.
[82] *Mineral Resources of the United States*, 1901:261.
[83] *Boulder County Miner* 12/11/03; Fritz, 1933:221, 224; Kemp, 1960:121-122; Loach, 1924:2; Tomblin, 1912:1.

The elements necessary to incite a tungsten boom were gathering in Boulder County during the early 1900s, and only several additional events were necessary to bring the boom to fruition. One of the events developed when the Copeland Mine failed to yield ore in the quantity and quality that Loach hoped for. Now in competition against Primos to secure the best ore veins, Loach had to pay dearly for the Charley, Clyde, Cold Spring, Denver, Illinois, Last Chance, and Oregon claims, which were quite rich. These were disbursed throughout a band that extended southwest from Upham Gulch to Hurricane Hill, located northwest of Nederland. Loach realized that the ore from these properties would have to be concentrated prior to shipment to the steel mills in Pennsylvania, and he came to the same conclusion as Chauncy Lake and Morris Jones that no metallurgical precedent existed. Any effective processes would have to be determined from experimentation, trial, and error, and to achieve this, Loach leased the Black Swan Mill, between Salina and Crisman, as a pilot plant. In 1904, he refitted the gold mill with new crushers, jigs, and vibrating tables, and made a number of runs over the course of several months. When Loach felt confident that he identified an effective concentration process, he and McKenna organized the Wolf Tongue Mining Company, named from a contraction of the words wolframite and tungsten. The company was a subsidiary of Firth Sterling, which furnished enough capital to buy the idle Caribou Mill at Nederland and renovate it for tungsten.[84]

By 1905, the milling successes, the acquisitions of mines, and an overall interest in tungsten finally attracted other industrial organizations and investors to Boulder County. The Nederland area was more than ready because it possessed an infrastructure that was capable of facilitating the discovery and production of ore. Prospectors who were intimate with the area were at hand, property owners were more than willing to lease or sell their tungsten-bearing lands, a workforce of miners was scattered throughout the area, and there were mills, roads, and the Colorado & Northwestern Railroad at Cardinal. These factors made it easy for tungsten investors to establish themselves, and they began a race to acquire the best properties. Their efforts would have failed were it not for the small army of professional prospectors who tried to remember where they saw the deposits of "barren silver." Boulder County was the only location in the United States where this was happening, as one statistician observed: "At the present time there is but one district in the United States that is being developed as a business proposition and on a large scale, and that is Boulder County, Colo, district..."[85]

Between 1905 and 1906, the Nederland area experienced a small boom led by Primos, Wolf Tongue, and Lake and Barnsdall, all of whom had a head start on the arriving competition. Primos took advantage of its financial superiority and acquired some of the most promising properties. In 1905, Primos purchased Morris Jones' Great Western company and reorganized it as the Stein & Boericke Mining & Milling Company with additional capital to buy more ground than the firm already owned. The following year, Primos made an offer to Lake and Barnsdall that they could not refuse for their Conger Mine, and when they accepted, Primos retained Lake as manager of operations.[86]

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[84] Cobb, 1999:72, 131; Fritz, 1933:224; Kemp, 1960:122; Loach, 1924:4-5; Tomblin, 1912:2.
[85] *Mineral Resources of the United States*, 1905:410.
[86] Fritz, 1933:222; Kemp, 1960:124; Loach, 1924:6; Tomblin, 1912:2.

Loach made a very clever move in 1905 that increased the volume of ore that flowed into the Caribou Mill, now known as the Wolf Tongue facility, while not costing his company anything. Specifically, he began buying ore from independent miners, who made their own arrangements to lease those properties that they could secure. In so doing, Loach established one of the most lasting systems of contracting and production for the county's tungsten industry. In 1906, Loach also acquired the 160 acre Trevarton Ranch centered around Gordon Gulch for $12,000, and paid an additional $20,000 for George Collins' separate mineral rights on the ranch.[87]

Between 1905 and 1906, at least four new firms with capital entered the field and encouraged prospectors to intensify their search for ore. In 1905, investors organized the Colorado Tungsten Corporation, purchased the Crow Patent land tract, then bought and refitted the Boyd Smelter to treat tungsten. The company divided its concentrates between Wolf Tongue and Primos. The Eagle Rock Reduction Company gladly embraced tungsten as an economic ore. Investors organized the company around 1900 and built the Cochran Mill in Boulder Canyon at the mouth of Black Tiger Gulch. The patented Cochran Process failed on the Sugar Loaf district's gold ore, so the company switched to tungsten in 1905. Phillip Bauer & Company arrived from Germany in 1906 and bought the Rogers Tract, on which rich tungsten had only recently been discovered. The company then began building the Clarasdorf Mill in Rogers Park on Middle Boulder Creek. When prospectors Gus Carlburg and Alfonse Ardourel traced tungsten veins to the Beaver Creek area south of Nederland, Pennsylvania investors backed them in the Tungsten Mining, Milling & Exploration Company. They developed the Tungsten and Sunday mines on Beaver Creek. By this time, at least four mills treated wolframite ore.[88]

By the end of 1905, prospectors and miners clearly saw that the tungsten industry held great potential and was generating notable profits, which encouraged them to expand their search for ore. In 1905, Boulder County's companies generated 642 tons of concentrates valued at a stimulating $231,120. At this time, the concentrates fetched $6.00 per unit, which was a quantity of measure specific to the tungsten industry. Whereas the gold and silver mining industry measured its production in terms of ounces of metal per ton of ore, and copper and lead was measured in pounds, tungsten was measured by the unit. One unit was defined as twenty pounds of concentrates of ore that consisted of at least sixty percent metal content, and one ton was equal to sixty units.

In terms of economics, one ounce of tungsten fetched approximately $0.04 per ounce in 1906 while silver was valued at around $0.60 per ounce and gold was valued at $20.70 per ounce. It seems curious that mining companies complained about the low price of silver at this time but had little issue with the even lower value of tungsten. Wealth could only be realized from tungsten by producing ore in economies of scale, which was the domain of capitalized mining companies. It seems that the economics of tungsten fostered the development of three categories of operations in the county. Prospectors and other individuals profited by locating and speculating on potential wolframite deposits. Partnerships and small companies were able to

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[87] Kemp, 1960:123; Loach, 1924:7, 10
[88] *Boulder Camera* 12/8/04; *Boulder News* 8/17/05; Cobb, 1999:96, 111; Loach, 1924:6-7; Tomblin, 1912:2-3.

realize limited income from small mines provided that both the ore was very rich and they kept their operating costs low. Large, capitalized companies, on the other hand, had the resources to produce ore in economies of scale. They operated groups of mines, employed mechanization, and hired substantial workforces to increase production. The economic geology of Boulder County's tungsten deposits assured roles for all of the above groups. Most of the wolframite veins were relatively shallow and short in length, and they were scattered. Hence, surface prospecting was necessary to locate veins that cropped out on ground-surface and underground exploration, usually conducted by organized prospecting ventures, had the capacity to strike additional veins. Shallow, isolated veins were best mined by small companies while large groups of veins were best worked by the substantial mining companies.[89]

In 1905 and 1906, prospectors spread out in all directions from Nederland in search of tungsten veins, and through their efforts, the industry began to recognize the geographic distribution of the economical ore bodies. Prospectors and mining companies found that, after much examination, the wolframite veins occurred in a belt extending northeast from Sherwood Flat through Hurricane Hill to Sugar Loaf. A concentration of very rich veins lay to the south of Nederland around Tungsten Hill, and another extended easterly along Boulder Creek. While portions of these areas overlay older mining districts, the entire tungsten-bearing region came to be known as the Boulder Tungsten District. The tungsten bearing region was never actually organized as a formal mining district because the original entities already existed.

The price of tungsten concentrates climbed during 1906 beyond $6.00 per unit, and the growing number of mining companies realized a record $309,600 for the year. This sparked a wave of prospectors, investors, and companies to take the Boulder Tungsten District seriously. During 1907, at least seven new companies were organized, acquired wolframite claims, and began production. The Crucible Steel Company of America, known as Crusca, had significant capital, and Pennsylvania investors organized the Lehigh Tungsten Mining & Milling Company. Other firms included Crescent Wolfram Estates, the Lincoln Mining, Milling & Improvement Company, the Redemption Mines Company, the Tungsten Mines Company, and Chauncy Lake's Cardinal Company. A mining camp developed around the Primos Mine, which was center to Stein & Boericke's Gordon Gulch operation, and the Postal Service recognized it as Primos in 1907.[90]

A year passed before the national recession of 1907 caught up with the tungsten industry. The value of tungsten concentrates fell from a height of $14 pr unit down to around $4.50, which destroyed those companies built on high prices and speculation. Impatient wealth-seekers lost confidence in the new metal and sold their interests, which the large companies with visions of the future quickly absorbed. Ultimately, the deadwood was removed and the industry was placed on a realistic foundation, at least for a while.[91]

The Colorado Tungsten Corporation was among the 1908 casualties, and it sold its assets and closed the Boyd Smelter. Philip Bauer & Company was another casualty, and it stopped

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[89] George, 1909:182; George, 1916:85; Fritz, 1933:227; Tomblin, 1912:1.
[90] Bauer, et al, 1990:116; George, 1909:216; *Mineral Resources of the United States*, 1907:712.
[91] *Mineral Resources of the United States*, 1908:721.

mining the Rogers Tract and closed the Clarasdorf Mill. Manager Eugene Stevens gained control over the company, purchased the assets, and prepared to resume operations. Chauncy Lake and Barnsdall merged their Cardinal Company with Stein & Boericke then immediately sold out to the Primos Chemical Company. The directors named the new subsidiary the Primos Mining & Milling Company and hired Lake as manager. It was probably Lake who ordered the Great Western Mill in Gordon Gulch dismantled in favor of his Cardinal Mill, which then became Primos' principal concentration facility. After the merger, Primos owned the Conger Mine, held 1,867 acres, and purchased additional claims from the defunct Colorado Tungsten Corporation. The Wolf Tongue company purchased a number of claims, as well.[92]

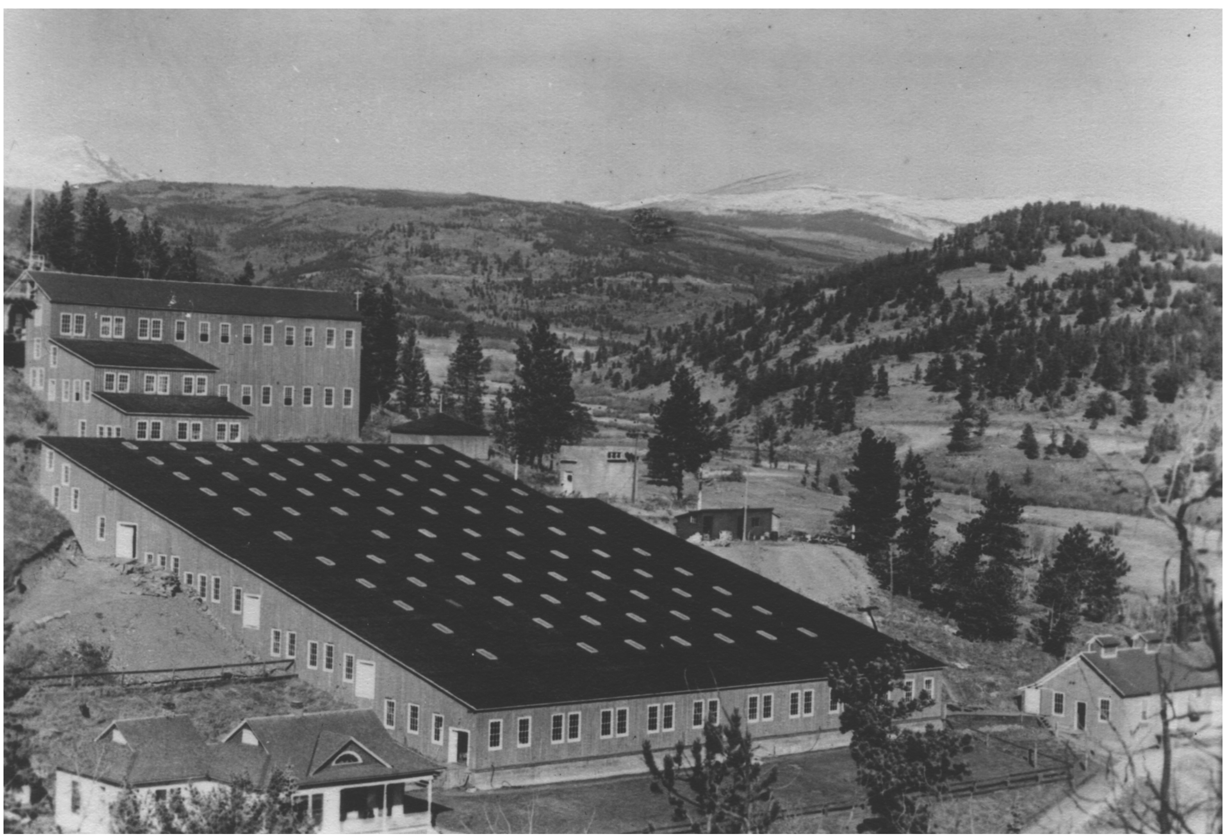

Figure E 4.11.2. The Primos Mill, also known as the Lakewood Mill, was the world's largest and most advanced tungsten concentration facility from 1910 through around 1918. At the mill, Primos metallurgists helped to establish precedent for understanding and treating tungsten ores. The town of Lakewood, which was not a quiet place, surrounded the mill's base. The view is northwest, and today, the Peak to Peak Highway passes by the foundations. Source: Boulder Carnegie Library, 219-7-14.

[92] Boulder County Metal Miners' Association, 1910:54; Cobb, 1999:119; George, 1909:182; Kemp, 1960:124; *Mineral Resources of the United States*, 1908:722; *Mineral Resources of the United States*, 1909:578; Tomblin, 1912:3, 4; *Tungsten, Printed Materials.*

The tungsten industry returned to high times in 1909 and produced a record amount of concentrates valued at $614,370, even though the price of tungsten rebounded only to approximately $6.50 per unit. The Primos and Wolf Tongue companies continued to employ their economies-of-scale strategies, which created some impressive improvements. Wolf Tongue generated wonderfully rich ore in the Hoosier, Oregon, Cold Spring, Bonanza, Last Chance, Clyde, Illinois, Cross, Western Star, and around twenty other small mines, and took in ore from lessees in 1909 and 1910. At the same time, Primos commissioned the world's largest tungsten mill on the south side of North Boulder Creek (on the west side of Peak to Peak highway). The Primos Mill, also known as the Lakewood facility in honor of manager Chauncy Lake, was massive and concentrated ore in a number of steps that achieved a high efficiency. A primary crusher broke cobbles into gravel and a battery of ten stamps pulverized the material into sand and slurry. The fine material went directly to banks of vibrating tables, settling tanks, and vanners for concentration. The course sand was ground to slurry in a rod mill then went on to the concentration process.[93]

When Primos started the mill in 1910, the company made the same mistake of trying to import inexpensive Chinese labor as the Mining Company Nederland did in 1875. Fearing competition for jobs, Whites rebelled and physically confronted the Chinese, and the company narrowly averted disaster by sending the Chinese back to Gilpin County. To house the mill workers and the miners employed at the nearby mines, Primos built the company town of Lakewood on North Boulder Creek by the mill. The town was relatively small, and a population of less than seventy workers and their families patronized a mercantile and a pool hall for their daily needs, and relied on a school and a movie theater as cultural moors. Mrs. Pettiford ran a boardinghouse for the workers that included a row of eight small cabins that she named the Blackbirds.[94]

The Primos and Wolf Tongue companies were not the only entities to expand during the buoyant conditions of 1909. In 1910, Carlburg and Ardourel built the Tungsten Mill on Beaver Creek to process ore from their Tungsten and Sunday Mines, and the Tungsten Mines Company of Denver built the Mammoth Mill a short distance down the valley. P.M. Osborne, H.H. Mund, and W.L. Tanner organized the company in 1909 to develop the Mammoth Mine and adjoining claims. Eugene Stevens began the organized development of the Rogers Tract in 1909. He divided the 160 acre plot into claims No.1 to No.16 in an upper group, and No.1 to No.8 on a lower group, then leased them out to independent partnerships. In 1910, investors organized the Eureka Tungsten Mining & Milling Company, purchased a number of claims, and equipped a mill at the mouth of Boulder Canyon. To the west of Nederland, on Coon Track Creek, the Alton Mining & Milling Company revised its interest in gold and silver in favor of tungsten. During the late 1890s, the company drove a long tunnel to develop what the directors thought was a gold and silver ore vein, then suspended operations. When prospectors proved tungsten ore on Sherwood Flat, the company resumed driving the tunnel to undercut the Minnie Foy,

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[93] Boulder County Metal Miners' Association, 1910:61; Cobb, 1999:123; Fritz, 1933:222; Kemp, 1960:124; *Mineral Resources of the United States*, 1910:735; *Mining Science* 8/25/10, p172; Tomblin, 1912:3.
[94] Boulder County Metal Miners' Association, 1910:53; *Vertical Files: Lakewood.*

Little Johnnie, and Junior claims on the landform. With full confidence in the operation, the directors began building a mill in 1910.[95]

By the late 1900s, the boom had a profound effect on the southwest quarter of Boulder County. Between 1905 and 1910, partnerships and companies brought an impressive 55 small mines into production, developed 11 significant operations, and ran at least four concentration mills. This came at a fortuitous time because gold and silver mining in the surrounding districts collapsed, which threatened to plunge the entire area into depression. Instead of dissipating, Nederland experienced a small population explosion. Nederland's population tripled from 182 in 1900 to 443 in 1910, with an additional 1,062 miners and their families taking up residence in the surrounding area.[96]

As the decade of the 1910s opened, however, several events cast a cloud over the growing boom. The most important was that Boulder County's tungsten industry lost its status as the most productive source of tungsten in the world. In 1911, mines in India, developed by British interests, assumed the title, and inexpensive labor in the country made the cost of production low. This competition threw the tungsten market into uncertainty as buyers assessed the new source of the metal, which caused Boulder County's production to decline from 1,221 tons of concentrates in 1910 to 730 tons in 1911. To make matters worse for Nederland, the business district burned in 1911.[97]

In spite of the temporary troubles, the price of tungsten concentrates changed little and the demand remained sound. In this climate, several groups of investors decided to join the other companies in the county. The Colorado Tungsten Mines Company was either a new venture with a recycled name or a reorganization of the original firm established several years ago. In either case, the company acquired a group of claims on Peewink Mountain and along North Boulder Creek near its confluence with Upham Gulch in 1911, and built a mill in Carrie Nation Park (Switzerland Park) the following year.[98]

John G. Clark organized the second venture, which became one of Boulder County's most important mining companies. Clark was born in 1871 on a farm in Fremont County, Iowa, and left to explore the West when old enough. Clark settled down with an uncle in Omaha during his early twenties, married Helen A. Hern, and whisked her off to Gunnison, where they married in 1894. The couple moved to Chicago, Clark found a position on the police force, and Helen died in 1898. Now rootless, Clark decided to return to Colorado, so he rode a freight train into Boulder and arrived with only $.30 to his name. Wishing to return to mining, Clark hiked up to Nederland in search of work and was immediately offered a position on the nightshift at the Boulder County Tunnel. During the 1900s, Clark spent time prospecting for gold and worked as superintendent of the Blue Bird Mine when he needed to replenish his coffers. In 1911, Clark

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[95] Boulder County Metal Miners' Association, 1910:56, 57, 58, 61; *Mineral Resources of the United States*, 1910:735; Tomblin, 1912:4.

[96] Schulz, 1977:1900-4; Schulz, 1977:1910-9; Smith, 1981:134; the number of active mines was estimated from surveys of various archival sources.

[97] Kemp, 1960:117; *Mineral Resources of the United States*, 1911:942.

[98] *Boulder County Miner* 2/22/12; *Boulder County Miner* 5/29/12; *Mineral Resources of the United States*, 1912:989; Tomblin, 1912:5; *Wolf Tongue Mining Company Records.*

helped organize the Boulder Tungsten Production Company to develop an extensive tract of claims on the east side of Hurricane Hill. In 1912, the company directors provided Clark with enough funding so he could acquire some of the claims, and he leased others.[99]

Between 1912 and 1914, the county's tungsten companies increased their production, which gave miners reason for optimism. They still generated approximately sixty percent of the tungsten mined in the United States, but companies in California were approaching fast. Primos concentrated more ore than ever, and in 1912, the Postal Service officially recognized its town of Lakewood with a post office. Activity at the settlement of Primos, however, was winding down, and when workers moved on to the company's other mines, the Postal Service revoked the post office there in 1913.[100]

When Archduke Ferdinand was assassinated in 1914, political alliances polarized Europe and set the stage for a tungsten boom that rivaled any mineral rush that Boulder County experienced up to that time. On the brink of a major change, the Boulder Tungsten District's first Period of Significance came to an end. The Period began in 1900 with the discovery of tungsten ore followed by some of the first commercial mining in the world. During the next ten years, a boom gained momentum and the industry puzzled out the problems of prospecting, mining, the acquisition of ore, and the concentration of ore.

During the first Period, Boulder County's tungsten industry resulted in several trends important on local, statewide, and national levels. On a local level, tungsten mining was important to the southwest portion of the county because it maintained communities and lifestyles that were threatened when the booms at Caribou and then Eldora came to end. During the 1900s, the population of Nederland tripled instead of declining, and tungsten mining granted the Nederland area a sense of victory over the forces that were deconstructing the surround mining districts. As in the past, miners and their families continued to dominate the demography of the Nederland area.

On a county-wide level, the production of tungsten had an inverse relationship with the production of gold and silver in other mining districts. While the production increased in the Boulder Tungsten District during the 1900s, it fell dramatically in the gold and silver districts, and the income generated by the tungsten industry partially offset the lost revenue from the decline of gold and silver mining. In addition, tungsten drew the capital of investors into the southwest portion of the county at the same time that they were losing interest in the county's gold and silver mines. The capital and the profits from the mines then made their ways into the county's economy.

Also on a county-wide level, the tungsten industry drew the county into the mining spotlight because, until 1911, the county was the most productive source for tungsten in the world. While the county lost its title in 1911, it remained the most important source of tungsten in the United States until California surpassed the county in 1915. Various effects of this trend

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[99] *Boulder Tungsten Production Company Stock Prospectus*; Clark, John G., printed materials; Fritz, 1933:228; Tomblin, 1912:5.
[100] Bauer, et al, 1990:85.

include increased investor confidence and awareness regarding the county's mines, interest among geologists, and a greater likelihood of drawing capital to the county.

The county's tungsten industry made a number of important contributions on a national level. Until 1911, the county supplied most of the world's tungsten, and afterward, the county continued to be a major source of the metal. Steel companies used the county's tungsten as the very material for developing hardened steel alloys. These in turn revolutionized manufacturing equipment, durable goods, and armaments. Because Boulder County was the first location where tungsten was mined on a commercial level, the county's industry set precedents for prospecting, understanding the economic geology of tungsten, producing ore, and concentrating the payrock into an economic commodity. Companies and organizations elsewhere then adapted the methods and technologies to exploit other tungsten deposits. Historic tungsten mining resources that retain integrity relative to the first Period may be important through an association with the above trends.

E 4.11.2: The World War I Tungsten Boom, 1915 - 1919

The outbreak of World War I in 1914 was the final event that caused the tungsten boom to swell into one of Colorado's last major rushes. Manufacturing industries in Europe mobilized to meet a heavy wartime demand, and as the war progressed and devastated Europe's ability to produce goods, governments there turned to American manufacturers for their needs. The war required a variety of steel goods, from guns to armor to machinery, on an unprecedented scale both in the United States and abroad. As a result, tungsten came under heavy demand and the price rose from $7.00 per unit to around $9.00 in 1915.

John G. Clark was one of the first major tungsten investors to respond to the upward trend by planning a project to increase production from the southeast side of Hurricane Hill. With financing from his Boulder Tungsten Production Company, Clark purchased a tract of land along Middle Boulder Creek below Barker Dam in 1915 and began driving a lengthy haulageway known as the Clark Tunnel northwest underneath his claims. Workers then constructed the Clark Mill at the tunnel for the sum of $30,000. The plan was to mine several veins from the bottom up, haul the ore out the tunnel, and concentrate it in the mill. The valley floor already featured the settlement of Stevens Camp, named after Eugene Stevens, and Clark's workers contributed a few tents and frame buildings to the camp. It seems likely that the miners who worked for Eugene Stevens established Stevens Camp well before Clark began driving his tunnel.[101]

Within a matter of several months, Stevens Camp exploded with activity, as did the rest of the Boulder Tungsten District. The reason was because the value of tungsten concentrates skyrocketed to $66.00 per unit at the beginning of 1916 and gave every indication of continuing to climb. At such prices, tungsten as a metal fetched almost as much money per ounce as silver,

[101] Colorado Mine Inspectors' Reports: Boulder Tungsten Production Co.; *Vertical Files: Tungsten*; Wolle, 1991:496.

and prospectors and miners knew that the Boulder Tungsten District offered plenty of veins with very rich ore. At the same time, mining elsewhere in the county was declining, leaving a surplus of miners who were hungry for jobs.[102]

Figure E 4.11.3. The tiny settlement of Steven's Camp mushroomed into the town of Tungsten in 1915. The town was both a center for prospectors and several profitable mining outfits, including John G. Clark's Boulder Tungsten Production Company. In this northern view taken around 1918, the Clark Tunnel's waste rock dump dominates photo-left, the Clark Mill stands at center, the business district is at right, and a second mill was under construction at far right. Source: Boulder Carnegie Library, Tungsten file.

Nederland, which was the commercial and cultural center of the district, hosted a frenzy that rivaled the past rushes of its neighbors Caribou and Eldora. The population of Nederland mushroomed from around 400 people during the early 1910s to 3,000 in 1916, and the increase was so sudden that the businesses and the existing infrastructure were completely overwhelmed.[103] William Loach, manager of the Wolf Tongue company, remembered the boom in Nederland during an interview with the *Boulder Camera*. "It was said, at the time, that there approximately 3,000 people getting their mail at the Nederland post office. The surrounding mountains, near the mining operations, were covered with tents and one-room shacks."[104]

People kept arriving through 1916. They joined the rush for its adventure and opportunity, they came as families in search of jobs, and some wanted nothing more than to capture a share of the money that flowed through the district. Like many of Colorado's early rushes, entrepreneurs realized that they could make more money mining the miners than prospecting for tungsten, and so they established a number of businesses. A saloon was probably worth more than many of the tungsten mines, and a number of saloons operated in Nederland regardless of the county government's attempts at licensing and regulation. William Loach recalled in his *Boulder Camera* interview: "There were four or five saloons in Nederland, where

[102] *Mineral Resources of the United States*, 1916:790.
[103] *Mineral Resources of the United States*, 1916:790.
[104] *Boulder Camera* 5/31/49, p5.

they had gambling devices in the back rooms, and these seldom closed their doors."[105] Individuals also established businesses that facilitated mining transactions and catered to everyday life. In addition to the usual mercantiles, butchers, bakeries, and cobblers, Nederland offered a bank, a telegraph, and a telephone exchange. The *Tungsten Light* newspaper carried the latest news, and several movie theaters offered entertainment for those individuals who did not drink.[106]

Unlike the Eldora boom, the tungsten industry justified the frenzy with measurable development, investment, and best of all, production. The district's companies generated almost 1,000 tons of concentrates in 1915, which more than doubled during the following year. Since the district had been subject to ten years of prospecting and the existing companies already owned most of the proven ground, the rush probably resulted in few new finds of bonanza proportions. Prospectors and mining companies did, however, discover plenty of minor veins, and their activities may have eclipsed the telluride gold boom in the Gold Hill district and the silver rush at Caribou. Between 1915 and 1919, prospectors were at work in more than fifteen deep exploratory operations. Partnerships and companies extracted ore from an impressive seventy small mines, twenty medium-sized operations, and five large producers. A total of fifteen mills of various sizes treated ore throughout the district.[107]

Primos and Wolf Tongue retained title as the county's two greatest producers, with John G. Clark a close third. In 1916 and 1917, Wolf Tongue employed as many as 150 workers at its richest mines, which included the Clyde, the Cold Springs, the Cross, and the Western Star properties. Wolf Tongue built a central plant at the Western Star that included shop facilities and a compressor that distributed compressed air to the surrounding mines. The Cold Springs property may have been Wolf Tongue's most important operation, which its state of development reflected. Miners worked several veins through the Cold Springs Shaft, the Old Shaft, the New Shaft, and the Firth Shaft. The shop, hoist room, and change room were at the Cold Springs Shaft, a compressor and shaft house were located at the Old Shaft, and the other shafts also featured hoisting systems. Wolf Tongue leased all its lesser properties such as the Bonanza, Carlburg, Daisy, Gale, Kicker, and Orange Blossom to as many as 200 different parties.[108] The total production was so great that, according to William Loach: "The Wolf Tongue Mill was operated 24 hours per day all during World War I, and the only holidays which were allowed were the Fourth of July, Thanksgiving and Christmas and then only one day for each holiday."[109]

John G. Clark's Boulder Tungsten Production Company kept its mill busy around the clock. Clark organized a number of his own ventures in 1916 to speculate with claims and to attempt production on some properties. The Degge & Clark Tungsten Milling & Mining

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[105] *Boulder Camera* 5/31/49, p5.
[106] Kemp, 1960:125; Smith, 1981:134.
[107] The number of active mines was determined from a survey of Colorado Mine Inspectors' Reports.
[108] Colorado Mine Inspectors' Reports: Cold Springs, Wolf Tongue Mining Co.
[109] *Boulder Camera* 5/31/49, p5.

Company, the Tungsten Mountain Mines Company, and the Big Thompson Mining & Milling Company were among his ventures. Like Nederland, the crush of boom participants completely overwhelmed Stevens Camp, which now filled the valley along Middle Boulder Creek. The population grew to 500 residents during 1916, and additional individuals lived in nearby Rogers Park where the Clarasdorf Mill operated. Due to the high number of people, Clark and someone else requested different post offices in 1916. The Postal Service recognized the settlement around the Clark Tunnel and the Clark Mill as the appropriately named Tungsten, and gave the adjacent hamlet the equally appropriate title of Ferberite, which was a form of tungsten ore. The residents of both towns supported the usual businesses such as stores, a bank, places of amusement, and a school. Workers and visiting guests stayed in several hotels and boardinghouses, one of which Clark operated for his employees, and W.J. Hardy ran the bank, Ted Green ran one of the stores, and Mrs. Hines ran another store. As was common for the time and place, some of the buildings were frame and many residences were no more than wall tents.[110]

Investors besides Clark organized a number of new ventures in hopes of profiting from the boom. In 1916, Dwight S. Young and Frank E. Wire organized the Denver-Boulder Tungsten Production & Development Company, which bought a collection of claims, sank a shallow shaft, and built a tiny mill consisting of a crusher and a jig. The Mojave-Boulder Tungsten Mining Company purchased the Good Friday Mine, employed a crew of forty, and leased blocks of ground to independent miners. Kay C. Hunt and G.W. Nicholas established the Allgrove Mining & Milling Company, rehabilitated the Alton Tunnel and Mill, and attempted production. A group of Pennsylvania capitalists organized the Tungsten Metals Corporation and specialized in properties that were on the east margin of the district. The company purchased the Dorothy Mine, located in Millionaire Gulch, and the Red Signe Mine on Boulder Creek. Both properties were well-developed, mechanized, and featured small concentration mills, and George Teal served as manager. William W. Cowdery began a long affair with tungsten when he organized the Long Chance Mining Company and leased both the Tungsten Mine and the mill.[111]

The McKenna brothers, who were some of the tungsten industry's founding fathers, established one of the industry's most significant companies during the boom. In 1916, NG., A.G., and J.A. McKenna obtained Pennsylvania capital for the Vanadium Alloy Steel Corporation, also known as Vasco. The McKennas saw great potential not only in tungsten, but also other alloy materials including vanadium, molybdenum, and carbon, and produced all the above. The McKennas naturally focused on tungsten in Boulder County and exercised their financial muscles to either purchase or lease a significant portion of the Rogers Tract. The McKennas then renamed the various blocks of ground Vasco No.1 through Vasco No.16 in imitation of Stevens' system. To treat the ore, Vasco purchased the refitted Boyd Smelter and built a second mill nearby. It appears that there was enough of the Rogers Tract to go around.

[110] Bauer, et al, 1990:53, 143; *Mineral Resources of the United States*, 1916:790; *Vertical Files: Tungsten.*
[111] Colorado Mine Inspectors' Reports: Allgrove Mining & Milling Co., Denver-Boulder Tungsten Production & Development Co., Dorothy, Good Friday, Red Signe, Tungsten, Tungsten Mines Co.

The property was an agricultural patent with mineral rights, and the Rogers brothers and Eugene Stevens retained the Rogers Mine and sent ore to the Clarasdorf Mill.[112]

W.F. Bleecker and William Crosley organized the last significant outfit in 1918 and purchased some of the available claims in the area. Their Tungsten Products Company acquired several small mines including the Lucky Two near Boulder Falls, the Stranaham Group near Stevens Camp, and a third in the general area. The company then purchased several mills in Boulder. Either the company had to accept custom orders to pay for the facilities or bought the mills merely for show to inspire investor confidence in the firm. Concerned about the tungsten boom's impacts to the scenic wonders of Boulder Falls, Charles G. Buckingham, a Boulder capitalist, donated the natural resource to the city of Boulder for protection.[113]

Competition for tungsten-bearing land was stiff, and Primos and Wolf Tongue used their capital to acquire some of the last available tracts, and then only at great cost. Primos expanded its empire the most in 1918, and already possessed a vast acreage of land and the Lakewood Mill, which was still the world's largest tungsten concentration facility. Primos owned the Lakewood Group with 1,234 acres, the Copeland Property with 324 acres, the Bummer Gulch Group in the Sugar Loaf district, the Double Header Group with 43 acres, the Gordon Gulch Group with 180 acres, and the Sovereign People Claims for a total of 1,867 acres. Some of Boulder County's bets tungsten mines were located on these tracts, including the Bedick, Conger, Great Western, Lone Tree, Ophir, Primos, and Quaker.[114]

In 1918, several factors brought the county's tungsten industry from great heights back down to reality. The first swept through the county like wildfire in the fall and caused panic in the streets. Almost overnight, people throughout the tungsten district came down with the dreaded Spanish influenza, and Nederland reported more than 150 life-threatening cases and 55 deaths. People shut themselves up in their houses, schools closed, workers left the mines, and public spaces were used as sick wards. A deathly silence hung over the district, and ore production slowed to a trickle. [115]

At the same time, the declaration of Armistice in 1918 brought a long-awaited end to the ravages of World War I, and with it, the manufacture of weapons. Steel makers forecasted a slowdown in the demand for tungsten alloys and decided to dump their stored surpluses of tungsten onto the market. Then, the very conditions that gave rise to Boulder County's frenetic tungsten industry became its undoing. During the war, the demand for and value of tungsten was so high that steel makers dispatched their experts abroad to search of more deposits, and they found them in China where the cost of labor was almost nothing. There was simply no way that American alloy suppliers were able to compete with the high volumes and low prices of tungsten

[112] Colorado Mine Inspectors' Reports: Boulder Tungsten Production Co., Vasco.
[113] Colorado Mine Inspectors' Reports: Tungsten Products Co.; Wolle, 1991:497.
[114] Colorado Mine Inspectors' Reports: Conger.
[115] *Boulder Camera* 5/31/49, p5; Kemp, 1960:128.

coming from China. The sum of factors had a synergistic effect that caused the price of tungsten concentrates to plummet within a month from around $60.00 down to $12.00 per unit.[116]

Boulder County's companies, investments, mining and milling operations, and even settlements were built upon a foundation of high prices, and as the prices toppled, so did the county's tungsten mining industry. Production fell from 1,910 tons of concentrates at the end of 1918 to almost nothing. The Vanadium Corporation of American, known as VCA, used the tungsten bust to acquire a considerable amount of holdings. VCA was a financial giant that produced and refined a variety of alloy materials throughout Colorado and in Peru. Instead of building an empire from the ground up, VCA purchased tungsten and vanadium outfits beleaguered by the end of the war, including the Primos Mining & Milling Company in 1919. In control of Primos, VCA suspended its Boulder County operations and closed the giant Lakewood Mill, and the town of Lakewood literally disappeared. The Postal Service canceled the post office in 1920 and VCA sold the Lakewood Mill and town to L.W. Wells, who completely dismantled everything. Uncertain about the future, John G. Clark's Boulder Tungsten Production Company and the McKennas' Vasco merged in 1919 or 1920 and formed the Tungsten Production Company. By 1919, investors lost small fortunes, hundreds of workers were laid off, many people were financially ruined, and one-half of the district's people left.[117]

The immediate collapse of tungsten mining in 1919 brought an end to the Boulder Tungsten District's second Period of Significance. The Period, which began in 1915, saw the district become involved with trends important on local, state, and national levels. Historic resources that retain integrity relative to the second Period of Significance, and can be attributed to tungsten prospecting, mining, milling, and its general manifestations, may be important through an association with the trends of tungsten mining. Only tungsten mining, and its related trends, was important during the second Period of Significance, and gold and silver mining in the area was unimportant because of a lack of production and a failure to make an impact during the 1910s. Given this, most gold and silver mining resources that were active in the district during the second Period will most likely be insignificant.

On a local level, the tungsten industry drew capital to the southwest portion of the county and was the driving force behind the continuation of mining in the area. This came at a time when, due to the exhaustion of gold and silver ores, the area was already in decline. The tungsten industry also became a foundation for the Nederland area's mining culture and the principal employer there when few other types of jobs existed. On a slightly broader level, tungsten mining contributed to Boulder County's economy through production and the dissemination of the capital invested in the Boulder Tungsten District. In addition, tungsten miners joined those in the Jamestown area in helping to diversify the county's mining industry into industrial minerals and away from gold and silver, which were exhausted by the 1910s. In so doing, both districts prevented the county from losing a viable mining industry. Further the

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116 *Boulder Camera* 5/31/49, p5; Fritz, 1933:231; *Mineral Resources of the United States*, 1919:721.
117 Bauer, et al, 1990:85; *Boulder Camera* 5/19/39; Cobb, 1999:124; Fritz, 1933:222.

tungsten mines developed during the 1910s provided a foundation for later mining, which proved to be an important source of income when most other types of ore were uneconomical.

At the statewide level, the high prices of tungsten combined with a relative rarity of the metal created one of Colorado's last major mineral rushes. The tungsten boom was a statewide phenomenon that drew a variety of people, investors, speculators, and companies to Boulder County, and the event was similar to the early and wild mining booms on Colorado's frontier.

While the Boulder Tungsten District lost its title as the nation's most productive tungsten source by 1915, it was still very important. In this capacity, the district contributed to Colorado's reputation as a mineralogical treasure trove and an important center of mining. In addition, the district's production contributed to Colorado's economy, especially on the Front Range, both through the income realized from the ore and through the disbursement of investments.

On a broad scale, the tungsten mines provided the steel industry with the raw materials necessary for the weaponry used to win World War I. In addition, the tungsten boom was a national phenomenon that helped to draw out-of-state investment and nationally important mining companies such as the Vanadium Corporation of America to Colorado. Once in the state, these companies spread their operations to many counties and had a major economic impact.

E 4.11.3: The Quiet Years, 1919 - 1929

John G. Clark and William Loach were among the few individuals who were experienced enough with mining not to balance their finances on high metals prices. For the first ten years of operations, Loach kept the Wolf Tongue company profitable when tungsten concentrates fetched $7.00 per unit, and these prices changed little when Clark began in 1911. However, even these two adept managers could not sustain production when the value of concentrates continued to fall to a rock bottom $3.50 per unit in 1920.[118]

Then, to the relief of Loach, Clark, and the unemployed miners, the value of tungsten concentrates rebounded to $10.00 per unit. Mining could resume at this price, but only high-grade ore would pay, and Clark and Loach would have to give close consideration to the efficiency of their mills. Clark and Loach employed small crews of miners in their best properties and leased out the others to independent parties who were glad for the opportunity to work.[119]

Clark's Tungsten Production Company leased the Vasco Group (formerly Rogers Group) and carried out the strategy of mining the veins from the bottom up and hauling the ore out the 1,900 foot long tunnel to the mill. By 1925, Clark employed forty miners underground and eleven workers in the mill, and they produced ore in the economies of scale necessary for profitability. The mill recovered tungsten at every step. A jaw crusher reduced the crude ore to gravel and three sets of crushing rolls ground it to sand and slurry in stages. Screens classified

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[118] Colorado Mine Inspectors' Reports: Vasco Group; *Mineral Resources of the United States*, 1920:411.
[119] *Boulder Camera* 5/31/49, p5; *Mineral Resources of the United States*, 1929:98.

the crushed particles by size, and oversized material returned for pulverization while the fines proceeded on for concentration. Jigs and hydraulic classifiers removed some waste, and the metalliferous material went on to vibrating tables and a spiral classifier. After the metalliferous material was removed, the tailings were ground in a ball mill then subjected to additional concentration machinery.[120]

Wolf Tongue leased out most of its small mines such as the Kicker, Illinois, Last Chance, and Madeline, but operated the Cold Springs itself. There, the company employed around 15 miners. Several parties of lessees worked some of VCA's claims, and E.K. Henderson and W.J. McKenzie leased the Mammoth Mine and treated ore in the mill. Both Henderson and McKenzie would go on to work other tungsten mines in later years.[121]

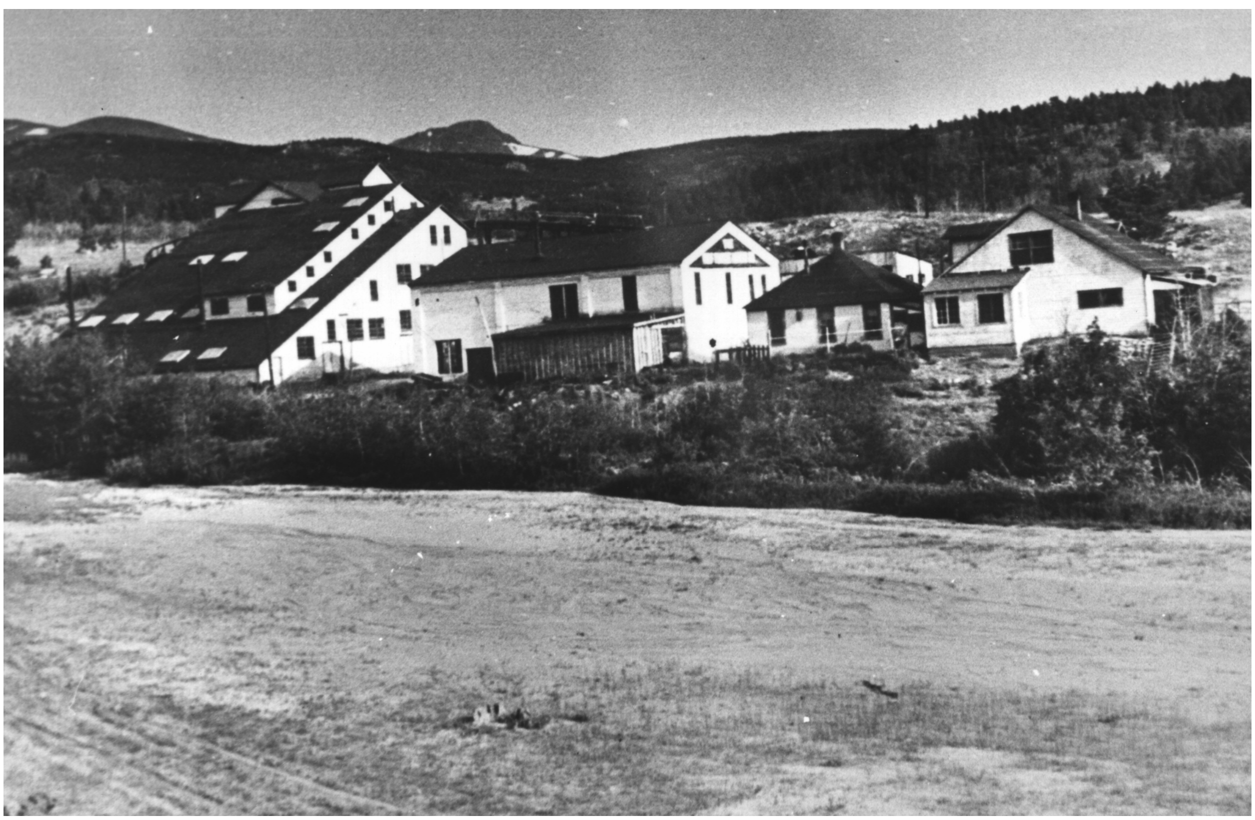

Figure E 4.11.4. In 1927, the Wolf Tongue Mining Company built a new mill to replace the facility that burned. Despite the tungsten mining industry's poor state, Wolf Tongue considered the new mill to be an investment in future production. In addition to treating company ore, the mill processed custom orders, which helped Boulder County's tungsten industry to thrive for at least twenty more years. Nederland is right and out of view. Source: Boulder Carnegie Library, 219-10-2.

[120] Colorado Mine Inspectors' Reports: Tungsten Production Co.
[121] Colorado Mine Inspectors' Reports: Bonanza, Cold Springs, Illinois, Mammoth.

Figure E 4.11.5. Lucky were the miners who had jobs in Boulder County during the 1920s. Based on the types of carbide lamps, the felt hats, and the lunchpail, these miners, employed by the Wolf Tongue Mining Company at its crown jewel Oregon Mine, posed early in the decade. Skilled, professional, and tough, miners like these were the cornerstone of Boulder County's long and successful mining industry. Source: Boulder Carnegie Library, 219-7-2d.

The county's tungsten industry underwent a few important adjustments during the latter half of the 1920s, and the changes reflected a certain level of stability. On the negative side, Clark's miners apparently ran out of economical grades of ore by 1927 so Clark suspended operations. This was a significant loss because Clark ran one of the largest operations during the 1920s. In the same year, the Wolf Tongue company suffered a major setback at a time when financial losses were difficult to bear. The Wolf Tongue Mill at Nederland caught fire and burned to the ground, which forced Loach to stop production and figure out what to do. Instead of selling the company, Loach expressed his confidence in the district's future by spending a weighty $85,000 on a new facility. Exercising prudence, Loach salvaged all the equipment he could to save costs and had workers build with concrete. Probably to recoup the loss as quickly as possible, Loach resumed production on a significant scale and employed a total of 34 miners in the Cold Springs, Clyde, Firth, and Madeline mines, and leased out other claims.[122]

George Teal and C.A. Barr used the tungsten bust of 1919 to buy the Dorothy Mine, located in the east end of the Boulder Tungsten District. Both were experienced mine operators and bought the Dorothy on the assumption that tungsten mining would rebound. Barr spent World War I working the Blue Bird Mine in the Caribou district, and Teal originally managed the Dorothy for the Tungsten Metals Corporation. When tungsten mining in fact rebounded, they brought the Dorothy back into production around 1927 and employed a crew of twelve miners. Interestingly, Teal also administered to George Rogers' tungsten properties, including portions of the Rogers Tract, when Rogers used his tungsten fortune to retire to a place known as Yorkshire Manor in Los Angeles. Nearby, the Clipper Tungsten Company worked the Good Friday Mine and treated ore in what was probably the remodeled Cochran Mill at the mouth of Black Tiger Gulch.[123]

E 4.11.4: Mining During the Great Depression, 1929 - 1942

In 1929, the Nation descended into its worst financial disaster ever, which was known as the Great Depression. As a general industry, mining was ruined because companies and partnerships could no longer afford even the smallest operating costs. The steel industry greatly curtailed production and cut costs at every opportunity because consumer demand evaporated. These factors combined with the continued competition from China crushed what little mining went on in the Tungsten district. Approximately one-quarter of Nederland's population left, and most of the twenty mines in production closed.

A number of conditions came together by 1934 to foster a meek but steady resumption of mining. First, President Franklin Roosevelt's National Recovery Act made measurable improvements in both the economy and in manufacturing. As a result, the demand for tungsten increased and the value of concentrates climbed from $9.58 in 1933 to $14.57 per unit the following year. At the same time, Roosevelt signed the Gold Reserve Act into law, which boosted the price of gold from the traditional $20.70 to $35.00 per ounce. This proved important because some of the ore bodies in the Tungsten district's eastern portion possessed enough gold to provide an incentive to mine.

The district's historic producers drew particular interest because they usually offered hidden pockets and chutes of ore, low-grade ore that past operations left as uneconomical, and similar material thrown out onto the waste rock dumps. Such mines were usually able to support at least several lessees, and when there was enough ore, partnerships with capital attempted some level of formal production. Like most of Boulder County's gold-bearing districts, the Boulder Tungsten District possessed a few historic producers that were capable of supporting company

[122] *Boulder Camera* 9/13/40; Colorado Mine Inspectors' Reports: Cold Springs, Wolf Tongue Mining Co.; Vanderburg, 1933:1.
[123] Colorado Mine Inspectors' Reports: Dorothy, Good Friday, Rogers Tract.

operations. Between 1933 and 1936, approximately ten small mines, one medium-sized operation, and one large producer were reopened.

John G. Clark, William Loach, and George Teal were the first property owners to respond to the improved climate. Clark was unable to wait for the tungsten market to return and began acquiring gold properties both for himself and his investors during the early 1930s. He combined these assets with the Tungsten Products Company to form Gold, Silver, & Tungsten Incorporated in 1933. Under this organization, a significant crew of miners reopened the Clark Tunnel, mined the Vasco Group of claims, and treated the ore in the Clark Mill. Clark also leased several mines and subleased them to independent parties.[124]

Loach picked up operations where he left them off in 1929. In 1934, Loach restored a crew of twenty to the Cold Springs property then reopened the Illinois and Bonanza mines with almost as many miners. At the same time, Loach leased out the Cross No.1, Last Chance No.2, Western Star, Clyde, Hoosier, and Tenderfoot mines to small parties. George Teal reopened the Red Signe, which he purchased from C.A. Barr, then leased the property out. Nebraska investors purchased the nearby Good Friday Mine from Earl Craig, organized the Star Tungsten Company, and reopened the property.[125]

Market conditions for the tungsten industry showed noticeable improvements during the late 1930s. Roosevelt's economic programs had a visible effect, the nation's economy was in the best shape since the depression began, and a new tungsten consumer drove prices up in its quest for the alloy metal. That consumer was Nazi Germany, which prepared for war. The price of concentrates reached as much as $19.50 per unit by 1937, which strengthened interest in Boulder County's tungsten mines.[126]

The price was now high enough to rouse VCA into action, and western division manager Robert Sterling joined Clark and Loach as the county's most important employers. In 1937, VCA canceled the independent leases at the Conger Mine and worked the venerable producer itself. Because VCA had no treatment facility, Sterling commissioned the Conger Mill in Sherwood Gulch, immediately below the mine, and installed the typical concentration equipment. A jaw crusher reduced the crude to gravel, several sets of crushing rolls pulverized it to sand and gravel, and jigs and vibrating tables separated the metalliferous material from waste. By the end of the year, Sterling employed 22 miners underground and 8 workers at the mill.[127]

Under Loach, the Wolf Tongue company intensified its operations but found that some of its best mines neared exhaustion. When this occurred, Wolf Tongue seemingly chased rich ore from property to property and was unable to keep any one mine open for long. In 1937, 65 miners were distributed among several mines, the most important of which was now the Illinois Mine instead of the Cold Springs. A crew of 15 miners sank the shaft and developed ore bodies,

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[124] Colorado Mine Inspectors' Reports: Vasco Group.
[125] *Boulder Camera* 9/13/40; Colorado Mine Inspectors' Reports: Bonanza, Cold Springs, Good Friday, Red Signe.
[126] *Minerals Yearbook*, 1938:569.
[127] *Boulder Camera* 5/19/39; *Boulder Camera* 1/29/42, p6; Cobb, 1999:123; Colorado Mine Inspectors' Reports: Conger; *Minerals Yearbook*, 1940:627; *Wolf Tongue Mining Company Records.*

and once they finished these tasks, Loach dispatched an additional 25 miners to extract ore. When Wolf Tongue moved on from a mine, it usually leased the property out to small parties who gleaned the remaining ore as best they could. The fact that the Illinois was Wolf Tongue's last mine of importance spoke of the dwindling ore reserves.

Partnerships not only opened up additional mines, but also found enough capital to make significant improvements. In 1937, H.M. Gregory leased the Oregon Mine from VCA and began building a mill to treat material recovered from the waste rock dump. The following year, Thomas and K.P. Walsh shifted operations from the Mammoth Mine on Tungsten Mountain, south of Nederland, over to the adjacent Rambler, Sunday, and Tungsten mines. Their crew of miners generated around ten tons of ore pre day, which was milled in the nearby Tungsten Mill. The Fansteel Mining Corporation reopened the old Fitzsimmons in the Tungsten Mountain area and apparently refitted the Mammoth Mill for better metals recovery. George Teal improved the Dorothy Mine into a significant operation during the late 1930s and organized the Mining Company of Colorado to bring it into production and build a mill. The company employed 18 at the mine, 6 in the mill, and treated 25 tons per day. In general, between 1936 and 1942, the district's capitalized companies brought approximately 7 medium-sized mines back into production while lessees worked almost 20 small mines and five deep prospects.[128]

The international political situation that restored some profitability to Boulder County's tungsten mining during the late 1930s erupted into World War II. The United States officially entered the war in 1941, and the manufacture of steel armaments caused the demand for tungsten to reach record levels. The Roosevelt administration began a mobilization campaign of unprecedented proportions that prepared tungsten sources to meet the demand, but the effect was not universally beneficial.

On the brink of transition, the Boulder Tungsten District's third Period of Significance came to an end. The Period began in 1929 when the Great Depression created economic conditions that caused the tungsten mining industry to cease for four years. Due to a combination of President Roosevelt's economic recovery programs, his passage of the Gold Reserve Act, and a general improvement in the national economy, the price of tungsten concentrates increased enough by 1934 to lure capitalized companies back into action. The third Period ended in 1941 when conditions created by World War II forced the Tungsten district to undergo a major transition.

During the third Period, the Tungsten district experienced several important trends. The first is that the Tungsten district saw its most significant period of production since the World War I boom. This was particularly timely because without mining, most residents probably would have abandoned the Nederland area since they had no other source of income during the Great Depression. Second, the Tungsten district's mines contributed to the economy of Boulder County both through the production of ore and the dissemination of capital that was spent on mining. Third, the workforce that the companies employed maintained a population in the Tungsten district and reinforced the original cultural geography of the mountains. Fourth, some

[128] Colorado Mine Inspectors' Reports: Oregon, Rambler, Sunday, Tungsten.

investors amassed capital through mining and milling that they reinvested in other ventures such as elements of infrastructure and mills, which furthered mining in later years. Overall, the Tungsten district's industry was an important and contributing element of a Depression-era revival that swept Boulder County and greater Colorado. Historic resources that currently retain integrity relative to the third Period may be important if associated with the above trends.

E 4.11.5: The World War II Tungsten Boom, 1942 - 1945

When the nation formally entered World War II, tungsten became a metal of immense strategic importance because, like World War I, it was a key alloy material for armaments. The Roosevelt Administration regulated nearly every strategic mineral in terms of production and distribution, and tungsten was no exception. Fully expecting tungsten mining and refining companies to take advantage of a high demand, the administration sought a balance between encouraging production and preventing enervating profiteering. As early as 1940, the government established the Metals Reserve Company to purchase, distribute, and stockpile strategic ores. When the Roosevelt Administration mobilized for the war in 1942, it then created several other agencies that closely regulated strategic minerals. The War Production Board oversaw the production of metals and minerals, and the Office of Price Administration governed prices and encouraged production from small firms through subsidies. The Metals Reserve Company and the Reconstruction Finance Corporation stimulated production through low-cost loans, and the Defense Plant Corporation provided loans and expertise to rehabilitate idle concentration mills. The Bureau of Mines and the U.S. Geological Survey engaged in extensive prospecting for new reserves of strategic minerals.[129]

These agencies had varying impacts on Boulder County's tungsten industry. Mining companies took advantage of the loan programs to reopen old mines and rebuild worn mills. The Bureau of Mines and the U.S. Geological Survey assumed the high cost of finding new ore bodies, which was an undertaking that most companies could not afford. The War Production Board became one of the principal tungsten customers and ensured a sound demand, and best of all, the Board increased the price of concentrates to as much as $30.00 per unit for small companies and $26.00 per unit for large producers.[130]

The programs worked as expected and the Tungsten district saw a wave of activity, and in particular, a number of partnerships and independent lessees took advantage of the assistance and high price tier. In the eastern portion of the Tungsten district, the partnerships created a small and self-sufficient industry. George Teal operated the Dorothy, Katie, and Gold Coin mines at full-blast, John G. Clark worked his Eureka Mine, and lessees reopened the Boulder Falls, the Black Tiger, and the Denver. George Jump, who leased a variety of tungsten mines during the 1930s, maintained production at the Good Friday Mine. Ray Betasso, who also leased

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[129] *Minerals Yearbook*, 1942:12, 15, 22, 26.
[130] *Minerals Yearbook*, 1942:675, 678; Warne and Everett, 1953:1, 2; *Wolf Tongue Mining Company Records: Scrap Book.*

tungsten mines during the 1930s, ran the Cochran Mill at the mouth of Black Tiger Gulch on ore from all these operations and more. The Eagle Rock Reduction Company converted the mill from gold to tungsten in 1905, someone bought it at a later time, and Betasso leased the mill in 1942.[131]

Jump and other lessees were quite active in the Gordon Gulch area, which hosted some of the earliest tungsten mining in the county. Jump leased and reopened the historic Oregon and built a small mill at the mine. Partnerships reopened the Ophir and Quaker mines, which VCA owned. Slide Mines, Incorporated leased claims No.1 through No.11 on the Rogers Tract, which Platt Rogers originally developed with a 600 foot tunnel. Slide Mines was one of Gold Hill's most important gold producers, and the directors adapted the organization to the World War II market by focusing on industrial metals. Slide Mines employed ten miners and six additional workers in a new mill that they built on claim No.11.[132]

The Tungsten district's western and southern portions, around Hurricane Hill and Tungsten Mountain, respectively, enjoyed a little activity in 1942. However, the revival was relatively minor, which suggested to some miners that the richest ore was gone. In the Hurricane Hill area, John G. Clark's Gold, Silver & Tungsten Production Company operated the Forest Home Mine, but only with a skeleton crew of four miners. VCA maintained full production at the Conger and developed the Gray Back to the south. Ray Sullivan, who was another 1930s lessee, made a significant showing by organizing Boulder Tungsten Mills, Incorporated and constructed a new mill by the same name on North Boulder Creek north of Hurricane Hill. Sullivan treated ore that he mined from Vasco claims and provided the important service of accepting custom orders from other lessees. In the Tungsten Mountain area, miner Thomas Walsh was not doing so well. Walsh ran out of ore in the Tungsten and closed the mine, leaving him to work only the Sunday property.[133]

The only major company that seemed to have been left out of the World War II revival was Wolf Tongue. Still shifting his crews from one mine to another, Loach sent 25 miners to reopen the Extension in 1942 and closed it the following year. Wolf Tongue leased out some of its claims such as the Quay Mine to W.J. McKenzie and accepted custom payrock at the mill, but production was less than grand. C.K. Mannion ran one of the most unusual mining operations in the district on a group of claims that he leased from Wolf Tongue. Specifically, Mannion discovered a tungsten placer deposit in a gulch that opened into North Boulder Creek, and he worked the gravel with heavy equipment. In so doing, Mannion uncovered a rich tungsten vein, which keenly interested Loach because Wolf Tongue possessed few new ore bodies.[134] In general, however, Wolf Tongue's future appeared to be cloudy, which deeply concerned Loach. In a report to the Board of Directors, Loach wrote:

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[131] *Boulder Camera* 1/29/42, p6; Colorado Mine Inspectors' Reports: Eureka, Good Friday.
[132] *Boulder Camera* 1/29/42, p6; *Boulder Camera* 5/16/42; Colorado Mine Inspectors' Reports: Rogers Tract.
[133] *Boulder Camera* 1/29/42, p6; *Boulder Camera* 6/5/42; Colorado Mine Inspectors' Reports: Sunday; Wolf Tongue Mining Co.; Loach, 1943:2; Loach 1944:2; *Wolf Tongue Mining Company Records: Scrap Book.*
[134] Loach, 1943:2; Loach 1944:2.

> "From the above, you will see that our immediate prospects for ore on company mines is not bright and we will undoubtedly be losing money for at least the next three months while prospecting work is being done and at the end of three months, you must decide how you are going to proceed or whether or not you are going to liquidate the WTMCO."[135]

The Wolf Tongue directors granted Loach both time and money for exploration, and in 1943, Loach presented them with mixed results. The company bought a bulldozer for surface prospecting and dispatched drilling crews to bore test holes onto suspected ore bodies. Extensive bulldozing revealed one new vein on the Cold Springs No.4 claim, and core drilling found a few more ore bodies on other properties. However, an intense exploration campaign in the Illinois and Cross mines demonstrated that they offered little beyond the existing ore reserves. Loach reduced the crews at these mines and sent the workers to the Cold Springs No.4. On the bright side, Loach petitioned the War Production Board to establish an ore buying station in Boulder in 1943, which reduced the costs of shipping the ore, and convinced the Board that the Wolf Tongue company qualified as a small business and was therefore eligible to sell its concentrates at $30.00 per unit.[136]

Loach managed to buy more time from the Wolf Tongue directors, which allowed him to intensify his search for missed tungsten veins during the first quarter of 1944. At the same time, the various companies and lessees elsewhere in the district carried on production as usual. Between 1942 and 1944, the partnerships and lessees worked approximately thirty small mines and ten prospects, and capitalized companies generated ore in seven medium-sized mines and one large operation. At least seven mills treated the payrock mined by all interests.[137]

Then, the Federal Government brought to an abrupt end the tungsten revival that it created. In April of 1944, the War Production Board declared that it possessed enough tungsten, reduced the price of concentrates to $24.00, and stopped buying the metal at inflated prices. The metal's value declined further, but because a demand still existed, the price did not collapse altogether. Western legislators balked and argued against the repeal of price supports in hopes of protecting the mining industries in their states, but the effort was useless.[138]

The result for the Tungsten district was predictable if not devastating. Most companies found that, given tungsten's backslide to market value, the low-grade ores would not pay, and the aggressive exploration campaign pushed by the U.S. Geological Survey and the Bureau of Mines revealed few new high-grade ore bodies. Out of 145 drill-holes and numerous bulldozer scrapes that the agencies completed during 1942 and 1943, only 27 new ore bodies were forthcoming, and based on tungsten's economic geology, these were discontinuous and shallow. The wave of

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[135] Loach, 1942:4.
[136] Colorado Mine Inspectors' Reports: Cold Springs, Illinois; Loach, 1944:6.
[137] The number of active mines was estimated from a survey of Colorado Mine Inspectors' Reports.
[138] Loach, 1944:8; *Minerals Yearbook*, 1944:652, 655; Warne and Everett, 1953:2; *Wolf Tongue Mining Company Records: Scrap Book.*

tungsten mining set in motion by World War II crested and broke, forcing most of the mines and mills to close. Dozens of miners were thrown out of work, and with no other source of income approximately one-third of the population left the Nederland area.[139]

The collapse of tungsten mining brought an end to the fourth Period of Significance in the Boulder Tungsten District. The Period began in 1942 when a combination of political and economic factors created the conditions and an environment that fostered activity on a scale not seen since the World War I boom. While production was less than half of that enjoyed prior to 1922, the tungsten industry was important on local, state-wide, and national levels. Historic tungsten mining resources that retain integrity today relative to the fourth Period may be important if associated with some of the events noted below.

On a local level, tungsten mining during World War II made economic contributions to the county through ore production and by drawing capital into the Tungsten district. These contributions were timely because, except in for the Jamestown area, passage of order L-208 forced nearly all the county's gold mines to close. The capital was important because it was invested in the Tungsten district then disseminated to other portions of the county. The tungsten mining companies contributed heavily to the maintenance of the social geography of the mountainous portion of the county by being major employers and by keeping the tradition of hardrock mining alive.

On a state-wide level, various interests recognized Colorado as one of the nation's important sources of strategic minerals, and tungsten was among these. The amount of tungsten concentrates contributed by Boulder County's tungsten mines reinforced Colorado's existing reputation and inspired interest among large mining companies in the state's other strategic mineral deposits.

On a national level, the county's tungsten mines contributed a significant volume of a raw material that was vital to the war effort. In 1942, the Boulder Tungsten District ranked as the nation's fourth most productive source of tungsten behind California, Nevada, and Idaho, respectively.[140]

E 4.11.6: The Post-War Years, 1946-1950

The fate of Boulder County's tungsten industry seemed to be sealed after World War II came to an end. The demand for tungsten dropped off and with it the price, which bottomed out at $20.17 per unit of concentrates in 1946. While this figure was numerically higher than the tungsten prices of the 1930s, the relative value was less because of post-war inflation. At the same time, the costs of mining were higher than ever due to increased regulation and oversight. Even if tungsten could fetch a higher price, mining companies in the county could not generate ore if it was no longer in the ground. As William Loach, the U.S. Geological Survey, and

[139] Warne and Everett, 1953:2.
[140] Warne and Everett, 1953:1.

Bureau of Mines clearly demonstrated during the war, the Boulder Tungsten District neared exhaustion after almost forty years of continuous mining.[141]

Against all odds, however, a handful of individuals calculated that the Boulder Tungsten District's days were not through, and while an end to mining was in sight, enough ore still existed to support limited operations for a while longer. William Loach was among these tungsten experts, and he was both one of the first and one of the last people to produce tungsten in the district. In a last-ditch attempt to keep the Wolf Tongue company alive after the 1944 program cancellation, Loach directed his resources to a project designed to penetrate a number of known veins in Hurricane Hill. In 1945, he commissioned the Hurricane Tunnel, which was supposed to undercut a significant number of the company's claims over the course of 12,000 feet. Miners drove the tunnel during 1946 and into 1947 then, after penetrating 1,400 feet of profitless ground, they struck one of the target veins. Loach was relieved to find that the vein offered ore, but core drilling revealed that the amount was relatively small. Loach instructed the miners to extract the payrock, which took several years, then determined that the tunnel would probably not pay for itself. With great reluctance, Loach then shut down the Wolf Tongue company's last viable mining proposition and made the arrangements to liquidate all the assets. After more than 45 years of mining, the Boulder Tungsten District's pioneer developer closed its doors.[142]

Elmer W. Hetzer was another individual who held out hope for tungsten mining, and he picked up where Loach left off. Hetzer was among the various partnerships that kept the county's mining industry alive during the Great Depression by leasing properties in the Magnolia and Tungsten districts, and in 1947, he was appointed manager of the Caribou Silver Mines Incorporated at Caribou. Hetzer also leased several Wolf Tongue properties in 1947, including the Hoosier Mine, and became fairly knowledgeable about the company's mines. When Loach put the Wolf Tongue company's properties up for sale in 1949, Hetzer wasted no time in gathering together the necessary capital. Under Hetzer Mines, Incorporated, he not only purchased the Wolf Tongue Mill and most of the mines, but also the Vasco Group from John G. Clark. Hetzer assembled an empire of the formerly richest tungsten producing properties.[143]

Hetzer was not particularly aggressive in reopening the Wolf Tongue properties at first, although he leased a few mines out. Then, the moment that he waited for arrived in 1951. In the environment of the Cold War and another gathering conflict in Korea, the Defense Minerals Administration and the Defense Production Administration issued a policy where the agencies would buy tungsten concentrates at $63.00 per unit until they either amassed 3 million units or July 1, 1956 arrived, which ever came first. At such prices, grades of ore that were previously uneconomical became profitable mine, and the Defense Minerals Exploration Administration thought that it would be successful in a search for fresh ore bodies during 1952, even though the U.S. Geological Survey found little during World War II.[144]

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[141] *Minerals Yearbook*, 1946:1194, 1197.
[142] Colorado Mine Inspectors' Reports: Wolf Tongue Mining Co.
[143] Colorado Mine Inspectors' Reports: Wolf Tongue Mining Co.; *Wolf Tongue Mining Company, Printed Materials.*
[144] *Boulder Camera* 3/29/51; *Minerals Yearbook*, 1951, V.3:1286; *Minerals Yearbook*, 1952, V.3:226.

E 4.11.7: The Final Revival, 1951 - 1956

The high demand coupled with an excellent price stimulated the Boulder Tungsten District's last revival of mining. Between 1951 and 1955, lessees and government agencies searched for ore in more than fifteen deep prospects. Partnerships and lessees worked more than twenty small mines, and Hetzer Mines and VCA generated ore from two medium-sized producers. Hetzer, George Teals' Boulder Tungsten Mines, Incorporated, and Harrison Cobb treated all the ore in their three mills.[145]

Elmer Hetzer, with his extensive empire, clearly produced the most during the early 1950s, but his operations were more focused on cleaning up the last vestiges of payrock than anything else. He hired a group of miners on the Vasco Group, and they produced a substantial ten tons per day. Other workers scraped together loose ore lying around the nearby Forest Home Mine and brought ore out of the Clyde Tunnel. Hetzer also leased out a number of properties including the Bonanza, Cold Spring, and Illinois mines. VCA also conducted cleanup operations during the early 1950s and leased the Wolf Tongue Mill from Hetzer to process the last truckloads of ore. Miners rounded up ore in the Hillside, the Quaker, and the Conger, then VCA decided to suspend operations and lease out some of its properties in 1953. The Conger was not among the leased properties, however, because it finally exhausted. Its closure was a clear sign to Nederland that the sun was setting on tungsten mining.[146]

George Teal, George Jump, and George Cowdery may have been the last three independent mine owners of note to operate during the early 1950s. Cowdery conducted intermittent underground exploration in his Tungsten Mine and enjoyed limited production. Jump leased the Good Friday Mine and generated ore through 1955. Teal worked the Dorothy and Marion mines in Millionaire Gulch and treated ore in the Bolder Tungsten Mill, and after decades of work, he decided to retire. In 1954, Teal sold his collection of properties to the Wah Chang Corporation, which continued to treat tungsten ore for a while, then took in orders for rare earth and radioactive minerals.[147]

In the fateful year of 1956, the Federal Government's tungsten purchase program ended as promised. Rather than let the program lapse, the Senate passed Bill S-3893, which guaranteed the price of tungsten concentrates at $55.00 per unit and $63.00 for small mines. The only problem with the new bill, however, was that the Federal Government wanted to use the prices supports to strengthen political ties with non-Communist nations. As a result, the bill extended the price supports to foreign producers and excluded domestic suppliers, which caused the value of tungsten concentrates to revert to the free market. The price of tungsten topped down to around $24.00 per unit during 1956, which caused the entire tungsten mining industry, both in

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[145] *Minerals Yearbook*, 1953, V.3:258; the number of active mines was estimated from a survey of Colorado Mine Inspectors' Reports.
[146] Colorado Mine Inspectors' Reports: Conger, Hillside, Quaker.
[147] Colorado Mine Inspectors' Reports: Dorothy, Good Friday, Tungsten.

the Boulder Tungsten District and elsewhere, to crumble.[148] With mining at en end, a statistician observed: "The tungsten-ore mining and milling industry of Boulder County, which has been important in the past, was virtually nonexistent in 1957."[149]

The southwest quarter of Boulder County lost its last mining industry of importance when tungsten mining came to an end. Between 1955 and 1957, companies and partnerships explored for ore in eight deep prospects and worked almost as many small mines, and within five years, only a handful of such operations were active. With no other source of income, most of those individuals dependent on mining left. In 1950, 266 people lived in Nederland and another 340 people, mostly mine workers, were scattered throughout the rest of the district. By 1960, the population fell to 272 for the entire area. Between 1956 and 1983, only several mining operations knocked around in the district, and most of these were weekenders interested in the gold content as much as the tungsten.[150]

The final collapse of tungsten mining in 1956 ushered in the fifth and final Period of Significance for the Boulder Tungsten District. The Period began in 1951 when Federal Government announced price supports and a purchase program, which encouraged production on a significant scale in the district. Several trends on local, state-wide, and national levels mark the fifth Period.

On a local level, tungsten mining made economic contributions to the county through ore production. This was timely because most of the county's gold mines failed to reopen after World War II, leaving the Jamestown area and the Boulder Tungsten District as the county's principal centers of ore production. The tungsten mining companies contributed heavily to the maintenance of the social geography of the mountainous portion of the county by being major employers and by keeping the tradition of hardrock mining alive.

On a state-wide level, Colorado maintained its status as the nation's fourth most important source tungsten, mostly because of the production from the Boulder Tungsten District.[151] This reinforced Colorado's existing reputation as a mineral treasure trove.

On a national level, the Boulder Tungsten District contributed a significant volume of a raw material that was vital to arming for the Korean War. Tungsten was a key ingredient for manufacturing armaments and electrical hardware.

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[148] *Minerals Yearbook*, 1956, V.1:1225; *Minerals Yearbook*, 1957, V.1:1206; *Tungsten, Printed Materials.*
[149] *Minerals Yearbook*, 1957, V.3:282.
[150] Schulz, 1977:1950-8; Schulz, 1977:1960-11; the number of active mines was estimated from a survey of Colorado Mine Inspectors' Reports.
[151] *Minerals Yearbook*, 1954, V.1:1226.

E 5: MINING AND MILLING TECHNOLOGY, METHODS, AND EQUIPMENT

Boulder County featured an unusually diverse array of metals and minerals that manifested in many forms. The rugged mountainous portion of the county offered silver and industrial metals in the form of hardrock ore, gold as both placer deposits and ore, and industrial minerals such fluorspar in veins. No single method proved effective for finding and extracting such a wide array of metals and minerals. Between 1859 and around 1960, engineers and mining companies adapted technologies proven to be effective at any given time, and where known methods failed, progressive individuals pioneered new solutions.

Below is a discussion of the general methods and technologies used to find and extract minerals from Boulder County's principal types hardrock and placer deposits. In many cases, the methods and technologies are specific to individual types of formations, although some of the machinery was ubiquitously applied.

E 5.1: Placer Mining

E 5.1.1: The Nature of Placer Deposits

For thousands of years, humankind prized gold for its rarity, appearance, malleability, and chemical stability. Gold oxidizes and forms compounds only under the most unusual physical circumstances, and otherwise remains in its native state. As a relatively soft metal with a low melting temperature, superheated fluids and gases associated with geothermal and magmatic activity tended to deposit gold in the forms of veins, replacement bodies, and disseminated deposits in existing rock formations. Typically, mountain-building events such as those that uplifted the Rockies created the fluids, gases, and the geologic conditions for gold ore, which often occurred with other metals.

Over the course of eons, erosion attacked the mountains and dismantled the ore veins that cropped out on ground-surface. Most of the minerals and metals were washed into waterways where they suffered reduction and dissolution, both physically and chemically, and decomposed into sediments. Stream action concentrated the sediments on the floors of drainages, and high runoff mobilized the sediments and washed them downstream.

Because gold is soft and inert, however, it neither dissolves nor forms chemical compounds and only slowly disintegrates through physical reduction. Hence, as erosion freed gold from its parent veins, the particles migrated into nearby drainages and slowly sifted downward into the gravel floors due to their high weight. As each high runoff event mobilized and shifted the stream gravel, the gold particles worked their way down toward the bedrock floor where they became concentrated and remained for thousands of years. Over time, water carried the gold from small, steep gulches near the parent veins into streams, then into rivers.

Because erosion is an unending process, fresh gold was constantly freed from its parent veins and introduced in small volumes into drainages, while older material continued to accumulate on the bedrock floors. Hence, fine gold disseminated throughout the upper strata of a stream's gravel often represented a richer deposit at depth. Overall, miners termed gold-bearing gravel *placer deposits* and referred to broad areas of such gravel as *placer fields*.

In Boulder County, prospectors and miners encountered four principal types of placer deposits. The first consisted of what were known as *gulch placers* or *gulch washings*, and these consisted of rich, gold-bearing gravel lining the floors of minor drainages that were often steep. Because gulch placers lay near a parent vein, offered few places for fine material to settle out, and were subject to high-energy, intermittent stream flows, the gravel tended to be coarse, the gold particles large and rough, and the gravel beds thin. Easily discovered and worked with relatively little effort, the gulch placers were the first to be found and yielded handsomely through hand-mining.

Miners recognized the second type of deposit as *river placers*, and it was created when streams introduced gold into the county's principal waterways, such as Boulder and Left Hand creeks. The creek currents sifted the gold downward into the lower levels of the gravel, where the particles became concentrated. The third type, informally known as *blanket deposits*, was limited to relatively arid areas that featured gold veins at ground-surface, such as around Gold Hill. Erosion and weathering attacked the veins and freed the gold, but runoff was not sufficient enough to immediately shunt the metal into waterways, leaving a veneer of gold-bearing soil easily processed by hand.

Deep placers, also known as valley gravel, constituted the fifth deposit. These filled the floors of several broad drainages and consisted of gold mixed in with glacial till and gravel, and concentrated along bedrock by stream action. Because of its extreme terrain and lack of rivers, Boulder County offered few deep placers, with the Happy Valley Placer at Eldora being the only one that saw extensive development.

E 5.1.2: Prospecting for Placer Gold

While some of the placer deposits lent themselves to specific types of extraction processes, all could be discovered by basic prospecting. All a prospector need do was excavate pits preferably in stream gravel and reduce the material in a gold pan. The presence of a few flakes of gold from the upper gravel suggested the potential for more at depth, spurring the prospector to dig deeper pits. By the late 1850s, experienced prospectors understood that the worth of a deposit could only be accurately assessed by testing gravel from near bedrock, which required considerable labor to expose. If the prospector confirmed the presence of placer gold in economic quantities, he was ready to begin mining.

E 5.1.3: Placer Mining Methods

One of placer mining's main attractions was that it was within practical and economic reach of both individual miners and organized companies. Gulch placers and gold-bearing soil saw mining by individual miners who worked by hand, and by companies with complex systems that depended on infrastructures. River- and deep placers, however, tended to be the domain of capitalized companies because they required capital investment for flumes, long sluices, and workforces to excavate high volumes of material.

When working by hand, individual miners often employed pans, cradles, and small sluices to separate gold from gravel. Miners merely excavated pits and trenches into stream gravel, and when they approached bedrock, the miners shoveled the gold-bearing material into a cradle or sluice. A cradle was a portable wooden box with a rounded bottom, a slanted board featuring riffles, and a lever. The miner rocked the cradle back and forth while introducing water, which washed off the gravel and left the heavy gold trapped behind the riffles. A sluice was a small, portable wooden flume with riffles nailed to the floor. The miner placed it in a stream and shoveled gravel into the interior, and the flow of water washed the light gravel away. When miners exhausted the gold-bearing gravel in their pits and trenches, they shifted laterally, began new excavations, and filled the old pits with new tailings. Over time, this created hummocky assemblages of tailings piles, pits, trenches, and buried excavations.

Organized mining companies had the same goals as individual miners, only they relied on infrastructures to process gravel in high volumes from groups of claims. Companies often erected systems of sluices, work stations, water-diversion structures to move streams out their beds to expose gravel, and ditches and flumes to deliver water to otherwise dry areas. The sluices tended to be lengthy, more than 1,000 feet in some cases, and featured either several branches feeding into a trunk line or several parallel sluices. Common sluices ranged from 2 feet wide and as deep, to 4 feet wide and 4 feet deep. They featured a relatively gentle gradient so fine gold was not washed off and stood on timber piers supported by timber or stacked rock footers. Workers usually installed the sluices in trenches and shoveled the surrounding gravel into the current flowing through the device. After prolonged excavation, workers reduced the height of the surrounding gravel until the sluice bed manifested as a raised berm.

When the sluice floor became choked with fine sediment, a worker closed the headgate and shut off the water flow so the gold caught behind the riffles could be recovered. Workers stepped down into the sluice and, under watch of a guard or superintendent, began removing large gold particles and scraping out gold-laden sand. The particles were collected and weighed while the sand was treated with mercury, which amalgamated with gold dust that was too fine to be easily picked out. After cleanup operations, the sluice was ready for more gravel and a worker opened the headgate, admitting water again.

While hand-methods were highly effective for gulch and blanket placers, the costs of labor were too high and the rate of processing too limited for most river- and deep placers. By nature, these deposits tended to feature fine gold disseminated through broad, deep gravel beds that had to be mobilized and processed in economies of scale for profitability. Such conditions required the investment of considerable capital to build the infrastructures necessary to achieve production in economies of scale, and mining companies arranged their infrastructures to carry out several distinct methods.

One of the most popular and earliest was known as *booming*, and it involved the sudden release of a torrent of water into placer workings from a nearby reservoir. The rush of water mobilized and carried gravel en masses through sluices, where riffles often retaining mercury collected the gold. Companies rarely employed booming alone and used the method to supplement the hand-mining described above.

To facilitate both the consumption of high volumes of water and the processing of large tonnages of gravel, companies formally engineered their infrastructures. Networks of supply ditches pirated water from area streams and directed it to the placer mine and the reservoir, distribution ditches shunted the liquid into the sluices, and boom ditches carried water from the reservoir into the workings. All featured headgates, and the sluice systems were as noted above.

Hydraulic mining, developed in California, was another method for processing thick gravel beds in economies of scale. A monitor, also known as a giant, was the key instrument in hydraulic mining. A monitor was a large nozzle that emitted a jet of water under pressure so high that miners were unable to pass sledge hammers through it. A worker played the jet against gravel banks, which crumbled and liquefied, and with the help of booming, were washed into sluices. The infrastructure for hydraulic mining was similar to that for booming with additional components for the monitors. To create the necessary pressure, ditches delivered water to a reservoir located far upslope from the mine, and a flume or pipe directed water into a structure known as a penstock or pressure box. A penstock was basically a rectangular tank made of planks retained by stout framing at least 6 feet wide, 6 feet high, and 8 feet long. A pipe, often at least 24 inches in diameter, exited the structure's bottom and descended to the mine, decreasing in diameter incrementally to increase the water current's velocity and pressure. The pipe entered the placer workings and connected to a monitor located on a strategically placed station, which commanded a full view of the gravel banks.

E 5.2: Hardrock Mining

E 5.2.1: The Nature of Hardrock Ore Deposits

While placer gold was of supreme importance to Boulder County because it initially drew prospectors and miners, it was hardrock ore that kept them in the region. In general, economic minerals and metals found in the hard, metamorphic and igneous rock formations of the mountainous portion of the county constituted hardrock ores. In the county, the principal precious and semi-precious metals included silver and gold, the principal industrial metals were tungsten, lead, and copper, and the most important industrial mineral was flurospar, which enjoyed a heavy demand as a smelting flux. Other metals that drew interest in the county but saw little production included uranium, radium, and zinc.

The common traits shared by most of the hardrock ores, which influenced how companies mined them, were the nature of the ore formations and their geographic locations. The ore formations were functions of the events that built both the existing and the ancestral Rocky Mountains. During these periods, superheated, plastic magmatic bodies slowly intruded the basement rocks deep under the surface and exerted great pressure. As these bodies made their way upward, pockets of liquid rock and superheated fluids and gases attempted to escape through paths of least resistance. Faults and fissures provided these paths, and they ranged from microscopic to several feet in width and tended to be oriented vertically. As the gases and fluids lost pressure and heat during ascent, insoluble minerals first precipitated out on the fault walls, followed by soluble minerals and metals with low melting points. The result was irregular and mineralized bands or seams impregnated with metals in the surrounding rock, which the mining industry recognized as *veins*. Most veins were barren of metals while some offered disbursed ore and a few featured rich pockets or stringers, and nearly all terminated less than 1,000 feet deep. While this is a great oversimplification of Colorado's mountainous economic geology, some understanding is necessary to appreciate how mining companies extracted ore.

In terms of geographic location, most of the faulting and magmatic activity occurred in a belt extending southwest from today's Rocky Mountain National Park to the San Juan Mountains. Given this, the veins manifested among the most rugged and inaccessible terrain, which presented a raft of problems for profitable mining. The crucial issues included bringing the payrock to the surface, providing support for activities underground, and shipping the ore to market, which are discussed below.

E 5.2.2: Prospecting for Hardrock Ore

Finding the ore formations was the first step in hardrock mining, and this was the task of prospectors. Popular history suggests that individual or pairs of prospectors found rich gold and silver veins by simply excavating pits with pick and shovel, or wandered the countryside until they encountered rich outcrops. In actuality, successful prospecting usually involved a basic knowledge of mineralogy and geology, hard work, patience, and strategy and planning. Prospectors also rarely worked alone because parties ensured safety and security, increased the likelihood of finding ore through group efforts, and hastened the examination and sampling of mineral bodies.

The process of prospecting often began with a cursory survey of an area of interest where prospectors sought geological and topographical features suggestive of ore bodies. They often examined visible portions of bedrock for seams, joints, outcrops of quartz veins, dykes, unusual mineral formations, and minerals rich with iron. In regions where vegetation, sod, and soil concealed bedrock, prospectors also scanned the landscape for anomalous features such as water seeps, abrupt changes in vegetation and topography, and changes in soil character.[1]

If an area offered some of these characteristics, the party of prospectors may have shifted to more intensive examination methods. One of the oldest and simplest sampling strategies, employed for locating gold veins, began by testing steam gravel for gold eroded off a parent vein. By periodically panning samples, a party could track the gold upstream, and when members encountered the precious metal no more, they knew they were near the point of entry. The party then turned toward one of the stream banks and began excavating test pits and panning the soil immediately overlying bedrock in hopes of finding a continuation of the gold. They tested soil samples horizontally back and forth across the hillslope in attempts to define the lateral boundaries of the gold flecks, then moved a short distance upslope and repeated the process. Theoretically, each successive row of pits should have been shorter than the previous one, since erosion tended to distribute gold and other minerals in a fan from their point sources. By excavating several rows of pits, the prospectors were able to project the fan's upslope apex where, they hoped, the vein lay. Employing such a sampling strategy occasionally paid off, but the party of prospectors had to undertake considerable work in the form of digging prospect pits with pick and shovel, hauling soil samples to a body of water over rough terrain, and panning in cold streams.[2]

One of the greatest drawbacks to systematic panning was that it detected only gold, while Boulder County abounded with the other minerals noted above. To find minerals in addition to gold, prospectors scanned the stream gravel and other areas of exposed soil for what they termed *float*, which consisted of isolated fragments of ore-bearing rock. As with free-gold, natural weathering fractured ore bodies and erosion transported the pieces downslope, often in the shape of a fan. If the prospectors encountered ore specimens, they walked transects to define the boundaries of the scatter, narrowing the search to the most likely area. Applying the same methods used to locate gold veins, prospectors excavated groups or rows of pits and traced ore samples until they could project where the vein supposedly lay. With high hopes, the prospectors sank several prospect pits down to bedrock and chipped away at the material to expose fresh minerals.[3]

If the exposed bedrock suggested the presence of an ore body, the party of prospectors may have elected to drive either a small shaft or adit with the intent of sampling the mineral deposit at depth and confirm its continuation. After clearing away as much fractured, loose bedrock as possible with pick and shovel, a pair of prospectors began boring blast-holes with a hammer and drill-steels. They often bored between 12 and 18 holes, 18 to 24 inches deep, in a special pattern designed to maximize the force of the explosive charges they loaded. Prior to the 1880s, prospecting parties usually used blasting powder, and by the 1890s, most converted to

[1] Bramble, 1980:11-13; Peele, 1918:381-385; Young, 1946:19-26.
[2] Bramble, 1980:11-13; Peele, 1918:381-385; Young, 1946:19-26.
[3] Bramble, 1980:11-13; Peele, 1918:381-385; Young, 1946:19-26.

stronger but more expensive dynamite. Until economic ore had been proven, the operation was classified as a *prospect adit* or *prospect shaft*.

E 5.2.3: Deep Exploration and the Development of Ore Bodies

The general methods by which prospectors and miners searched for and extracted ore and equipped their mines to do so were universal throughout the West. Boulder County was no exception, and the methods fell into several common patterns. A *prospect* differed greatly from a *mine*. A prospect was an operation in which prospectors sought ore. The associated workings ranged from shallow pits to adits or shafts with hundreds of feet of horizontal and vertical workings. A mine, by contrast, usually consisted of at least several hundred of feet of workings and a proven ore body. All mines began as prospect operations, and when prospectors determined the existence of ore, the activity at the mineral claim often shifted at first to quantifying how much ore existed, then to profitable extraction.

In efforts to address the above two production issues, companies hired crews of miners who proceeded to enlarge the small adit or shaft and systematically block out the mineral body. Generally, ore bodies tended to take one of two forms; miners and engineers recognized the first form as a *vein*, and they defined the other as being massive and globular. In Boulder County, most of the economic minerals tended to be deposited in veins, while some silver, tungsten, and fluorspar deposits were in massive form. At the point where a tunnel or shaft penetrated the mineral body, miners *developed* the body with internal workings consisting of *drifts* driven along the vein, *crosscuts* extending 90 degrees across the vein, internal shafts known as *winzes* which dropped down from the tunnel floor, and internal shafts known as *raises* which went up. Drifts and crosscuts explored the length and width of the ore, and raises and winzes explored its height and depth.

Miners and prospectors consciously sank shafts or drove adits in response to fundamental criteria. A shaft was easiest and the least costly to keep open against fractured and weak ground, and it permitted miners to stay in close contact with an ore body as they pursued it. A shaft also lent itself well to driving a latticework of drifts, crosscuts, raises, and winzes to explore and block out an ore body.

Mining engineers discerned between vertical and inclined shafts. One contingent of engineers preferred inclined shafts because, as they pointed out, mineral bodies were rarely vertical and instead descended at an angle. In addition, inclined shafts needed smaller, less expensive hoists than those used for vertical shafts. The other camp of engineers, however, claimed that vertical shafts were best because maintenance and upkeep on them cost less. Vertical shafts had to be timbered merely to resist swelling of the walls, while timbering in inclines had to also support the ceiling, which was more expensive, especially when the passage penetrated weak ground. Inclined shafts also required a weight-bearing track for the hoist vehicle, which, including maintenance such as replacing rotten timbers and corroded rails, consumed money.

An adit or tunnel, by contrast, was easier and faster to drive and required significantly less capital than a shaft. Some mining engineers determined that the cost of drilling and blasting a shaft was as much as three times more than driving an adit or tunnel. Prospectors and mining engineers alike understood that adits and tunnels were self-draining, they required no hoisting equipment, and transporting rock out and materials into the mine was easier. However, adits and tunnels were not well suited for developing deep ore bodies because interior hoisting and ore transfer stations had to be blasted out, which proved costly and created traffic congestion. One other problem, significant where the rock was weak, lay in the enormous cost of timbering the passages against cave-in. While the exact differentiation between a tunnel and an adit is somewhat nebulous, mining engineers and self-made mining men have referred to narrow and low tunnels with limited space and length as *adits*. Passages wide enough to permit incoming miners to pass outgoing ore cars, high enough to accommodate air and water plumbing suspended from the ceiling, and extending into substantial workings have been loosely referred to as *tunnels*.[4]

Despite the hypothetical advantages of shafts and adits, in some cases factors beyond miners' or engineers' control governed the actual choice. Geology proved to be a deciding criterion; steep hillsides, deep canyons, and gently pitching ore bodies lent themselves well to exploration and extraction through adits. In many cases prospectors who had located an outcrop of ore high on a hillside elected to drive an adit from a point considerably downslope to intersect the formation at depth, and if the ore body proved economical, then the mining company carried out extraction through the adit.[5]

One additional, significant factor influenced the decision to sink a shaft instead of driving an adit. Historians of the West aptly characterized intense mineral rushes as frenzies of prospectors who blanketed the surrounding territory with claims. In most districts, including those in Boulder County, the recognized hardrock claim was 1,500 feet long and 300 to 500 feet wide, which left limited work space both above and below ground. A shaft was the only means to pursue a deep ore body within the confines of such a claim.[6]

E 5.2.4: The Mine Surface Plant

Driving underground workings required support from on-site facilities. Known among miners and engineers as the *surface plant*, these facilities were equipped to meet the needs of the work underground. Large, productive mines boasted sizable surface plants while small prospect operations tended to have simple facilities. Regardless of whether the operation was small or

[4] Twitty, 1999:30.
[5] Colliery Engineer Company, 1893:257; International Textbook Company, 1899:A40:8.
[6] *Morrison's Mining Rights*, 1899:17, 20; Peele, 1918:1474.

large, the surface plant had to meet five fundamental needs. First, the plant had to provide a stable and unobstructed entry into the underground workings. Second, it had to include a facility for tool and equipment maintenance and fabrication. Third, the plant had to allow for the transportation of materials into and waste rock out of the underground workings. Fourth, the workings had to be ventilated, and fifth, the plant had to facilitate the storage of up to hundreds-of-thousands of tons of waste rock generated during underground development, often within the boundaries of the mineral claim. Generally, both productive mines and deep prospects had needs in addition to the above basic five requirements, and their surface plants included the necessary associated components.[7]

Open pit mines had similar needs to underground operations, but because miners worked on the surface, the surface plants lacked some facilities such as ventilation. Transportation systems had to facilitate the movement of materials into and rock out of the surface workings, and the entry into the workings had to be unobstructed.

The basic form of a surface plant, whether haphazardly constructed by a party of inexperienced prospectors or designed by experienced mining engineers, consisted of a set of *components*. In terms of underground operations, the entry usually consisted of a shaft collar or an adit portal, and transportation arteries permitted the free movement of men and materials into and out of these openings. At adit operations, miners usually used ore cars on baby-gauge mine rail lines, and at shafts, a hoisting system lifted vehicles out of the workings. Materials and rock at shaft mines were usually transferred into an ore car for transportation on the surface. The surface plants for all types of mines included a blacksmith shop where tools and equipment were maintained and fabricated, and large mines often had additional machining and carpentry facilities. Most of these plant components were clustered around the adit or shaft and built on cut-and-fill earthen platforms made when workers excavated material from the hillslope and used the fill to extend the level surface. Once enough waste rock had been extracted from the underground workings and dumped around the mouth of the mine, the facilities may have been moved onto the resultant level area. The physical size, degree of mechanization, and capital expenditure of a surface plant was relative to the constitution of the workings below ground.

In addition to differentiating between surface plants that served tunnels from those associated with shafts, mining engineers further subdivided mine facilities into two more classes. Engineers considered surface plants geared for shaft sinking, driving adits, and underground exploration to be different from those designed to facilitate ore production. Engineers referred to exploration facilities as *temporary-class plants*, and as *sinking-class plants* when associated with shafts. Such facilities were by nature small, labor-intensive, energy inefficient, and most important, they required little capital. *Production-class plants* on the other hand usually represented long-term investment and were intended to maximize production while minimizing operating costs such as labor, maintenance, and energy consumption. Such facilities emphasized capital-intensive mechanization, engineering, planning, and scientific calculation.

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[7] Twitty, 1999:27.

Mines underwent an evolutionary process in which the discovery of ore, the driving of a prospect shaft or adit, installation of a temporary plant, upgrade to a production plant, and eventual abandonment of the property all were points along a spectrum. Depending on whether prospectors or a mining company found ore and how much, a mine could have been abandoned in any stage of evolution. Engineers and mining companies usually took a cautionary, pragmatic approach when upgrading a sinking plant to a production plant. Until significant ore reserves had been proven, most mining companies minimized their outlay of capital by installing inexpensive machines adequate only for meeting immediate needs.

Mining engineers extended the temporary- and production-class classifications to structures including machine foundations. Because of a low cost, ease of erection, and brief serviceable life, timber and hewn log machine foundations were strictly temporary while production-class foundations consisted of concrete or masonry. The structure of wooden foundations usually consisted of cribbing, a framed cube, or a frame fastened to a pallet buried in waste rock for stability and immobility. The construction and classification of machine foundations is of particular importance because they often constitute principal evidence capable of conveying the composition of the surface plant.[8]

E 5.2.5: Surface Plants for Adits

The surface plants for adits and shafts shared many of the same components. Yet, because of the fundamental differences between these two types of mines, the layout patterns and characteristic for each were different. Following is a list and description of the principal components found at most adit operations, and since adit operations and open pit mines had similar needs, the descriptions apply to both.

E 5.2.5.1: The Adit Portal

The adit portal was a primary component of both simple prospects and complex, profitable mines. Professionally trained mining engineers recognized a difference between prospect adits and production-class tunnels. Height and width were the primary defining criteria. A production-class tunnel was wide enough to permit an outgoing ore car to pass an in-going miner, and headroom had to be ample enough to house compressed air lines and ventilation tubing. During the latter portion of the Gilded Age, some mining engineers defined production-class tunnels as being at least 3½ to 4 feet wide and 6 to 6½ feet high. Anything smaller, they claimed, was merely a prospect adit.[9]

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[8] Twitty, 1999:30-32.
[9] Peele, 1918:459; Young, 1923:463.

Mining engineers paid due attention to the tunnel portal because it guarded against cave-ins of loose rock and soil. Engineers recognized *cap-and-post timber sets* to be best suited for supporting both the portal and areas of fractured rock further in. This ubiquitous means of support consisted of two upright posts and a cross-member, which miners assembled with precision using measuring rules and carpentry tools. They cut square notches into the timbers, nailed the cap to the tops of the posts, and raised the set into place. Afterward, the miners hammered wooden wedges between the cap and the tunnel ceiling to make the set weight-bearing. Because the tunnel usually penetrated tons of loose soil and fractured rock, a series of cap-and-post sets were required to resist the ground, and they had to be lined with *lagging* to fend off loose rock and earth. In areas penetrating swelling ground, the bottoms of the posts had to be secured to a floor-level cross-timber or log footer to prevent them from being pushed inward.

Wood used for the purposes of supporting wet ground decayed quickly and had to be replaced as often as several times a year. Professionally trained mining engineers claimed that dimension lumber was best for timber sets because it decayed slowly and was easy to frame, but high costs discouraged its use where hewn logs were available.[10]

E 5.2.5.2: Mine Transportation

Miners working underground generated tons of waste rock that had to be hauled out, while tools, timbers, and explosives had to be brought in. As a result, both prospect operations and large, paying mines had to rely on some form of a transportation system. The conveyances used by prospectors had to be inexpensive, adaptable to tight workings, and capable of being carried into the backcountry. To meet these needs, prospect outfits often used wheelbarrows on plank runways. A wheelbarrow cost as little as $12, it was easy to pack on a mule, and it fit into tight workings. Mining engineers recognized the functionality of wheelbarrows but classified them as strictly serving the needs of subsurface prospecting because of their light duty.[11]

Outfits driving substantial underground workings required a vehicle with a greater capacity. The vehicle most mining outfits chose was the ore car, which consisted of a plate iron body mounted on a turntable that was riveted to a rail truck. Cars were approximately 2 feet high, 4 feet long, and 2½ feet wide, they held at least a ton of rock, and they had a swing gate at the front to facilitate dumping. Further, the body pivoted on the turntable to permit the operator to deposit a load of rock on either side of or at the end of the rail line.

Ore cars ran on rails that mine supply houses sold in a variety of standard sizes. The units of measure were based on the rail's weight-per-yard. Light-duty rail ranged from 6 to 12 pounds-per-yard, medium-duty weight rails included 12, 16, 18, and 20 pounds-per-yard, and heavy mine

[10] International Textbook Company, 1899:A40:42.
[11] Twitty, 1999:42.

rail weighed from 24 to 50 pounds-per-yard. Prospecting outfits installing temporary plants usually purchased light-duty rail because of its transportability and low cost. Mining engineers erecting production-class transportation systems had miners lay track using at least medium-duty rail because it lasted longer.[12]

The specific type of rail system installed by a mining operation reflected the experience and judgment of the engineer or superintendent, as well as the financial status of the company, the extent of the underground workings, and whether the mine produced ore. The basic rail system used in nearly all Colorado mines was fairly simple and straightforward. The track consisted of a main rail line that extended from the areas of work underground, though the surface plant, and out to the waste rock dump. Productive mines and deep prospect operations usually had rail spurs extending off the main line underground to other headings in feeder drifts and crosscuts where drilling and blasting teams were at work. Spurs also branched off into stopes and ore bin stations. Substantial mines with extensive surface plants also featured spurs off the main line on ground-surface that extended to different parts of the waste rock dump, to a storage area, and to the mine shop. Many large mines built special stake-side, flatbed, and latrine cars for the coordinated movement of specific materials and wastes.

Mining engineers understood that hiring miners to hand-tram single ore cars was the most cost-effective means of transportation at small and medium-sized operations. But at large mines, they strongly recommended the use of ore trains pulled by a motive source greater than one or two struggling miners, and many mining companies in Boulder County turned to draft animals. As mining matured through the nineteenth century, miners learned that mules were the best animals suited for work underground because they were reliable, strong, of even temperament, and intelligent.

The electric locomotive, termed an *electric mule* by some miners, arrived in the West during the 1890s. Mining engineers working for coal mines in the East and in the Appalachians introduced the first electric locomotives in 1887 or 1888 to move the immense volumes of the fossil fuel produced by coal companies. The early machines consisted of a trolley car motor custom-mounted onto a steel chassis, and they took their power from overhead *trolley lines* strung along the mine's ceiling.

The spread of electric mules to Boulder County proved slow. Locomotives required special mechanical and electrical engineering, they were too big for the tortuous workings of most mines, and they required considerable capital to purchase, install, and operate. During the first decade of the twentieth century, the electrical system necessary to power a locomotive included a steam engine, a generator, electrical circuitry, plumbing for the engine, installation, and an enclosing building. The system alone cost around $3,100, and a small locomotive cost an additional $1,500. Further, an electric locomotive cost approximately $7.50 per day to operate.

[12] International Textbook Company, 1899:A40:53; Young, 1923:192.

A mule, on the other hand, cost only $150 to $300 to purchase and house, and between $.60 and $1.25 to feed and care for per day.[13]

Upgrades to the rail line necessary to accommodate a heavy locomotive presented the engineer with additional costs. Mules were able to draw between three and five ore cars that weighed approximately 2,500 pounds each, and for this 16 pound rails spiked at an 18 inch gauge proved adequate. But electric locomotives and their associated ore trains usually weighed dozens of tons, and as a result they required broad tracks consisting of heavier rail. Mining engineers recommended that at least 20 pound rail spiked 24 inches apart on ties spaced every two feet be laid for small to medium-sized locomotives. Heavy locomotives required rail up to 40 pounds per yard spiked at 36 inch gauge. The reason for the heavy rails and closely spaced ties was that the heavy machines pressed down on the rail line and perpetually worked uphill against the downward-flexed rails. This wasted much of the locomotive's power and energy, and engineers sought to minimize the sag with stiff rails on a sound foundation of closely spaced ties.[14]

Some academic mining engineers criticized the fact that electric locomotives were tied to the fixed route defined by the trolley wires. To remedy this problem, electric machinery makers introduced the storage battery locomotive around 1900, which had free reign of the mine's rail lines. Despite its independence, very few of Boulder County's mining companies employed battery-powered locomotives because they were costly and required a recharging facility.

A few prominent academic mining engineers espoused the compressed air locomotive, which consisted of a compressed air tank fastened to a miniature steam locomotive chassis. These locomotives were able to negotiate tight passageways, they had plenty of motive power, they spread fresh air wherever they went, some of the machines were able to operate on the ubiquitous 18 inch rail gauge, and they did not require complex electrical circuitry. However, compressed air locomotives were not inexpensive, costing as much as their electric cousins, and they required a costly compressor capable of delivering air at pressures of 700 to 1000 pounds per square inch.

For most of Boulder County's mining outfits, locomotives and the necessary improvements to the rail lines were well beyond their financial means. These companies continued the ages-old method of hand-labor to move single cars. During the capital-scarce times of the Depression, the county's outfits constructed rail lines out of whatever rails and ties they were able to salvage. They straightened bent rails, the companies used large nails instead of proper rail spikes, and they fashioned ties from a variety of pieces of lumber. To save materials, many mining outfits spaced the ties far apart, spliced rails of varying lengths and weights into a single line, and broke connector plates that usually featured four bolt holes in two to make them join twice as many rails.

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[13] General Electric Company, 1904:23; Peele, 1918:862, 871.
[14] Colliery Engineer Company, 1916:767; International Textbook Company, 1906:A55:6; International Textbook Company, 1907:A48:2; International Textbook Company, 1926:1; Young, 1923:192.

E 5.2.5.3: The Mine Shop

Every prospect operation and paying mine required the services of a blacksmith who maintained and fabricated equipment, tools, and hardware. The common rate for driving an adit with hand-drills and dynamite in hard rock was approximately one to three feet per 10 hour shift. Over the course of such a day, miners drilled numerous blast-holes and blunted drill-steels in substantial quantities. For this reason, the blacksmith's primary duty was to sharpen the steels.[15]

To permit the blacksmith to work in foul weather, mining companies erected buildings to shelter the shop. The shop structure tended to be small, simple, and rough, and operations lacking capital often relied on local building materials such as hewn logs. Prospecting and mining outfits almost invariably located the blacksmith shop adjacent to the adit portal to minimize handling heavy batches of dull drill-steels.

Blacksmiths at small operations required few tools and much skill for their work. A typical basic field shop consisted of a forge, bellows or blower, anvil, anvil block, quenching tank, several hammers, tongs, a swage, a cutter, a chisel, a hacksaw, snips, a small drill, a workbench, iron stock, hardware, and basic woodworking tools. Prior to the 1910s, some mining outfits working deep in the backcountry dispensed with factory-made forges, both to save money and because they were cumbersome to pack, and used local building materials to make vernacular forges. The most popular type of custom-made forge consisted of a gravel-filled dry-laid rock enclosure usually 3 by 3 feet in area and 2 feet high. Miners working in forested regions substituted small hewn log walls for rock. A tuyere, often made of a 2 foot length of pipe with a hole punched through the side, was carefully embedded in the gravel, and its function was to direct the air blast from the blower or bellows upward into the fire in the forge.[16]

The shops that served prospect operations were inadequate for larger, productive mines. The size of a shop and its appliances were functions of capital, levels of ore production, and the era during which it was built. The shops at small mines typically featured a forge and blower in one corner of the structure, an anvil and quenching tank next to the forge, a work bench with a vice located along one of the walls, and a lathe and drill-press. Rarely did shops at small mines include power appliances; instead, most of these shops were equipped with manually operated machinery.

[15] Hoover, 1909:150; International Textbook Company, 1907:A48:13; Peele, 1918:184; Young, 1946:87.
[16] Twitty, 1999:45.

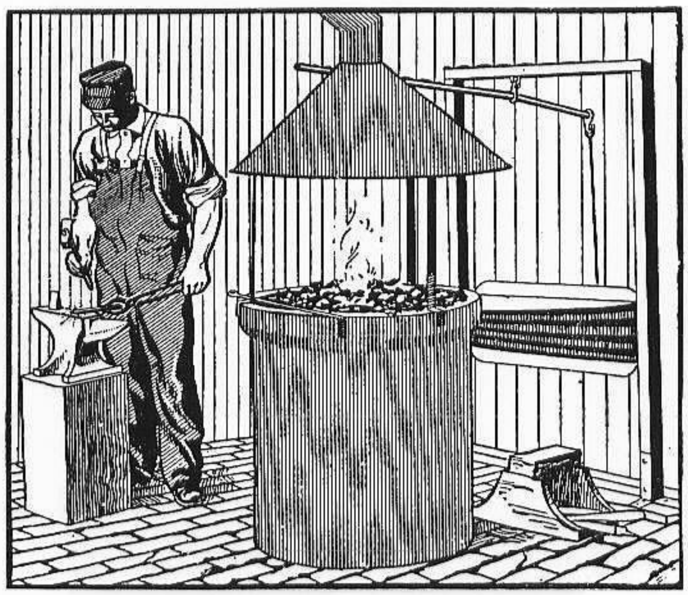

Figure E 5.2.1. Small, poorly capitalized outfits tended to construct basic shops such as the one illustrated. These shops usually consisted of little more than a forge, an anvil, and hand-tools, which restricted the type of work that the blacksmith could accomplish. Source: Drew, 1910:1.

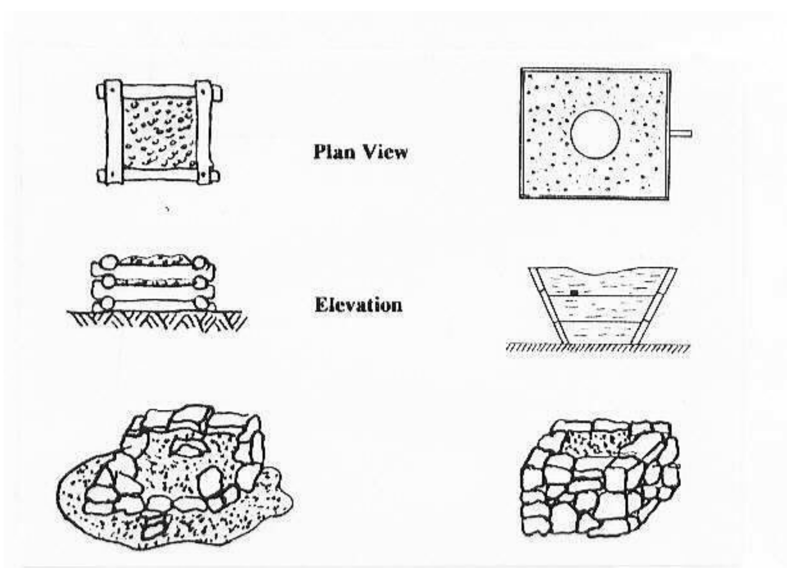

Figure E 5.2.2. Above are examples of the common forges used in mine shops. At upper left is a gravel-filled log forge, at right is a wood box forge, and at lower right is a dry-laid rock forge. Over time, rock forges decay and collapse, and manifest as the remnant at lower left. Source: Author.

A greater availability and affordability of steam engines and air compressors during the 1890s brought power appliances within reach of many companies. Typical shops at medium-sized mines featured the traditional facilities augmented with several power appliances such as lathes or drill-presses. Because medium-sized mines had materials handling needs exceeding those at small mines, forges were typically either a 4 by 4 foot free-standing iron pan model, a gravel-filled iron tank 4 feet in diameter and 2 feet high, or a 3 by 3 foot gravel-filled wood box. In addition to the above appliances, many shops at large mines were also equipped with a mechanical saw, a grinder, and a pipe threader, which may have been power-driven.[17]

The physical composure of a shop building reflects the financial state of a mining company. Outfits with limited financing used local building materials while well-capitalized mining companies often erected frame buildings. One trait shared by most shops was the use of windows to afford natural light to permit the blacksmith to see what he was doing through the smoke and soot. Due to the risk of fire started by loose embers, the floors of most blacksmith shops were earthen. The blacksmith arranged the shop interior to suit the cramped space, usually scattering his tools on the workbench and forge, arranging iron stock and hardware inside and outside the shop building, and kept his coal either in a sack or wood box near the forge.

At large, substantial mines, the primary function of shop laborers continued to be drill-steel sharpening. But when compressed-air powered rockdrills, used to bore blast-holes underground, became common in the county during the 1890s, the sooty blacksmiths had to change their sharpening methods. While the machines proved to be a mixed blessing for their operators, generating silicosis-causing rockdust and being difficult to handle, they were a boon for shop workers. The noisy and greasy machines produced high volumes of dulled drill-steels and broken fittings. Contrary to today's popular misconceptions, Boulder County's mining companies did not universally adopt rockdrills when they were introduced. Instead, the conversion required 30 years and progressed faster among the well-financed mining companies. During the conversion period, blacksmiths became proficient in sharpening both hand-steels and machine drill-steels, each of which had specific requirements.[18]

In the first decade of the twentieth century, mining equipment manufacturers introduced drill-steel sharpening machines to expedite the sharpening process. The early drill-steel sharpeners, similar in appearance to horizontal lathes, were very costly and few if any were employed in Boulder County. During the 1910s, however, leading rockdrill makers introduced compact units that stood on cast iron pedestals bolted to timber foundations. Both moderate and well-financed mining companies in the county installed the revised types of sharpeners with increased frequency through the 1910s. Most small mining companies with limited funds, on the other hand, did not purchase drill-steel sharpeners because such outfits lacked available capital, their miners were unlikely to generate enough dull steels to justify the expense, and they did not possess adequate air compressors. Instead, they relied on traditional forge sharpening methods.

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[17] Twitty, 1999:65.
[18] International Textbook Company, 1924:A24:1.

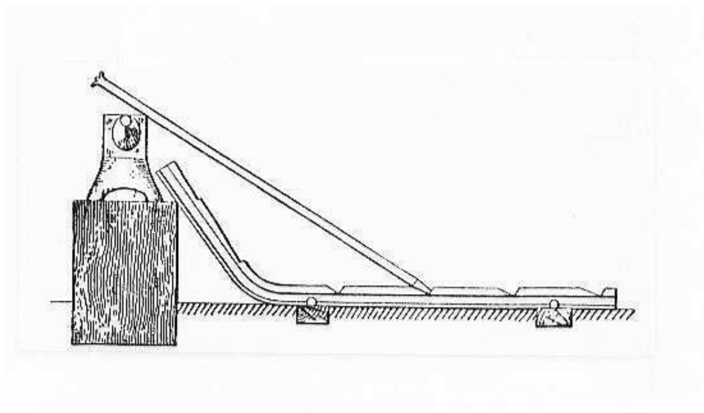

Figure E 5.2.3. The profile illustrates a backing block, which shop workers used to brace hot drill-steels during sharpening. The drill-steel rests in a divot in a steel bar, and its neck rests against an anvil on a timber stand, ready for the blacksmith's hammer. Backing blocks were embedded in the shop floor adjacent to the forge. Source: Engineering & Mining Journal, 1916:14.

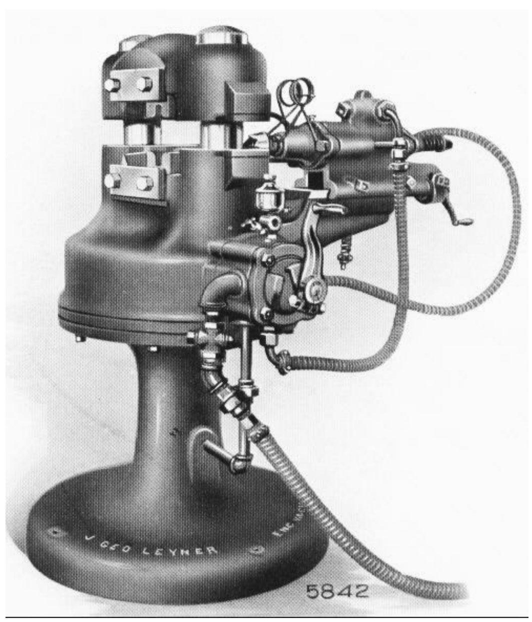

Figure E 5.2.4. Shortly after 1910, leading rockdrill makers introduced a compact drill-steel sharpening machine around 5 feet high. The device, purchased by well-capitalized mining companies, expedited the drill-steel sharpening process. Source: Ingersoll-Rand, 1913:2.

Particularly profitable mining companies equipped their shops with additional power appliances to facilitate advanced fabrication. The power hammer was one such apparatus, and it permitted a single blacksmith to do some jobs that usually required a team of two. Well-capitalized companies installed factory-made steam or compressed air-powered models, which consisted of a heavy plate iron table fixed to the top of a cast iron pedestal, and a piston hammer that pounded items with tremendous force. Many companies were unwilling to buy factory-made hammers and instead cleverly adapted heavily worn but operational rockdrills. The drill was fixed onto a stout vertical timber, and when a shop worker threw the air valve open, the drill's chuck rapidly tapped an iron table.[19]

E 5.2.5.4: Mine Ventilation

The use of explosives for blasting, open flame lights, the respiration of laboring miners, and natural gases often turned the atmosphere in underground workings into an intolerably stifling and even poisonous environment. Ventilating mine workings of such unbreathable air was not an easy proposition but it was necessary to sustain life. Many mining outfits approached the ventilation problem by relying on one or a combination of two basic systems. The first, *passive ventilation*, relied on natural air currents to remove foul air, but it proved marginal to ineffective in dead-end workings. *Mechanically assisted systems*, the second, were expensive and intended for production-class plants.

Some prospecting outfits employed several ventilation systems that cleverly combined passive and mechanical means. One of the simplest consisted of a canvas windsock fastened to a wooden pole. The windsock collected air wafted by breezes and directed it through either canvas tubing or stovepipes into the underground workings. The obvious drawback to the system was poor performance on calm days. Another system that was popular in Boulder County involved the convection currents created by ordinary woodstoves to draw foul air of the underground workings. The stove stood near the mine opening, and ventilation tubes extended from the stove into the underground workings. As a fire burned in the stove, the hot gases rising up the stovepipe created a vacuum in the ventilation ducting and siphoned foul air from the mine.[20]

A few prospecting operations attempted to employ primitive mechanical systems for ventilation. These outfits installed large forge bellows' and small hand-turned blowers at the mouths of adits and shafts, and they used stovepipes or canvas tubing to duct the air into the workings. A bellows effectively ventilated shallow adits and shafts, but it lacked the pressure to clear gases out of relatively deep workings. Hand-turned blowers cost more money and took greater effort to pack to a prospect operation, but they forced foul air much more surely from workings.

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19 Twitty, 1999:77.
20 Twitty, 1999:51.

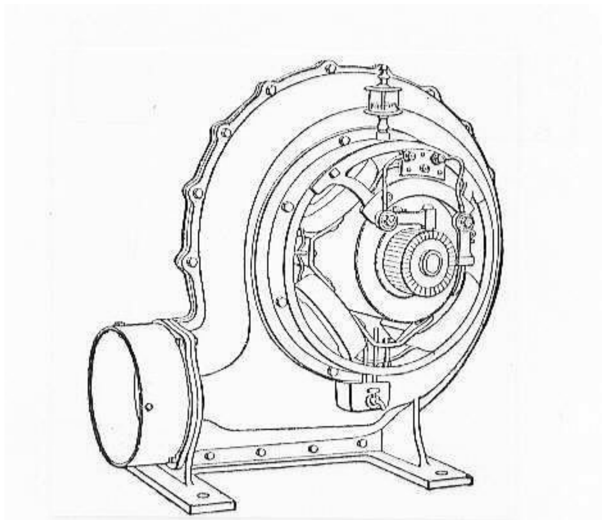

Figure E 5.2.5. Above is a common type of ventilation blower used to force fresh air underground. Ducting was fastened to the nozzle, and the machines were usually powered by a belt. Source: International Text Book Company, 1899, A41:146.

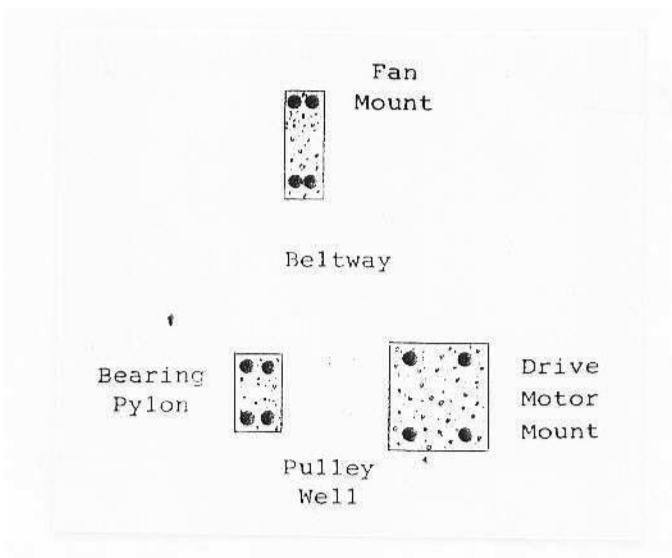

Figure E 5.2.6. The plan view depicts a typical concrete foundation for a ventilation blower and its drive motor. Source: Author.

The simple windsocks and hand-turned mechanical blowers were not effective for medium-sized and large mines, and engineers applied several better methods for providing the miners with fresh air. One of the most popular systems involved an *incast* air current balanced by an *outcast* current laden with the bad air. Multiple mine openings proved to be the most effective means of achieving a flushing current, and temperature and pressure differentials acted as the driving forces.[21]

Mechanical ventilation proved to be the most effective, but also it was much more expensive. One of the most popular and effective approaches was the use of power-driven fans and blowers, and machinery manufacturers offered three basic varieties. Engineers termed the first design, which dates back to the 1870s, the *centrifugal fan*, and miners knew it as the *squirrel cage fan*. This machine consisted of a ring of vanes fixed to a central axle, much like a steam boat paddle wheel, enclosed in a shroud. As the fan turned at a high speed, it drew air in through an opening around the axle and blew it through a port extending out of the shroud. Manufacturers produced centrifugal fans in sizes ranging from one to over ten feet in diameter. The small units were employed for both mining and a variety of other purposes such as ventilating industrial structures, and the largest units saw extensive application in coal mines. The second type of fan also acted on centrifugal principles, but it consisted of a narrow ring of long vanes encased within a curvaceous cast iron housing. The *propeller fan*, the third type of blower, was similar to the modern household fan, and it too was enclosed in a shroud.

E 5.2.6: Surface Plants for Shafts

The surface plants that supported work in shafts incorporated many of the same components as those for adit mines. However, due to the vertical nature of shafts, their surface plants also necessarily included hoisting systems, which engendered specific engineering needs. Typical hoisting systems installed by operations in Boulder County consisted of a hoist, a headframe, a power source, and a hoisting vehicle. The components of a hoisting system shared fundamental relationships with each other, and they interfaced with the other facilities comprising the surface plant. For example, the type of hoist an engineer selected influenced the type of headframe, the power source, and the transportation system. Yet, the greatest factors that overshadowed the types of plant facilities that an engineer installed included the financial state of the mining company, the operation's physical accessibility, and the quantity of proven ore. The following section discusses the variety of the hoisting systems employed during the nineteenth century until around 1960.

[21] International Textbook Company, 1899:A41:133; International Textbook Company, 1905:381; Lewis, 1946:454; Peele, 1918:1038; Young, 1923:255.

E 5.2.6.1: Shaft Form and Hoisting Vehicles

Experienced prospectors and mining engineers recognized that crude prospect shafts were inadequate for anything other than a cursory examination of the geology underground. In instances where a prospecting outfit strongly suspected or had confirmed the existence of ore, they sank a better, more formal shaft that was conducive to deep exploration and even, the outfit hoped, ore production. Between the 1880s and 1920s, mining engineers were critical toward distinguishing between temporary-class shafts and production-class shafts.

Engineers understood that the size of a shaft directly influenced a mine's level of production. Small shafts limited the quantity of ore that could have been hauled out per vehicle trip, and large shafts facilitated economies of scale. Temporary-class shafts often featured one large compartment 3½ by 7 feet in-the-clear or less.

During the 1880s, engineers established a standard for the composition of production-class shafts. The convention dictated the division of these shafts into a *hoisting compartment* and a *manway*, also known as a *utility compartment*, and timbering to support guide rails for a hoisting vehicle. Further, mining engineers defined the hoisting compartment as being at least of 4 by 4 feet in-the-clear. By the late nineteenth century the definition expanded as a result of the introduction of larger hoisting vehicles. Mining engineers felt that a 4 by 5 foot hoisting compartment was better suited for ore production, and 5 by 7 feet was best because it facilitated large loads.[22]

Mining engineers also came to recognize the utility of balanced hoisting. The use of one hoisting vehicle to raise ore became known as *unbalanced hoisting*, and while this system was very inefficient in terms of production capacity and energy consumption, it was the least costly and hence most commonly employed. *Balanced hoisting* relied on the use of two vehicles counterweighing each other, so that as one vehicle rose the other descended. Such as design required two hoisting compartments and a double-drum hoist, which constituted a considerable expense. But the hoist only had to do the work of lifting the ore, and as a result this system was energy efficient and provided long-term savings. Some wealthy companies anticipating production over an extended period of time spared the expense and installed balanced systems.

Mining companies in Boulder County used four basic types of hoisting vehicles. The first was the *ore bucket*, the second was the *ore bucket and crosshead*, the third was the *cage*, and the last was the *skip*. The ore bucket found great favor at prospects and small mines because its shape and features were well suited for primitive conditions. The typical ore bucket consisted of a body with convex sides that permitted the vessel to glance off the shaft walls while being raised without catching on obstructions. Manufacturers forged a loop into the bail to hold the hoist cable on center, and the bottom of the bucket featured a ring so the vessel could be upended once it had reached the surface.

[22] Eaton, 1934:13; International Textbook Company, 1905:261; Peele, 1918:251; Young, 1923:171, 461.

Mining companies engaged in deep shaft sinking took great risks when they used ore buckets. To prevent the bucket from swinging and catching on the shaft walls, emptying its contents onto the miners below, some mining companies installed a hybrid hoist vehicle that consisted of an ore bucket suspended from a frame that ran on guide rails bolted the length of the shaft. The frame, known as a *crosshead*, held the ore bucket steady and provided miners with a platform to stand on, albeit dubious, during their ascents and descents. The advantage of using a crosshead was that miners working underground were able to switch empty buckets with full ones, and the system could have been easily adapted to a cage or skip at a later point. Many small, poorly financed, and marginally productive mining companies in remote locations favored this type of hoisting vehicle. In any form, mining engineers considered ore buckets as temporary-class hoisting vehicles.

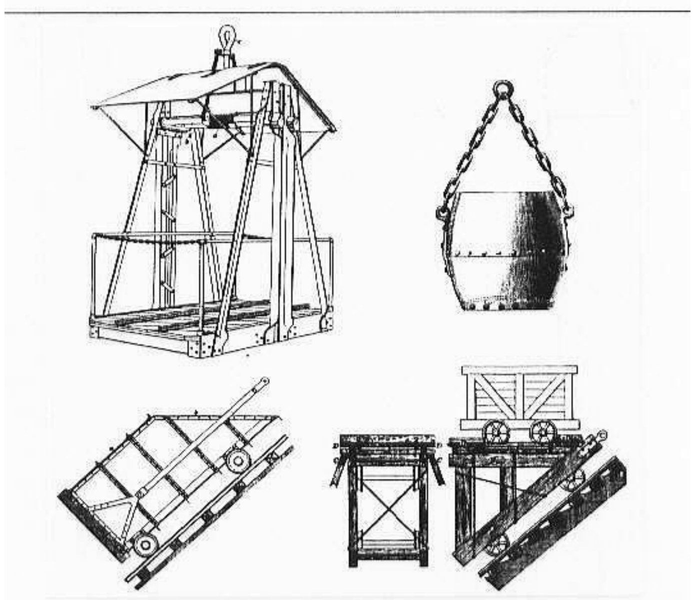

Figure E 5.2.7. Mining companies employed several types of hoisting vehicles in shafts. The cage at upper left, popular from the 1870s through the 1930s, ran on guide rails and carried miners or an ore car. The sinking bucket at upper right required no rails and was common among small operations. The skip at lower left was popular in both vertical and inclined shafts during and after the 1900s. It ran on rails and required guides in the headframe to empty. At lower right is a vehicle for inclined shafts that became obsolete by the 1900s. Source: Twitty: 2002:151.

A mining industry institution for over 120 years, the cage consisted of a steel frame fitted with flooring for crews of miners and rails to accommodate an ore car. Nearly all cages used in Boulder County featured a stout cable attachment at top, a bonnet to fend off falling debris, and steel guides which ran on special fine-grained 4x4 inch hardwood rails. After a number of grizzly accidents in which hoist cables parted, mining machinery makers installed special safety-dogs on cages designed to stop an undesired descent. Usually the dogs consisted of toothed cams that were controlled by springs kept taught by the weight of the suspended cage. If the cable broke, the springs retracted, closing the cams onto the wood rails.

Cages proved to be highly economical because mining companies did not have to spend time transferring ore and waste rock between various vehicles. A miner or trammer underground merely pushed on an ore car and another worker retrieved it at the surface. But cages presented mining companies with several drawbacks. One of the biggest problems lay in drilling and blasting a shaft that not only possessed enough space in-the-clear to make way for the cage, but also one that was large enough to accommodate timbering for the guide rails.

Cornish mining engineers originally developed the skip for haulage in the inclined shafts of Michigan copper mines during the 1840s and 1850s, and they quickly became popular in Colorado's mines. The typical skip consisted of a large iron or wood box on wheels that ran on a mine rail line. Skips had little deadweight, they held much rock, and because they ran on rails, they could have been raised quickly.

During the 1890s, mining engineers began to recognize the skip as superior to the cage for ore production in vertical shafts. Skips were lighter than cages because they did not have the combined dead weight of the vehicle and an ore car, and this resulted in energy savings. Skips also offered the benefit of being quickly filled and emptied, resulting in a rapid turnover of rock. Shortly after the turn-of-the-century, Western mining companies began replacing cages with skips for use in vertical shafts. The change proceeded slowly through the 1900s, it accelerated rapidly during the 1910s, and by the 1930s most large and many medium-sized mines used skips.

E 5.2.6.2: Hoists

When prospectors and mining companies decided to sink a shaft, they were forced to install a hoisting system to permit vertical work. Like other surface plant components, hoists came in a wide range of sizes, types, and duties. Hoists designed for prospecting adhered to *sinking-class* characteristics, and hoists intended for ore production met *production-class* specifications. The *hand windlass* was the simplest form of sinking-class hoist, and prospectors used it for shallow work. The windlass was an ages-old manually powered winch consisting of a spool made from a lathed log fitted with crank handles, and its working depth was limited to approximately 100 feet. Prospectors sinking inclined shafts had the option of using what mining engineers termed a *geared windlass* or *crab winch*, which offered a greater pulling power and depth capacity. Geared windlasses cost much less than other types of mechanical hoists and were small and light enough to be packed into the backcountry. The winch was not easily used at vertical shafts, however, because the rope spool and hand-crank fitted onto a frame which had to be anchored onto a well-built timber structure.[23]

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[23] Twitty, 1999:177, 178.

Prospect operations often worked at depths greater than the limitations presented by windlasses, forcing them to install more advanced hoisting systems. The *horse whim* proved to be a favorite in Boulder County because it was relatively inexpensive to purchase and operate, it was portable, and it was simple to install. Through the 1860s, the mining industry accepted the horse whim as a state-of-the-art hoisting technology for both prospecting and ore production. But by the 1870s, practical steam hoists came of age and the status accorded to horse whims began a downward trend. By around 1880, the mining industry fully embraced steam hoists and mining engineers felt that horse whims were well-suited for backcountry prospecting, but they were too slow and limited in lifting power for ore production. Regardless, mining companies with little income continued to use whims in Boulder County into the 1910s.[24]

Mining companies and prospect outfits could select from several varieties of horse whims. The simplest and oldest version, christened by Hispanic miners as the *malacate* (mal-a-ca-tay), consisted of a horizontal wooden drum or reel directly turned by a draft animal. Early malacates featured the drum, a stout iron axle, and bearings fastened onto both an overhead beam and a timber foundation. Prospectors usually positioned the drum so that it rotated in a shallow pit that they lined with either rockwork or wood planking. The cable extended from the drum through a shallow trench toward the shaft, it passed through a pulley bolted to the foot of the headframe, then up and over the sheave at the headframe's top. The draft animal walked around the whim on a prepared track, and the party of prospectors usually laid a plank over the cable trench for the animal to walk across. The controls for the malacate consisted of brake and clutch levers mounted to the shaft collar, and they were connected to the apparatus by wood or iron linkages that passed through the trench.[25]

Mining machinery makers offered factory-made horse whims which were sturdier and performed better than the older hand-made units. The *horizontal reel horse whim* consisted of a spoked iron cable reel mounted on a timber foundation that miners embedded in the ground, and it performed like the malacate. These whims remained popular among poorly funded prospect operations into the 1900s. The *geared horse whim* appeared in Colorado during the 1880s and it remained popular among prospect operations into the 1910s. The machine consisted of a cable drum mounted vertically on a timber frame, and a beveled gear transferred the motion from the draft animal's harness beam. Geared horse whims were supposedly faster, could lift more than horizontal reel models, and featured controls and cable arrangements like the other types of whims.[26]

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[24] Twitty, 1999:196.
[25] Twitty, 1999:197.
[26] Twitty, 1999:198.

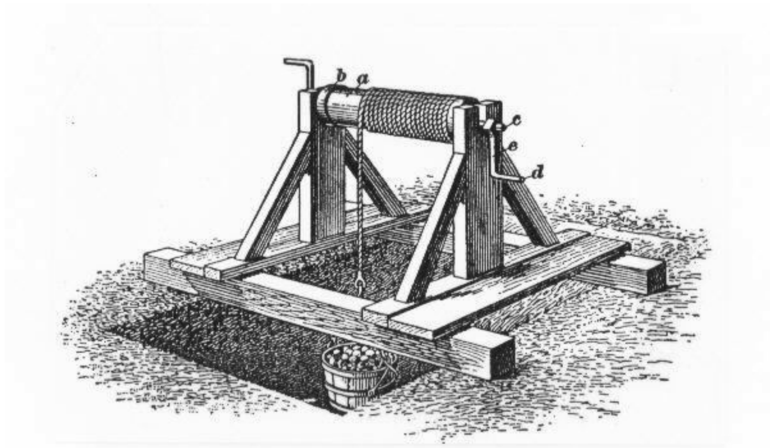

Figure E 5.2.7. The windlass was a mining frontier institution, and nearly all prospect shafts less than 100 feet deep were equipped with this simple, inexpensive, and portable type of hoist. Source: Twitty, 2002:145.

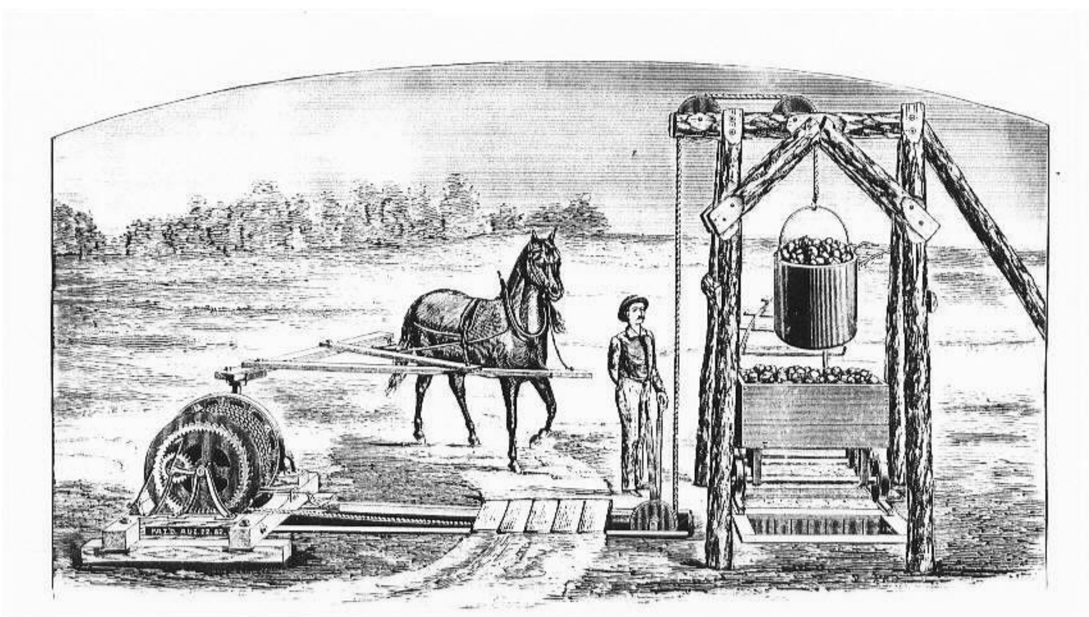

Figure E 5.2.8. Horse whims were the most primitive form of mechanical hoist, and because of their simplicity and portability, they were a favorite among prospectors. The unit shown is a geared whim, which was popular from the 1880s through the 1910s. Source: Ingersoll Rock Drill Company, 1887:60.

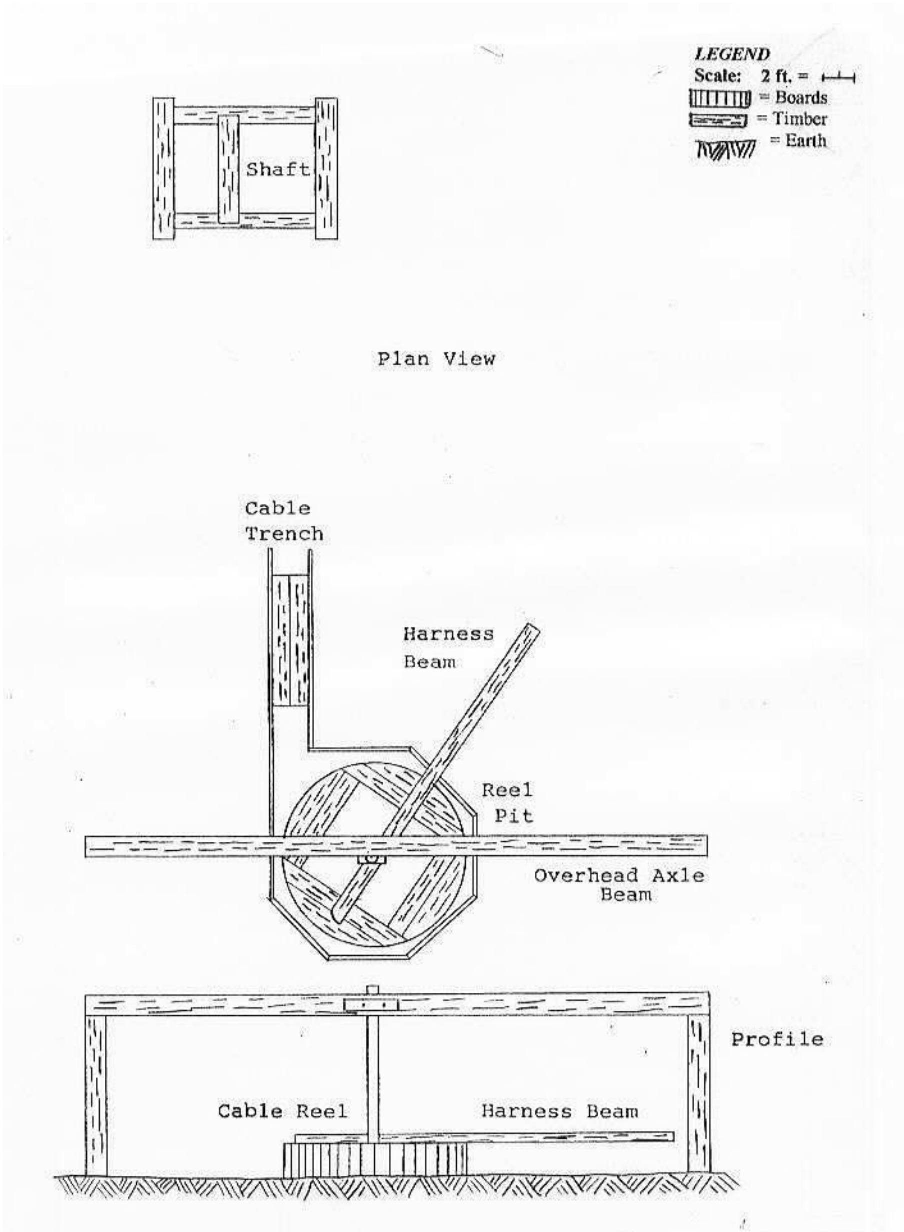

Figure E 5.2.9. The plan view, top, and elevation, bottom, depict a horizontal reel horse whim, which was a universal prospecting hoist prior to the 1880s. Usually, only the reel pit and cable trench remain at prospect sites today. Source: Twitty: 2002:158.

A horse whim required a headframe over the shaft, and in keeping with the temporary-class structures built by prospect operations, the structures were small and simple. Prospectors favored a tripod, tetrapod, or a small four-post derrick that was just wide enough to straddle the shaft.

Prospect operations working in deep shafts began to use steam hoists in large numbers by around 1880. These systems required a relatively substantive infrastructure that had to be planned and engineered, and hence they were beyond the financial means of simple, poorly financed partnerships. Steam hoisting systems included a heavy hoist and boiler, cable, pipes, a headframe, and foundations. The mining company also had to provide a reliable source of soft water and fuel for the boiler. After around 1880, the *geared single-drum duplex steam hoist*, known simply as single drum steam hoist, was the most popular type. These hoists became the ubiquitous workhorse for shaft mining and featured a cable drum, two steam cylinders flanking the drum, reduction gears, a clutch, a brake mechanism, and a throttle.

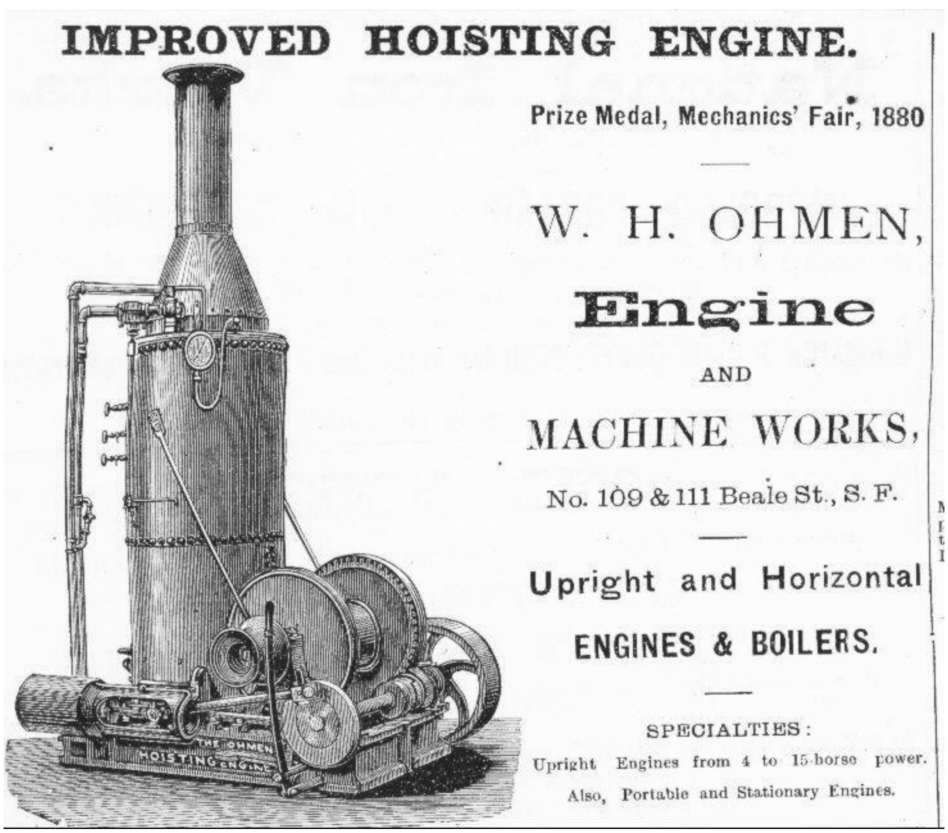

Figure E 5.2.10. Donkey hoists were popular for deep prospecting after the 1880s because they were self-contained and required little site preparation other than a flat area. Source: *Mining & Scientific Press* 1881.

Mining engineers selected the specific model and size of hoist primarily according to the budget granted by the company, and secondary on the speed and depth of the anticipated workings. Nearly all of the sinking-class hoists used for deep prospecting had bedplates smaller than 6 by 6 feet in area and were driven either by gearing or by a friction drive mechanism. A friction-drive consisted of rubber rollers which pressed against the hoist's drum flanges, and while these systems cost less than geared hoists, they were slow and apt to slip under load. Both types of hoists had limited strength, which was often less than 40 horsepower, a slow speed of 350 feet per minute, and a payload of only several tons. Professionally educated engineers defined such hoists as sinking-class in duty and not for ore production, which applied well into the twentieth century. Regardless, many mining companies used these substandard hoists for ore production.[27]

A significant number of deep prospect operations in Boulder County fell into an awkward niche where horse whims were inadequate, but the outfit could not, or would not, come up with the capital necessary to install a stationary steam hoist and boiler. During the late 1870s, machinery manufacturers introduced a revolutionary type of hoisting system that met the needs of these small operations. The *steam donkey hoist*, so named for its broad utility, consisted of either a small single cylinder or duplex steam hoist and an upright boiler mounted onto a common wood or steel frame. While donkey hoists were not manufactured exclusively for mining, being used for logging and in freight yards, they endeared themselves to prospect operations. The durable machines withstood mistreatment, they were relatively inexpensive, they did not require much site preparation, and they could literally drag themselves around the landscape. In addition, donkey hoists did not require a deep understanding of engineering, and nearly anyone could have operated one.

Prospect operations seeking riches deep in the backcountry reluctantly spent the capital required to install steam equipment. The problems they faced were twofold. Not only did these operations have to ship and erect the hoisting system, but they also had to continuously feed it fuel and water, which proved costly. In the early 1890s, the Witte Iron Works Company and the Weber Gas & Gasoline Engine Company both began experimenting with a new hoisting technology that alleviated many of the fuel and water issues. Witte and Weber both introduced the first practical petroleum engine hoists. These innovative machines were smaller than many steam models, they required no boilers, and their concentrated liquid fuel was by far easier to transport than wood or coal.

[27] Twitty, 1999:201.

Table E 5.2.6.2: General Hoist Specifications: *Type, Duty, Foundation*

Hoist Type	Hoist Class	Foundation Size	Foundation Footprint	Foundation Profile	Foundation Material
Hand Windlass	Shallow Sinking		Rectangular	Wood frame over shaft	Timber
Hand Winch	Shallow Sinking	3x3 ft.	Square or Rectangular	Flat	Timber
Horse Whim: Malacate	Shallow Sinking	7 to 10 ft. Diameter	Ovoid Depression	Cable Reel Axle Located in Pit	Timber
Horse Whim: Horizontal Reel	Sinking	4x4 ft.	Rectangular	Timber Footers in Depression	Timber
Horse Whim: Geared	Sinking	4x4 ft.	Rectangular	Timber Footers in Depression	Timber
Steam Donkey	Sinking	Portable	Rectangular	None	None
Gasoline Donkey	Sinking	Portable	Rectangular	None	None
Single Drum Gasoline	Sinking	2.5x8 ft. to 4x14.5 ft.	Rectangular	Flat	Timber or Concrete
Single Drum Gasoline	Sinking	2.5x8 ft. to 4x14.5 ft.	T-Shaped	Flat	Timber or Concrete
Single Drum Steam	Sinking	6x6 ft. and Smaller	Rectangular	Flat	Timber or Concrete
Single Drum Steam	Light Production	6x6 ft. to 7.5x10 ft.	Square or Rectangular	Flat	Concrete or Masonry
Single Drum Steam	Moderate Production	7.5x10 ft. and Larger	Rectangular	Irregular	Concrete or Masonry
Double-Drum Steam	Moderate Production	4x7 ft. to 7x12 ft.	Rectangular	Irregular	Concrete or Masonry
Double-Drum Steam	Heavy Production	7x12 ft. and Larger.	Rectangular	Irregular	Concrete and Masonry
Single Drum Geared Electric	Sinking	5x6 ft. and Smaller	Square or Rectangular	Flat	Concrete
Single Drum Geared Electric	Production	6x6 ft. and Larger	Square or Rectangular	Flat	Concrete
Single Drum Direct Drive Electric	Production	5x6 ft. and Larger	Square or Rectangular	Flat	Concrete
Double-Drum Geared Electric	Heavy Production	6x12 ft.	Rectangular	Irregular	Concrete
Double-Drum Direct Drive Electric	Heavy Production	6x12 ft.	Rectangular	Irregular	Concrete

(Copied from Twitty, 1999:291).

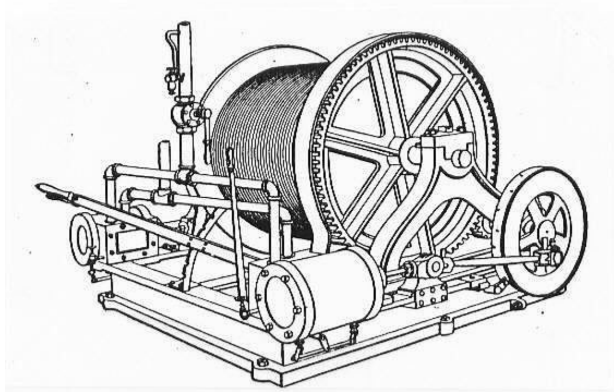

Figure E 5.2.11. Single-drum geared steam hoists were the most common types of power hoists employed between the 1870s and 1910s, when gasoline and electric models became popular. Source: International Text Book Company, 1906, A50:8.

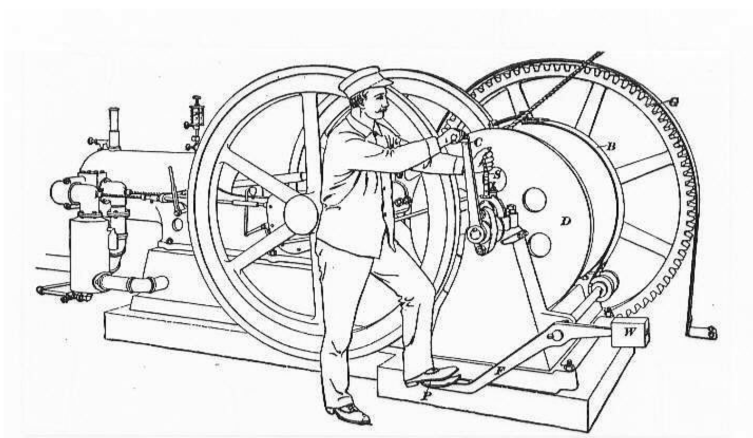

Figure E 5.2.12. This type of gasoline hoist was employed for deep prospecting and minor ore production between around 1900 and 1930. A single-cylinder engine is at left, dual flywheels are at center, and the cable drum is at right. Source: International Textbook Company, 1906, A50:31.

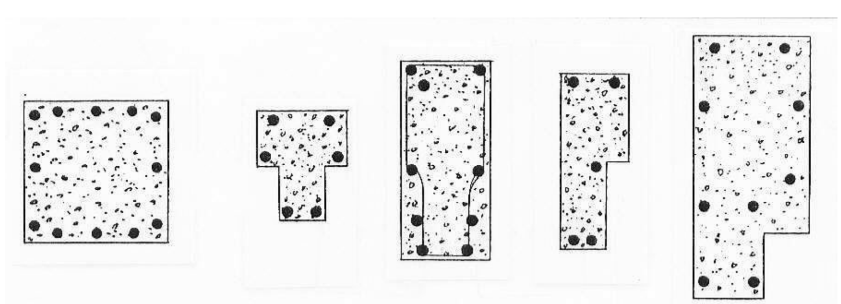

Figure E 5.2.13. Hoist foundation plan views. Single-drum steam hoists were bolted to foundations like the one at left, and the other foundations were for various types of gasoline hoists. Source: Twitty, 2002:187, 241.

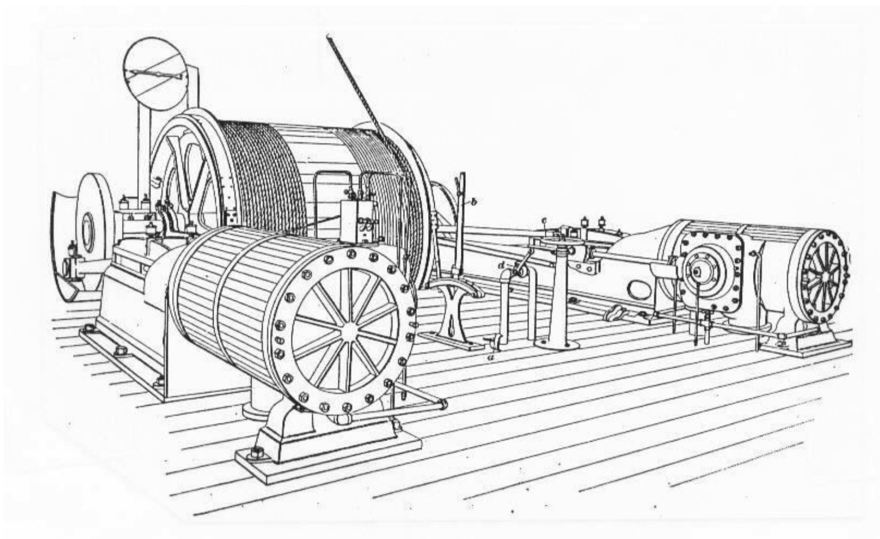

Figure E 5.2.14. Rear quarterview of a direct-drive single-drum steam hoist. Powerful steam cylinders flank the hoist's controls, and the drive-rods are directly coupled to the cable drum. Source: International Text Book Company, 1906, A50:16.

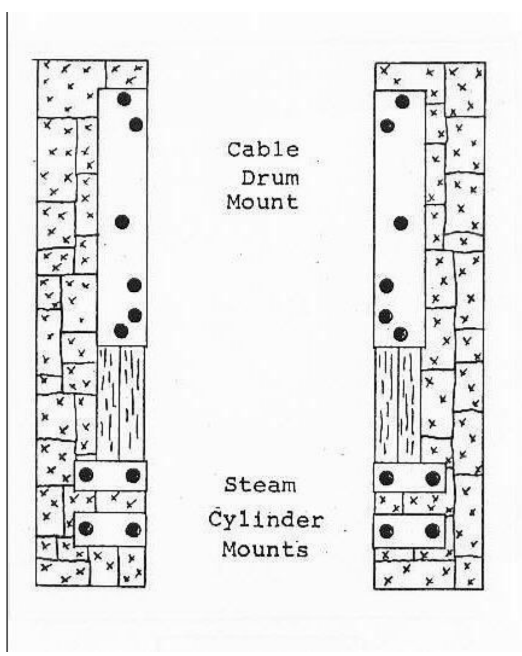

Figure E 5.2.15. The plan view depicts a typical foundation for a direct-drive single-drum steam hoist. Such foundations are usually less than 14 by 17 feet in area. Source: Twitty, 2002:241.

Despite the potential advantages of petroleum hoists, mining companies in Boulder County did not immediately embrace the apparatuses. Steam technology, the workhorse of the Industrial Revolution, held convention in the mining industry into the 1900s for several reasons. First, many mining companies and engineers were by nature conservative, and out of familiarity they stayed the course with steam into the 1910s. Second, during this time, petroleum engine technology was relatively new and had not seen widespread application, especially for hoisting. The few operations to employ petroleum hoists during the 1890s found the engines to be cantankerous and that their performances were limited. Further, petroleum hoists were slow, possessing speeds of 300 to 400 feet per minute, they could not raise much more than 4,500 pounds, and their working depth was limited to less than 1,000 feet. For these reasons professionally educated mining engineers felt they were barely adequate for sinking duty, and total acceptance took approximately fifteen years.[28]

The petroleum hoists available to Boulder County's mining outfits were similar in form to the old-fashioned steam donkey hoists. A large single cylinder engine was fixed to the rear of a heavy cast iron frame and its piston rod connected to a heavy crankshaft located in the frame's center. Manufacturers located the cable drum, turned by reduction gearing, at the front, and the hoistman stood to one side and operated the controls. Because the early petroleum engines were incapable of starting and stopping under load, they had to run continuously, requiring the hoistman to delicately work the clutch when hoisting and to disengage the drum and lower the ore bucket via the brake.

For production-class hoisting systems, steam technology maintained supremacy into the 1920s, when gasoline and electric power finally superseded it. Prior to the 1920s, machinery manufacturers offered steam hoists in a wide array of sizes for ore production. Manufacturers also offered hoists equipped with either *first-motion* or *second motion* drive trains. First-motion drive, also known among mining engineers as *direct-drive*, meant that the steam engine drive rods were coupled directly onto the cable drum shaft, much like the way the drive rods were directly pinned onto a steam locomotive's wheels. Second motion drive, also commonly known as a *geared-drive*, consisted of reduction gearing like the sinking-class hoists discussed above.

The difference in the driving mechanisms was significant in both performance and cost, and each served a distinct function. Gearing offered great mechanical advantage, which permitted the use of relatively small steam cylinders and allowed the hoist's footprint to be compact. First-motion hoists, on the other hand, required that the cable drum be mounted at the ends of large steam cylinders so that the drive rods could gain leverage. Where the footprint of geared hoists was almost square, the footprint of first-motion hoists was that of an elongated rectangle with the long axis oriented toward the shaft. First-motion hoists were intended by manufacturers to serve as high-quality production-class machines designed to save money only over protracted and constant use, while geared hoists were intended to be inexpensive and meet

[28] Twitty, 1999:211.

the short term needs of small, modestly capitalized mines. First-motion hoists were stronger, faster, and more fuel-efficient than geared models. The large size, necessity of using high-quality steel to withstand tremendous mechanical forces, and the fine engines made the purchase price of first-motion hoists three to four times that of geared hoists, the latter costing from approximately $1,000 to $3,000 for light to heavy production-class models. First-motion hoists had a speed of 1,500 to 3,000 feet per minute, compared with 500 to 700 feet per minute for geared hoists. These hoisting speeds reflect the ability of first-motion hoists to work in shafts with depths well into the thousands of feet. Geared hoists usually relied on old-fashioned but durable slide valves to admit steam into and release exhaust from the cylinders, while first-motion hoists usually were equipped with Corliss valves for the engine, which were initially more expensive but consumed half the fuel.[29]

Not only were the costs of purchasing first-motion hoists high, the expenses associated with their installation were exorbitant. Because geared hoists were self-contained on a common bedplate, the surface crew at a mine merely had to build a small foundation with anchor bolts projecting out of a flat surface, and drop the hoist into place. First-motion hoists, on the other hand, required raised masonry pylons for the steam cylinders, pylons for the cable drum bearings, a well for the drum, and anchor bolts in masonry between the pylons for the brake posts. The hoist pieces then had to be brought over, maneuvered into place, and simultaneously assembled.

Mining engineers chose specific hoists for the power that they delivered, which had a proportional relationship with the hoist's overall size. Geared hoists smaller than 6 by 6 feet were usually made for deep exploration and delivered less than 50 horsepower. Hoists between 7 by 7 feet and 9 by 9 feet were for minor ore production and offered 75 to 100 horsepower. Hoists 10 by 10 feet to 11 by 11 feet were for moderate to heavy production and generated up to 150 horsepower, and larger units were exclusively for heavy production. Mining engineers rarely installed geared hoists larger than 12 by 12 feet, because for a little more money they could have obtained an efficient first-motion hoist.[30]

Regardless of the drive mechanism, single drum hoists were restricted to shafts with single hoisting compartments, which had inherent inefficiencies. Double-drum hoists, on the other hand, offered greater economical performance because they increased the tonnages of rock produced while saving energy costs. They achieved this through a balanced hoisting system, which required the two hoisting vehicles discussed above. However, double-drum hoists possessed several drawbacks that limited their appeal to particularly well-financed mining companies. The hoists were considerably more expensive than single drum models to purchase and install, and sinking and timbering a shaft with two hoisting compartments and the obligatory utility compartment constituted a great cost.

[29] Twitty, 1999:242.
[30] Twitty, 1999:244.

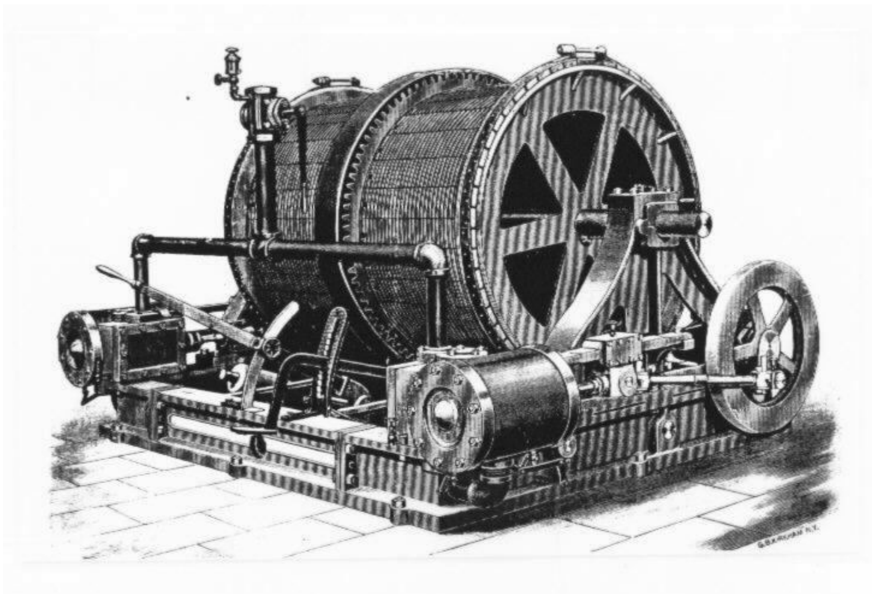

Figure E 5.2.16. Rear quarterview of a geared double-drum steam hoist. Double-drum hoists, hallmarks of significant ore production, were used to achieve balanced hoisting with two vehicles. Source: Ingersoll Rock Drill Company, 1887:65.

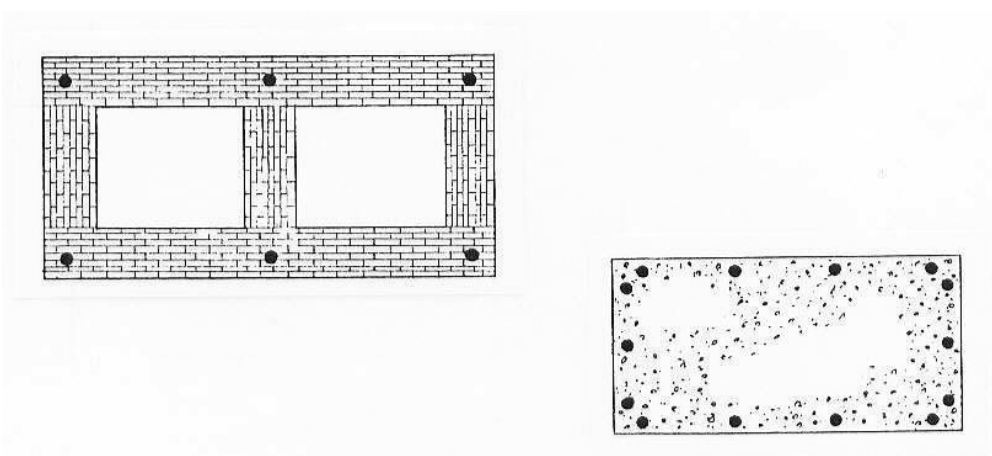

Figure E 5.2.17. The plan views depict typical foundations for geared double-drum steam hoists. The foundation at left features wells for the hoist's cable drums. Source: Twitty, 2002:242.

Like single-drum hoists, double-drum units came with geared or first-motion drives, which were either self-contained on a bedplate or consisted of components that had to be anchored to masonry foundation piers. Double-drum geared hoists, ranging in size from 7 by 12 feet to 12 by 17 feet, were slower, less powerful, and noisier than their direct-drive brethren, and they cost much less to purchase, transport, and install. The ultimate answer for raising the maximum quantity of ore in minimal time was the installation of a double-drum first-motion hoist. This type of hoist ranged in size from approximately 18 by 25 feet to over 30 by 40 feet in area, and its visual impact mirrored its performance. The extreme difficulty and exorbitant costs of transporting and installing these massive machines relegated them to only the most heavily capitalized mining companies. Not only did these types of double drum hoists permit mining companies to maximize production, but also they served as a statement to the mining world of a company's financial status, levels of productivity, and quality of engineering.

As early as around 1910, shortly after Barker Reservoir was finished, many of Boulder County's well-capitalized mining companies embraced the electric hoist for most types of shaft work. It should be noted that the county's mining industry lagged the rest of Colorado by around 10 years, and not until the 1930s were electric hoists common among the county's mines. Like the steam hoists of old, electric models came in four basic varieties: geared single- and double-drum units, and direct-drive single- and double-drum units. The geared electric hoists were built much like their steam ancestors in that the motor turned a set of reduction gears connected to the cable drum, and the components came from the manufacturer assembled onto a heavy bedplate. The gearing permitted hoist manufacturers to install small and inexpensive motors ranging from 30 to 300 horsepower. Direct-drive electric hoists, on the other hand, had huge motors rated up to 2,000 horsepower attached to the same shaft that the cable drums had been mounted on. These hoists, considerable in size, had to be assembled as components onto special foundations, as did the old direct-drive steam hoists. Few if any of these hoists saw use in Boulder County due to their high cost.[31]

Like the antiquated steam hoists, mining engineers classified single drum electric hoists smaller that 6 by 6 feet in area as meeting the qualifications for sinking duty. Most of the production class hoists installed by engineers during this time featured motors rated to at least 60 horsepower for single drum units and 100 horsepower for double-drum units. Even with large motors, these geared hoists had slow hoisting speeds of less than 600 feet-per-minute, their payload capacity was limited, and they were not able to work in the deepest shafts. Out of economic necessity during the capital-scarce Great Depression, many mining companies had to settle for small, slow, sinking-class hoists. It was not uncommon for these companies to use hoists with motors rated at only 15 horsepower, which in better times might have been used instead for work over winzes underground.[32]

[31] Eaton, 1934:86, 295; Lewis, 1946:187; Staley, 1936:137; Young, 1946:203; Zurn, 1928:760.
[32] Twitty, 1999:341.

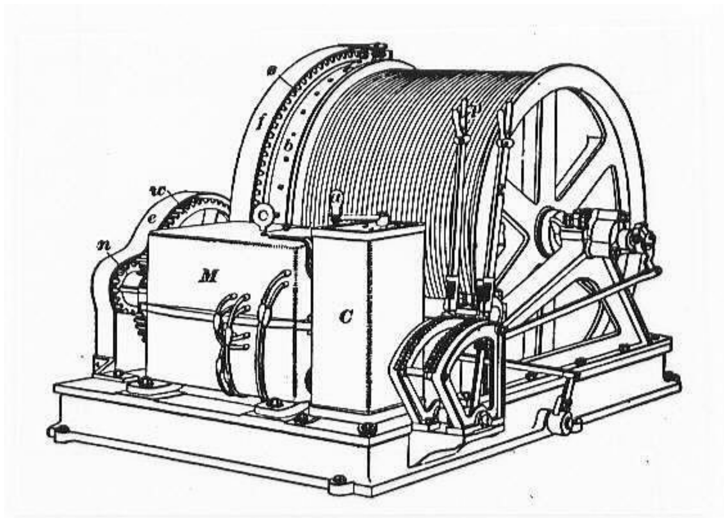

Figure E 5.2.18. The illustration depicts the common single-drum electric hoist, which grew in popularity during the 1910s, where power was available. The motor is in the case, the upright box is a speed controller, and the motor turned the drum via gearing. Source: Twitty, 2002:224.

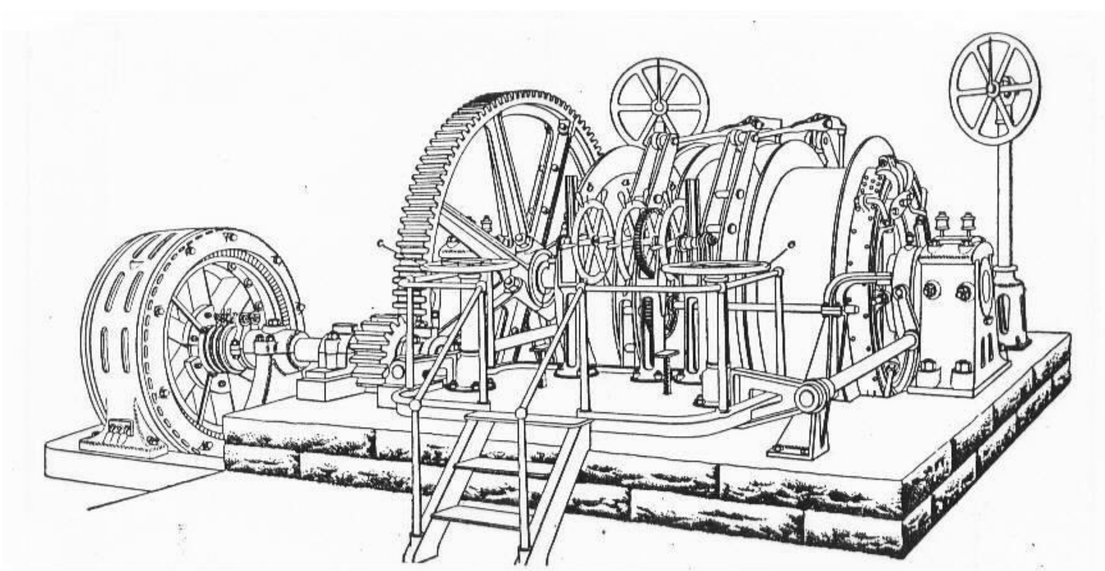

Figure E 5.2.19. Rear quarterview of a double-drum electric hoist. The motor at left drove the dual cable drums via the large bull gear. Such hoists facilitated heavy production, saw use after the 1910s, and were popular among well-capitalized companies by the 1930s. Note the foundation. Source: International Textbook Company, 1906, A50:40.

During the Great Depression, some outfits reconditioning abandoned mines on narrow budgets cobbled together hoists from machinery that had been cast off during earlier decades. Miners exercised creativity in making obsolete machinery work, and their solutions fell into several basic patterns. One common method involved obtaining an old geared steam hoist, stripping it of the steam equipment, and adapting an electric motor to turn the hoist's gearing. To adapt the motor to the hoist, miners had to build a small foundation with anchor bolts adjacent to the hoist, and they had a machine shop custom-make a pinion gear for the motor with teeth capable of meshing with the hoist's bull gear. After ensuring that the original clutch and brake worked and that the hoisting cable was sound, the miners were ready to go to work.[33]

Mining outfits with limited funding practiced another clever means of bringing new life to antiquated steam hoists. Unlike the method described above, the miners left the steam equipment on the hoist intact and ensured that the pistons and valves were in good condition. They reconnected pipes to the hoist's cylinders and, instead of routing the line to a boiler, the miners used compressed air to power the hoist. The only drawback to such an innovation was that a costly multi-stage compressor had to supply the air. In some cases, impoverished mining operations were able to contract with neighboring companies that possessed the necessary compressors for the air.

The third practice that capital-poor mining companies followed was to assemble hoists from odd and unlikely pieces of machinery. A favorite system involved coupling a small hoist, stripped of everything but the brake and clutch, to the power train of a salvaged automobile. Slow, noisy, and of questionable reliability, these contraptions worked well enough to allow many mining operations to turn a small profit. Lacking the money and possibly the knowledge of how to construct a proper foundation, miners simply bolted the hoist and salvaged automobile to a flimsy timber frame that had not necessarily been anchored in the ground.[34]

Small and medium-sized mining outfits that had access to capital were able to afford factory-made gasoline hoists. Mining companies continued to use the old single-cylinder gasoline hoists, and they also purchased factory-made donkey hoists offered by machinery suppliers such as Fairbanks-Morse and the Mine & Smelter Supply Company. The donkey hoist manufactured during the 1930s consisted of a small automobile engine that turned a cable drum through reduction gearing. The makers designed the little machines to be portable and they affixed all of the components onto a steel frame.

Few shaft mines in the county today retain their hoists and instead feature the foundations, which are distinct today. By examining the footprint of a foundation, the research can often determine the exact type of hoist that served a mine. Foundations for production-class *single-drum steam hoists* and *single-drum electric hoists* tend to be slightly rectangular and flat, feature at least six anchor bolts around the outside, and usually consist of concrete or masonry.

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[33] Twitty, 1999:341.
[34] Twitty, 1999:343.

Some foundations greater than 8 by 8 feet in area may feature a depressed center that accommodated a large cable drum.

Direct-drive single-drum hoists were usually bolted to complex foundations that anchored the machines' individual components. The foundation usually consists of two parallel masonry footers capped with dressed sandstone or granite blocks. The blocks toward the rear supported the steam cylinders and feature clusters of heavy anchor bolts. The blocks toward the front supported the cable drum's bearings and feature additional heavy anchor bolts. Foundations are rarely larger than 14 by 19 feet in area.[35]

Foundations for *double-drum geared steam hoists* tend to possess an elongated rectangular footprint oriented 90 degrees to the shaft. They usually consist of concrete or masonry, feature a perimeter of anchor bolts, and wells for the cable drums. Small anchor bolts on the edges of the drum wells often braced brake shoes.

Double-drum geared electric hoists were bolted to foundations similar to those for their steam-driven counterparts. The principal difference manifests as a separate mount for the electric motor, which is often rectangular, less than 4 by 5 feet in area, and features four anchor bolts.

Foundations for *direct-drive double-drum steam hoists* are similar to enlarged versions of those for direct-drive single-drum types. The foundation features a broad masonry footing with dual wells for the cable drums, and a depression or platform behind for the power-assist clutch and brake cylinders. Two clusters of dressed sandstone or granite blocks for the drum bearings stand on both sides of the wells and one stands between. Clusters of blocks stand at the foundation's rear, and they supported the steam cylinders. Parallel rows of blocks that supported the drive rods should extend along the foundation's sides. The various clusters of blocks almost always feature symmetrically arranged large anchor bolts, while small bolts that anchored the steam-assist cylinders and linkages lie between.

E 5.2.6.3: Steam Boilers

Boilers were a necessary component of steam-powered hoisting systems. While specific designs of boilers evolved and improved over time, the basic principle and function remained unchanged. Boilers were iron vessels in which intense heat converted large volumes of water into steam under great pressure. Such specialized devices had to be constructed of heavy boilerplate iron riveted to exacting specifications, and they had to arrive at the mine ready to withstand neglect and abuse. The problem that boilers presented to mining companies was that they were bulky, heavy, cumbersome, and required engineering to install.

During the 1870s, the *Pennsylvania boiler*, the *locomotive boiler*, and the *upright boiler*, also known as the *vertical boiler*, quickly gained popularity among Boulder County's prospect operations. These boilers were well-suited to the county's geographic and physical environment

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35 Twitty, 2002:240.

because they were self-contained and freestanding, ready to fire, and able to withstand mistreatment. Because the above three types of boilers were designed to be portable at the expense of fuel-efficiency, mining engineers declared them fit only for sinking duty.

In general, the above sinking-class boilers consisted of a shell that contained water, flue tubes extending through the shell, a firebox inside the shell at one end, and a smoke manifold. When the fireman stoked a fire in the firebox, he adjusted the dampers to admit enough oxygen to bring the flames to a steady roar. The flue gases, which were superheated, flowed from the fire through the flue tubes, imparting their energy to the surrounding water, and they flowed out the smoke manifold and up the smokestack.

Great danger lay in neglecting the boiler's water level. An explosion was imminent if the flue gases contacted portions of the shell that were not immersed in water on a prolonged basis. Usually the front of the boiler featured a glass sight tube much like the level indicator on a coffee urn so the fireman could measure the water level. Boiler tenders, often serving also as hoistmen, usually kept the boiler three-quarters full of water, the empty space being necessary for steam to gather. When the fire grew low the boiler tender opened the fire door, the upper of two sets of cast iron hatches, and threw in fuel. Mining engineers recognized that cord wood was the most appropriate fuel in remote and undeveloped mining districts because poor roads and great distances from railheads made importing coal too expensive. However, coal was the most energy-efficient fuel, a half ton equaling the heat generated by a cord of wood, and as a result mining operations proximal to sources of the fossil fuel preferred it.

During the 1880s, mining companies came to appreciate the utility and horsepower of the locomotive boiler. So named because railroad engine manufacturers favored it for building locomotives, the locomotive boiler consisted of a horizontal shell with a firebox built into one end and a smokestack projecting out of the other end. Nearly all of the models used in Boulder County stood on wood skids and were easily portable, but some units required a small masonry pad underneath the firebox and a masonry pillar to support the other end. Locomotive boilers were usually 10 to 16 feet long, 3 feet in diameter, and stood up to around 6 feet high, not including the steam dome on top. These workhorses, the single most popular sinking-class source of steam into the 1910s, typically generated from to 30 to 50 horsepower, which was enough to run a sinking-class hoist.[36]

Upright boilers were the least costly of all boilers. They tolerated abuse well and were the most portable. However, because upright boilers could not generate the same horsepower as locomotive or Pennsylvania units, they could not power large sinking-class hoists, let alone additional machines such as air compressors. Upright boilers consisted of a vertical water shell that stood over a firebox and ash pit that had been built as part of a cast iron base. The flue tubes extended upward through the shell and opened into a smoke chamber enclosed by a hood and smokestack, which appeared much like an inverted funnel. The flue gases' path up directly up and out of the firebox made these steam generators highly inefficient, and the rapid escape of

[36] Twitty, 1999:204.

gases and the quick combustion of fuel caused great fluctuations and inconsistencies in the pressure and volume of steam. The short path for the gases and intense fire put heavy heat stress on the top end, causing it to wear out quickly and leak, and the firebox and doors also saw considerable erosion. However, upright boilers required little floor space and maintenance, and were so durable that they almost could have been rolled from site to site. Plenty of remote prospect operations saw great advantage in vertical boilers, and consequently these steam generators enjoyed substantial popularity into the 1910s.[37]

The third basic type of sinking-class boiler used in noteworthy numbers was the Pennsylvania boiler. This unit combined the form and portability of the locomotive boiler and the function of the Scotch marine boiler, discussed below. Like the other portable boilers, the Pennsylvania boiler featured an enclosed firebox that was surrounded by a jacket of water. The flue gases traveled through a broad tunnel in the shell, rose into a small smoke chamber, reversed direction and traveled toward the front of the shell through flue tubes, and escaped through a smokestack. The Pennsylvania boiler, which originated in the Keystone State's oil fields, proved to be remarkably efficient and saw use at a number of Colorado mining operations.[38]

Developed in Scotland for maritime purposes, the Scotch marine boiler was the least popular sinking-class steam generator. Scotch marine boilers consisted of a large-diameter shell enclosing the firebox, and the path for the flue gases was similar to that of the Pennsylvania boiler. While this type of boiler was one of the most efficient portable units, it never saw popularity in Colorado primarily because convention dictated the use of the other types, and because it was heavy, large, and difficult to haul to remote locations.[39]

Engineers who designed production-class surface plants rarely relied on portable boilers because of their inefficiency. Rather, engineers predominantly used *return-tube boilers* in masonry settings, or they erected *water-tube boilers*, which offered the ultimate fuel economy.

The concept and design behind the return-tube boiler was brilliant. The boiler shell, part of a complex structure, was suspended from legs known as *buckstaves*, so named because they prevented the associated masonry walls from bucking outward. Brick walls enclosed the area underneath the boiler shell, and a heavy iron façade shrouded the front. A firebox lay behind the façade underneath the boiler shell. Under the firebox lay an ash pit, and both were sealed off from the outside by heavy cast iron doors. When a fire burned, the superheated flue gases traveled from the firebox along the belly of the boiler shell and rose up into a smoke chamber at the rear of the structure. They reversed direction and traveled toward the front through large flue tubes extending through the shell, and then exited through the smoke manifold. The path under and then back through the boiler shell offered the flue gases every opportunity to transfer energy to the water within and convert it into steam.

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[37] Croft, 1921:48; International Textbook Company, 1899:A18:34; Kleinhans, 1915:12; Rand Drill Company, 1886:47; Tinney., 1906:50.
[38] Twitty, 1999:206.
[39] Colliery Engineer Company, 1893:262; International Textbook Company, 1899:A18:28; Peele, 1918:2083; Thurston, 1901 p31.

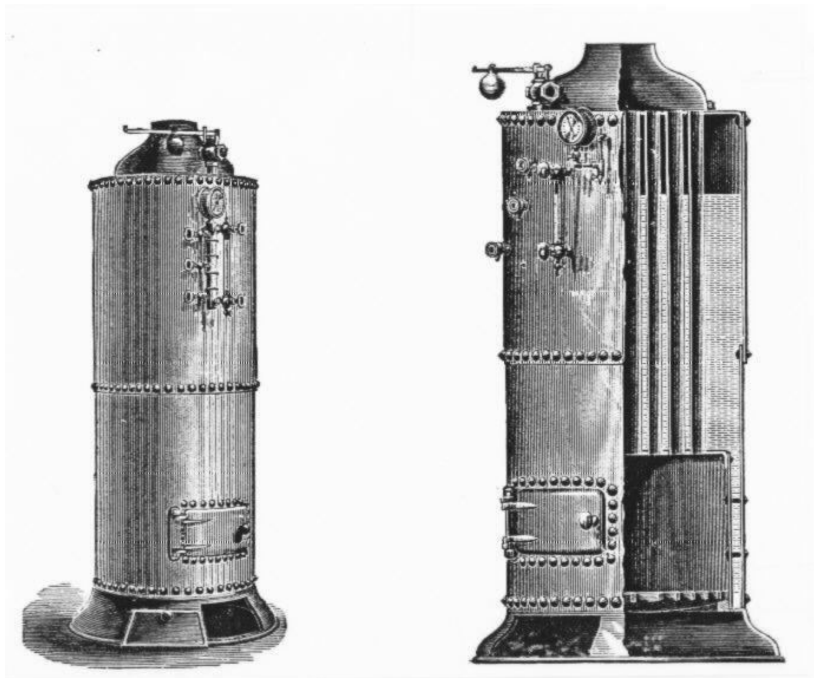

Figure E 5.2.20. Upright boilers were the least expensive and most portable type of boiler, but they were also inefficient. Flue gases rose from the firebox at bottom, through the flue tubes, and out a smokestack at top. Note the water level sight tube, pressure gauge, and pressure valve. Source: Rand Drill Company, 1886:47.

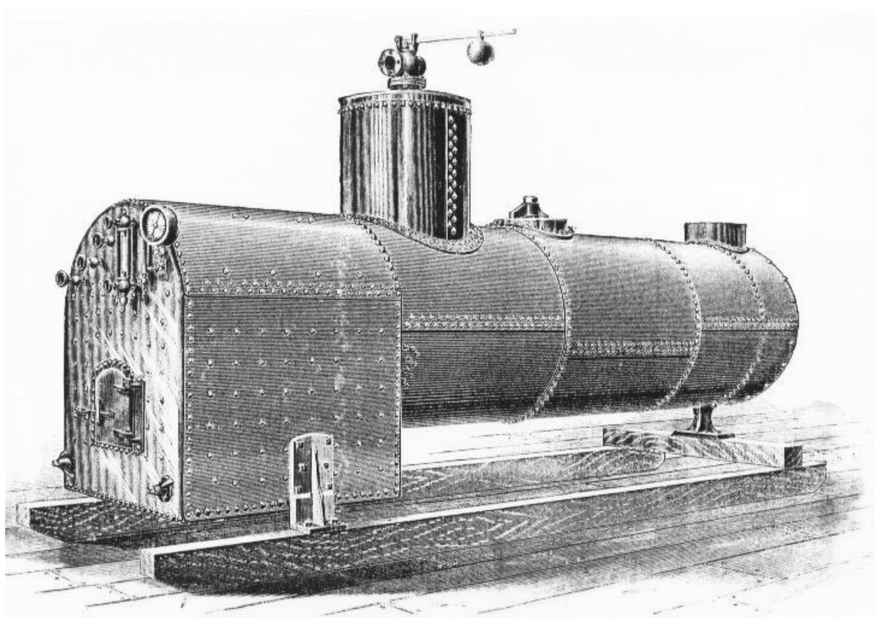

Figure E 5.2.21. The locomotive boiler was one of the most popular steam generators. Flue gases traveled from the firebox at left through flue tubes in the tank and out a smokestack at right. Source: Rand Drill Company, 1886:45.

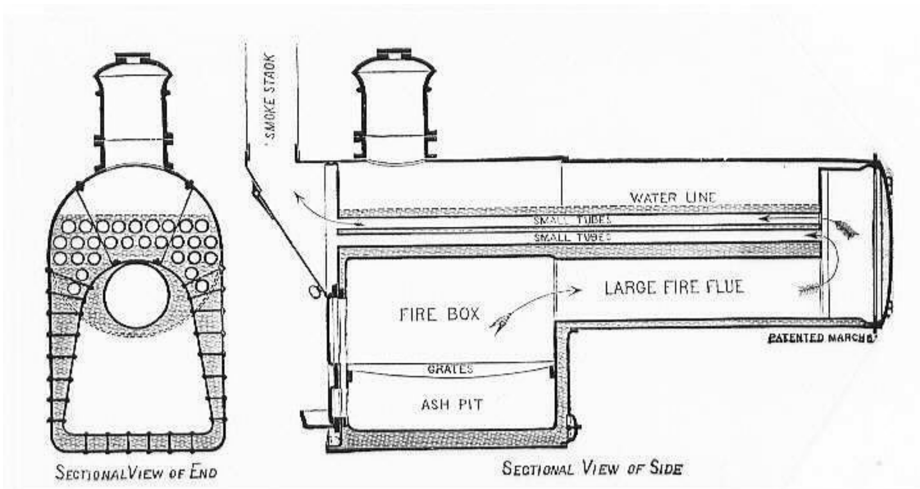

Figure E 5.2.22. The Pennsylvania boiler was portable, stood on skids, and provided greater fuel economy than the locomotive type. Note the path traveled by the flue gases, which prolonged contact with the boiler surfaces. Source: Rand Drill Company, 1886:46.

Figure E 5.2.23. A Pennsylvania boiler at the Ouray Shaft, Summit County, Colorado. Source: Author.

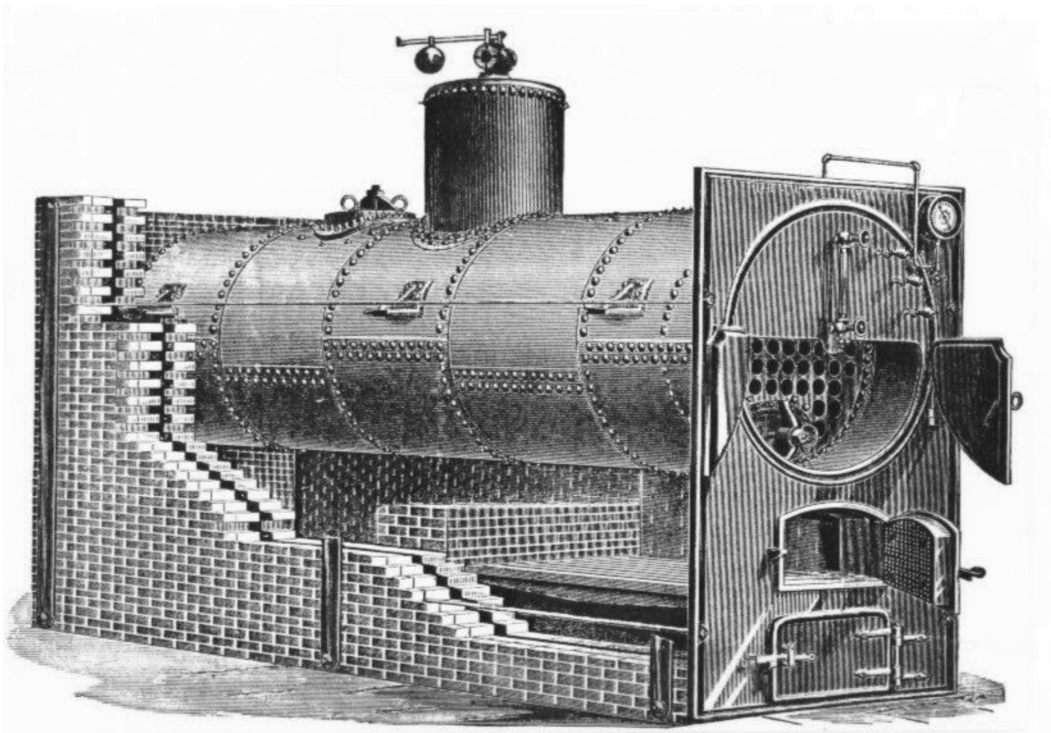

Figure E 5.2.24. The return-tube boiler was the most popular industrial steam generator prior to the widespread embrace of electricity. The unit consisted of an iron shell, a masonry setting, and a cast iron façade. Flue gases traveled from the firebox behind the façade and under the shell. The gases rose into a smoke chamber at rear, reversed direction and returned through the flue tubes perforating the shell, and escaped out a smokestack over the façade. The top doors permitted workers to swab out the flue tubes. Source: Rand Drill Company, 1886:44.

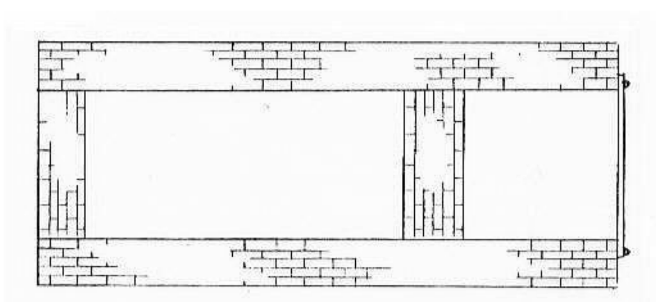

Figure E 5.2.25. Few return-tube boilers currently remain intact and have been reduced to setting remnants and foundations. The plan view depicts the footprint of a setting remnant. Source: Twitty, 2002:145.

Return-tube boilers were workhorses that withstood the harsh treatment and neglect endemic to the mine as a workplace. However, boiler tenders and firemen had to attend to a few basic services to avoid life-taking, disastrous explosions and ruptures. First, they had to keep the boiler at least two-thirds full of water. Second, the fireman had to clean the ashes out of the ash pit regularly to ensure that the fire did not suffocate. Third, the fireman ensured that the water and steam valves were operational, and that the pressure did not exceed the critical point. Last, the fireman had to feed the fire. Skilled firemen were able to add just enough fuel in an even distribution so that the fire kept a fairly constant glow. To ensure that firemen and boiler tenders had easy access to plenty of coal, the mining engineer usually had a coal bin built facing the firebox doors. In other circumstances cordwood may have been stacked in the bin's place.

Mining engineers with access to plenty of capital installed additional devices to improve the energy efficiency and performance of their return-tube boilers. First, they may have installed feed water holding tanks to allow sediment and mineralization to settle out. Second, some engineers installed feed water heaters, which were small heat exchanging tanks that used some of the boiler's hot water or steam to preheat the fresh feed water. These had been proven to moderate the shock of temperature changes to the boiler, prolonging the vessel's life, as well as increasing fuel efficiency. A few engineers working at the largest mines attempted to mechanize the input of coal into the fireboxes of heavily used boilers with mechanical stokers. While they were costly, mechanical stokers did a better job than laborers. Engineers also fitted heavily stoked boilers with rocking or shaking grates that sifted the ashes downward, promoting better combustion of the fuel. Last, many engineers had mineworkers wrap the heater, the steam pipes, and exposed parts of the boiler with horsehair or asbestos plaster as an insulation. Except for feed water heaters and insulation, only a few large mining companies employed these accessories because of the expense involved.[40]

At the time that boiler technology was nascent, in 1856 an American inventor named Wilcox devised a boiler radically different and much more efficient that the best return-tube models. Wilcox's system consisted of a large brick vault capped with several horizontal iron water tanks. The vault contained a firebox, an ash pit, and a smoke chamber, all underneath 50 to 60 water-filled iron tubes. The tubes drew water from one end of the tanks and sent the resultant steam to the other end. By 1870, the design, known as the *water-tube boiler*, had been commercialized and was being manufactured by the firm Babcock & Wilcox.[41]

After Babcock & Wilcox's water-tube boiler had proven itself in a number of industrial applications, mining engineers began to take an interest. The fact that the water ran through the tubes and not around them greatly increased the liquid's heating area, which resulted in much greater efficiency than return-tube boilers. In addition, the threat of a catastrophic explosion was

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[40] Ihlseng, 1892:581; International Textbook Company, 1924:A23:53; Keystone Consolidated Publishing Company Inc., 1925:115; Peele, 1918:2086.
[41] Croft, 1921:18, 53; Greeley, et al, 1872; International Textbook Company, 1899:A18:35; Linstrom and Clemens, 1928:30; Peele, 1918:2083; Thurston, 1901:34; Tinney, 1906:63.

almost nonexistent. By the 1890s, a number of mechanical engineers had devised other water-tube boilers that saw production, such as the Heine, the Sterling, the Wickes, the Hazelton, and the Harrisburg-Starr.

The problem with all of the above models, however, was that they required much more attention than the rugged return-tube boilers, they were significantly more costly, and they were beyond the understanding and field skills of average mining engineers. As a result, water-tube boilers saw use only at large, well capitalized mines under the supervision of talented, professionally trained engineers. As the prices of water-tube boilers fell during the 1900s and capital became abundant following the Silver Crash of 1893, their popularity began growing, but the embrace of electricity in the 1910s prevented the widespread adoption of water-tube boilers.

E 5.2.6.4: Headframes

Nearly all mechanical hoisting systems in Boulder County required a headframe over the shaft. The purpose of the headframe was to support and guide the hoist cable and assist the transfer of rock from and supplies into the hoisting vehicle. Professionally educated engineers recognized six basic structural forms of headframes, including the tripod and tetrapod used with horse whims, as well as the two-post gallows, four and six-post derricks, and the A-frame.

The *two-post gallows* was one of the most common headframes erected in Boulder County, and self-made and professionally educated engineers unanimously agreed that it was best for prospecting. The variety used by small operations usually consisted of two upright posts, a cap timber and another cross-member several feet below, and diagonal backbraces, all standing at most 25 feet high. The cap timber and lower cross-member featured brackets that held the sheave wheel in place. The gallows portion of the structure stood on one end of a timber foundation equal in length to the headframe's height. The diagonal backbraces extended from the posts down toward the hoist, where they were tied into the foundation footers. The foundation, made of parallel timbers held together with cross members, rested on the surface of the ground and straddled the shaft collar.

The four-post derrick erected for prospecting was similar in height, construction, and materials to two-post headframes, it featured four posts instead of two, and it stood on a timber foundation. The A-frame was based on the same design as the two-post gallows. The difference between the two types of structures was that the A-frame featured fore and aft diagonal braces to buttress the structure in both directions. A-frames were not erected directly over inclined shafts and instead were placed between the hoist and shaft so that the angle of the cable extending upward from the hoist equaled that extending down the inclined shaft.

The common features shared by the above structures included a small size, simplicity, minimization of materials, ease of erection, and portability of materials. For comparison, a two-post gallows frame 20 feet high cost as little as $50 and a slightly larger structure cost $150, while a production-class A-frame cost $650, and a production-class four-post derrick headframe cost up to $900.[42]

Figure E 5.2.26. The headframe at the Village Belle Mine above Eldora exemplifies a typical two-post gallows headframe. Sinking-class headframes tend to be less than 25 feet high and stand on timber footers. Source: Carol Beam.

When designing sinking-class headframes, the mining engineer had to consider three basic stresses. The first was live load, created by the weight of a full hoist vehicle and cable, the second was braking load, which was a surge of force created when the hoistman quickly brought a vehicle to a halt in the shaft, and the third was the horizontal pull of the hoist. To counter these forces, mining engineers often build their headframes with 8x8 timbers, and they installed diagonal backbraces to counter the pull of the hoist. Usually, carpenters assembled the primary components with mortise-and-tenon joints, 1 inch diameter iron tie rods, and lag bolts. Professionally trained mining engineers specified that the diagonal backbraces were most effective when they bisected the angle of dead vertical and the diagonal pitch of the hoist cable as it ascended to the top of the headframe. By tying the backbraces into the foundation between the shaft and hoist, engineers had determined that the total horizontal and vertical forces put on the

[42] Twitty, 1999:215.

headframe would have been equally distributed among both the vertical and the diagonal posts. When a mining engineer attempted to find the mathematically perfect location for a hoist after erecting a headframe, he merely had to measure the distance from the shaft collar to the diagonal brace, double the length, and built the hoist foundation. Many prospect operations followed this general guideline but a few poorly educated engineers strayed and gave the diagonal braces either too much or too little of an angle.[43]

Unlike the simplicity of sinking-class headframes, production-class headframes were more complex and designing them was a rigorous task. Mining engineers had to account for a wide variety of stresses, consider the structure's multiple functions, and coordinate the structure with other hoisting system components. They had to build a structure capable of withstanding vertical forces including an immense dead load, live load, and braking load. Engineers had to calculate horizontal forces including the powerful pull of the hoist and windshear, which could not have been underestimated in Boulder County. Last, mining engineers had to plan for racking and swaying under loads, and vibration and shocks to the structure.[44]

Building a headframe that could stand under the sum of the above forces was not enough for service at a producing mine. Mining engineers had to forecast how they thought the headframe would interacted with the mine's production goals, and how it would interface with the rest of the hoisting system. The depth of the shaft, the speed of the hoist, and the rail system at the mine directly influenced the height of the structure. Deep shafts served by fast hoists required tall headframes, usually higher than 50 feet, to allow the hoistman plenty of room to stop the hoisting vehicle before it slammed into the sheave at top. Highly productive mining operations often utilized vertical space on their claims and constructed multiple shaft landings. Some companies using skips as hoist vehicles built rock pockets into the headframe, which also required height.

Mining engineers found four basic headframe designs adequate for the needs of heavy ore production. These included the *four-post derrick*, the *six-post derrick*, an *A-frame* known also as the *California frame*, and a heavily-braced two-post structure known as the *Montana type*. As the names suggest, engineers working in specific regions in the West favored certain headframe designs over others. While the above structures were intended to serve vertical shafts, two-post gallows headframes and a variety of A-frame up to 35 feet high were also erected to serve inclined shafts.[45]

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[43] Twitty, 1999:215.
[44] Ihlseng, 1892:91; International Textbook Company, 1899:A23:105; International Textbook Company, 1906:A53:31; Ketchum, 1912:41; Peele, 1918:926; Twitty, 1999:274.
[45] Twitty, 1999:275.

Figure E 5.2.27. The headframe at the Blue Jay Mine near Jamestown exemplifies a typical four-post derrick headframe. Production-class headframes, such as the one illustrated, tend to be higher than 25 feet. Source: Carol Beam.

To meet the various forces and the performance needs, nearly all mining engineers built their headframes with heavy timber beams assembled with mortise-and-tenon joints, timber bolts, and iron tie rods. In general, they used lumber of at least 10x10 inch dimensions and attempted to allocate full-length, uncut timbers for the posts and backbraces because of the solidity they offered. Skilled carpenters assembled the materials into towers that featured cross-members and diagonal bracing spaced every 6 to 10 feet. All four and six-post headframes featured stout backbracing anchored between the shaft and the hoist, and the entire structure stood on foundation footers straddling the shaft. The posts on A-frames, on the other hand, were set at an exaggerated batter, meaning they splayed out to absorb all of the vertical and horizontal stresses, and as a result A-frames used in association with both vertical shafts and inclines rarely had backbraces.[46]

[46] International Textbook Company, 1906:A53:35; Ketchum, 1912:7; Peele, 1918:935.

Mining engineers determined that production-class headframes, which weighed dozens of tons, required sound and substantial foundations to remain stable. A pre-planned and well-built foundation was one factor that set these structures apart from sinking-class headframes, and engineers used one of three basic designs. The first consisted of a squat timber cube featuring bottom sills, timber posts, and caps. The second type consisted of several log cribbing cells assembled with notches and forged iron spikes, and the third was a log or timber latticework consisting of open cubes between 4 and 6 feet high, capped with dimension timbers. The problem with the above foundations was that the perishable wood rotted when covered with waste rock, especially when the rock was highly mineralized. A few progressive mining engineers attempted to substitute concrete or rock masonry for wood to gain a lasting foundation, but only well-financed companies anticipating lengthy operation spent the time and money.[47]

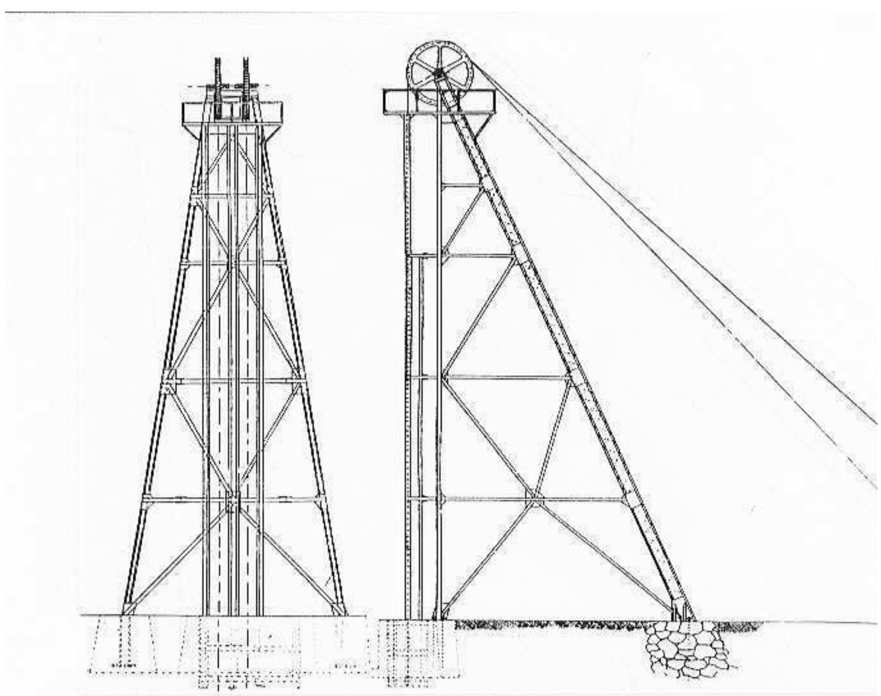

Figure E 5.2.28. The illustrated headframe is a production-class two-post gallows structure known as a Montana type. These headframes were usually tall, well-built, and stood over deep shafts. Source: Twitty, 2002:233.

[47] Twitty, 1999:283.

Table E 5.2.6.5: Headframe Specifications: *Type, Material, Class*

Headframe Type	Material	Class	Capital Investment
Tripod	Hewn Logs	Sinking	Very Low
Tripod	Light Timber	Sinking	Very Low
Two Post (Gallows Frame): Small	Timber	Sinking	Low
Two Post (Gallows Frame): Large	Timber	Production	Low to Moderate
Two Post (Gallows Frame): Large	Steel	Production	Moderate to High
Four Post: Small	Light Timber	Sinking	Low
Four Post	Timber	Production	Moderate
Six Post	Timber	Production	Moderate to High
Four and Six Post	Steel	Production	High
A-Frame	Timber	Production	Moderate to High
A-Frame	Steel	Production	High

(Copied from Twitty, 1999:281).

In the 1890s, professionally trained mining engineers working for the wealthiest and largest mining companies began experimenting with steel girders for headframes as an alternative to timber. According to many prominent mining engineers, steel was the ultimate building material for production-class operations because it did not decay, it was much stronger, it was non flammable, and it facilitated the erection of taller headframes. However, steel was significantly more expensive than timber, and as a result, few companies in Buolder County put up such structures.

Mining operations that were active during and after the Great Depression had the same needs for headframes as their predecessors. Most Depression-era outfits attempted to reuse existing headframes to save capital, and in such cases, the outfit merely had to effect necessary repairs. If the mine lacked its original headframe, then the outfit had to erect another one, and the replacement structures differed according to the outfit's nature.

Large mining companies under the guidance of formally trained engineers continued the practice of building four and six post derricks and A-frames to meet the rigors of ore production. Mining engineers still considered steel to be the ultimate answer for production-class headframes, although out of financial necessity they often resorted to timbers. But by the 1930s, a certain element of construction quality and craftsmanship had been lost. Workers no longer took the trouble to assemble the structure with intricate mortise-and-tenon joints. Instead, they simply butted the timbers against each other or created shallow square notch joints and bolted the frame together.

Impoverished outfits with neither the funding nor the means to build substantial structures instead assembled small headframes designed to be functional while incorporating little material. When possible, these mining companies relocated entire headframes from abandoned mines to their properties of interest. By nature, the headframes tended to be old sinking-class two-post gallows or four post derrick structures because they were simple, easy to transport, and required no formal engineering. Poorly funded and well-capitalized mining companies both installed timber A-frames to serve inclined shafts.

One practice that many mining companies shared was the utilization of salvaged timbers for building their headframes. Stout timbers were a precious and costly commodity during and after the Great Depression, and in hopes of saving capital, mining companies reused the heavy beams left by abandoned operations. As a result, headframes remaining from the 1930s and afterward may feature timbers differing in exact dimensions, weathering, and quality of the wood. In addition, salvaged timbers frequently exhibit abandoned mortise-and-tenon joint sockets, as well as abandoned bolt- and nail holes. The heavy use of such material for headframes, as well as for other structures, is typical of Depression-era construction.

E 5.2.7: Additional Surface Plant Components

The above descriptions of adit and shaft mines account for the elementary surface plant components found at both types of operations. Productive mining companies, however, often installed additional surface facilities that enhanced their ability to increase production and sustain activities underground. Below are descriptions of these facilities, and one or all the components could have been erected at adit, shaft, open pit mines.

E 5.2.7.2: Air Compressors

Blasting was of supreme importance to mining because it was the prime mover of rock underground. During much of the nineteenth century, miners traditionally drilled holes by hand, loaded them with explosives, and fired the rounds. Hand-drilling proved slow, but no practical alternative existed to take its place until mining companies began introducing mechanical rockdrills during the 1870s and 1880s. When drilling by hand, miners typically advanced tunnels and shafts only one to three feet per shift in hard rock. By contrast, the types of mechanical rockdrills manufactured during the 1880s and 1890s permitted miners to bore greater numbers of deeper holes and advance a tunnel or shaft approximately three to seven feet per shift, instead. As drilling technology improved during the 1890s and 1900s, miners were able to make even greater progress. The rates of work achieved with the greasy and noisy machines convinced many mining engineers that the relatively high cost was justified.[48]

The air compressor lay at the heart of the compressed air system, and while those manufactured between the 1880s and 1920s came in a variety of shapes and sizes, they all

[48] Gillette, 1907:15; Hoover, 1909:150; International Correspondence Schools, 1907:13; Peele, 1918:184, 213; Young, 1946:87.

operated according to a single basic premise. Compressors of this era consisted of at least one relatively large cylinder, much like a steam engine, which pushed air through valves into plumbing connected to an air receiving tank. The volume of air that a compressor delivered, measured as *cubic feet of air per minute* (cfm), depended on the cylinder's diameter and stroke, as well as how fast the machine operated. The pressure capacity, measured as *pounds per square inch* (psi), depended in part on the above qualities as well as how stout the machine was, its driving mechanism, and on check valves in the plumbing. Generally, high pressure, high volume compressors were large, strong, durable, complex, and as a result, expensive.

The mechanical workings of the air compressors manufactured prior to around 1890 were relatively simple. The two most popular types were *steam-driven straight-line* and the *steam-driven duplex* models, and both styles served as a basis for designs that served the mining industry well for over 60 years. The straight-line compressor, named after its physical configuration, was the least expensive, oldest, and most elemental of the two types of machines. Straight-line compressors were structurally based on the horizontal steam engine and featured a large compression cylinder at one end, a heavy cast iron flywheel at the opposite end, and a steam cylinder situated in the middle, all bolted to a cast iron bedplate. The steam cylinder powered the machine and the flywheel provided momentum and smoothed the motion.

During the 1870s and early 1880s, mechanical engineers improved many of the inefficiencies attributed to early straight-line models. First, engineers modified the compression cylinder to make it double-acting, much like an old-fashioned butter churn. In this design, which became standard, the compression piston was at work in both directions of travel, being pushed one way by the steam piston and dragged back the other way by the spinning flywheel. In so doing the compression piston devoted 100 percent of its motion to compressing air.

The other fundamental achievement concerned cooling. By nature, air compression generated great heat, which engineers found not only fatigued the machine but also greatly reduced efficiency. Early compressor makers added a water-misting jet that squirted a spray into the compression cylinder, cooling the air and the machine's working parts. While the water spray solved the cooling issue, it washed lubricants off internal working parts and humidified the compressed air, all of which significantly shortened the life of what constituted an expensive system. By the mid-1880s, American mining machinery makers replaced the spray with a cooling jacket, leaving the internal working parts dry and well-oiled. Mining companies employing the machines had to include a water system for cooling, which was usually no more that a water tank plumbed to the compressor.

During the early 1880s, mechanical engineers forwarded several other significant improvements. Engineers found that coupling the compression piston to the steam piston with a solid rod, so that both acted in tandem, proved highly inefficient. The steam piston was at its maximum pushing power when it was just beginning its stroke, while the compression piston, also beginning its stroke, offered the least resistance. When the steam piston had expended its energy and reached the end of its stroke, the compression piston offered the greatest resistance because the air in the cylinder had reached maximum compaction. Mechanical engineers recognized this wasteful imbalance and designed an intermediary crankshaft that reversed the relationship between the pistons. Despite the superior efficiency of this design, mining companies usually selected the simpler compressors with solid shafting because they cost less.

During the late 1880s and early 1890s, mining engineers fine-tuned compressed air technology used for hardrock mining. The most significant advance was a design that generated greater air pressure, which made drills run faster and improved the pressurization of the maze-like networks of plumbing in large mines. Mining machinery makers began offering straight-line and duplex compressors capable of achieving what the industry termed *multistage compression*. To increase pressure, mechanical engineers divided the compression between high and low pressure cylinders in several stages, instead of in a single cylinder. They designed the low-pressure cylinder to be relatively large, and it forced semi-compressed air into the small high-pressure cylinder, which highly compressed the air and released it into a receiving tank.

Mining machinery makers designed multistage straight-line compressors with two and even three compression cylinders coupled onto the steam drive piston, and they produced duplex compressors with several multistage cylinder arrangements. The most common multistage duplex compressor was the *cross-compound* arrangement, in which one side of the machine featured the low-pressure cylinder, and the air passed from it through an intercooler to the high-pressure cylinder on the other side. In general, companies with heavy air needs installed multistage compressors while operations with limited capital continued to rely on the less costly, conventional models.

As the 1890s progressed toward the turn-of-the-century, mining machinery makers began to offer air compressors that were smaller, more efficient, and provided better service for the expense than the early duplex and straight-line models. Machinery makers adapted several designs to be run by electric motors and gasoline engines, which were energy sources well-suited for remote mines. Progressive mining engineers working in regions where fuel was costly eagerly experimented with electricity and gasoline, while mining companies in areas where coal and cord wood were more plentiful continued to install steam compressors as late as the 1910s. Gasoline and electric compressors underwent gradual acceptance rather than being embraced overnight, but once they had proven their worth by the 1910s, many mining companies throughout Boulder County replaced their aging steam equipment with electric and petroleum-powered machinery.

The motor-driven compressors offered by machinery manufacturers around the turn-of-the-century were based on belt-driven models made since the early 1880s. By the late 1890s, mining machinery makers offered three basic types of electric compressors, including a straight-line machine that was approximately the same size as traditional steam versions, a small straight-line unit, and a duplex compressor. Duplex models, conducive to multistage compression, were most popular among medium-sized and large mining companies, while moderately sized mining operations favored the small straight-line units. Due to limited air output compared with a relatively large floor space, the large electric straight-line compressors never saw popularity.

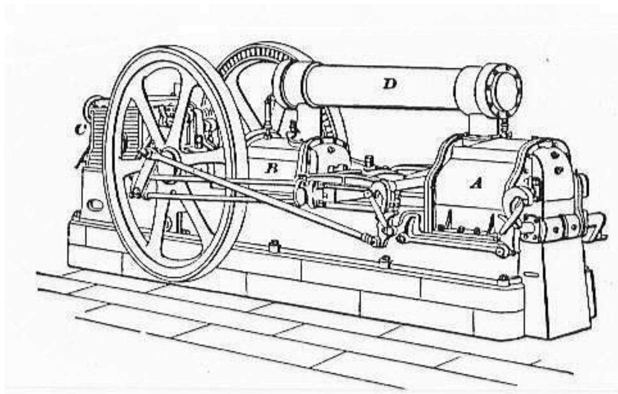

Figure E 5.2.29. The line drawing depicts a straight-line steam compressor that provided two stages of compression. One compression cylinder is at right, another is at center, and the steam drive cylinder is at left. The flywheels imparted momentum to the machine. Source: International Textbook Company, 1899, A20:32.

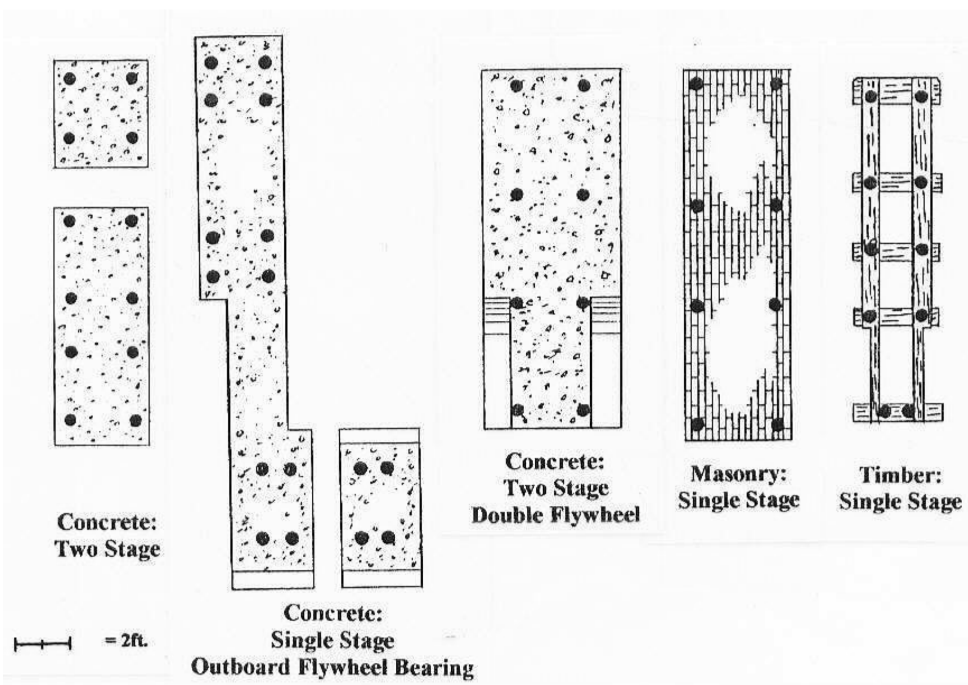

Figure E 5.2.30. The plan view depicts foundations for straight-line compressors. Source: Twitty, 2002:145.

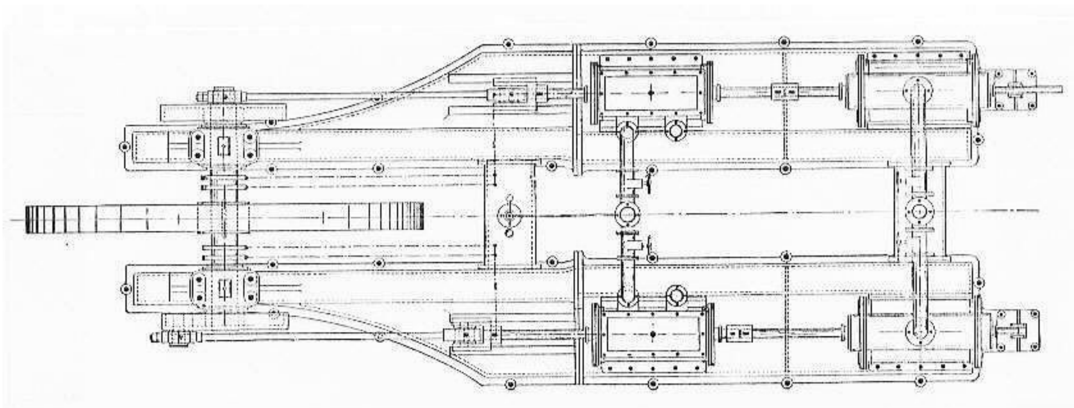

Figure E 5.2.31. The plan view depicts a duplex steam compressor. The compression cylinders are at right, the steam drive cylinders are at center, and the flywheel is at left. Source: Ingersoll Rock Drill Company, 1887:34.

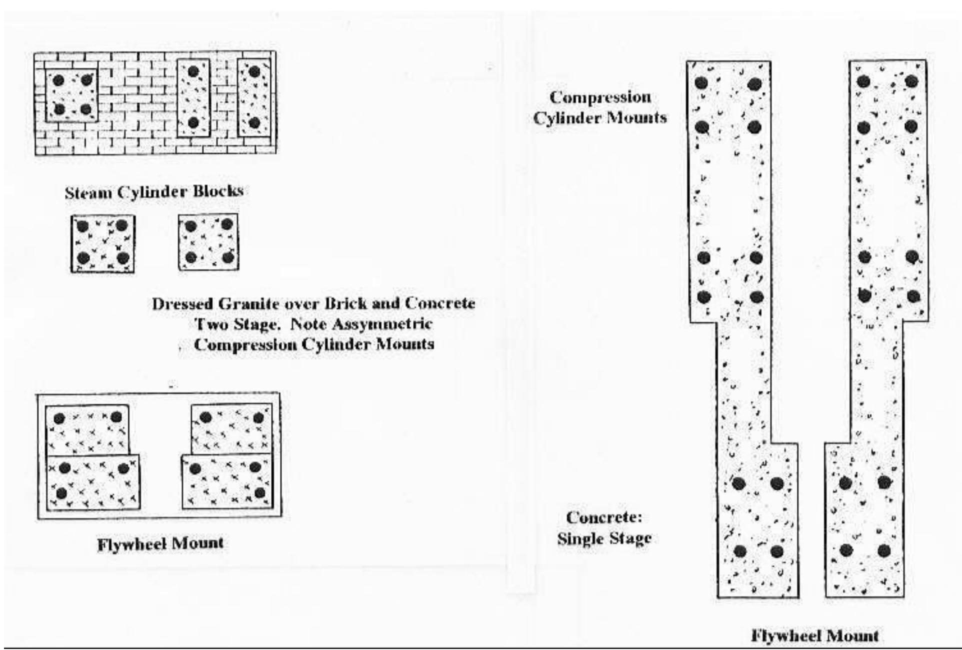

Figure E 5.2.32. The plan view portrays two common foundations for steam-driven, duplex compressors. The foundation at right was for a machine like the one in the figure above, and the foundation at left anchored a compressor with compound action. Source: Twitty, 2002:108.

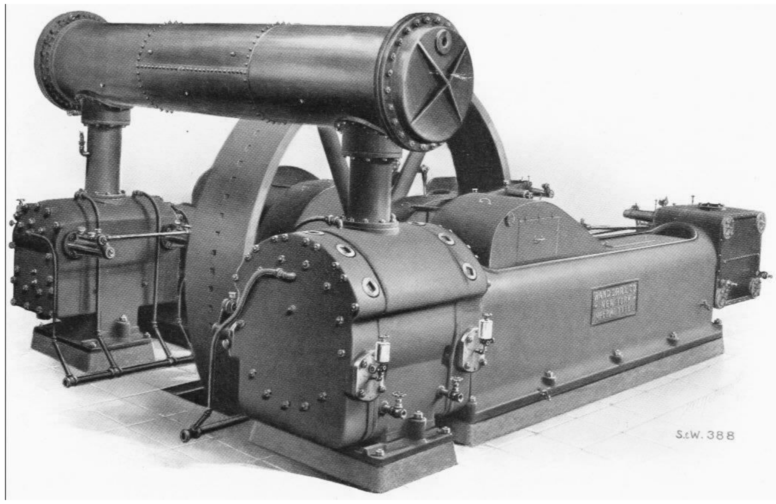

Figure E 5.2.33. During the 1890s, the above form of duplex compressor became popular due to its efficiency and compact size. Originally, these machines were powered by steam, and by the 1900s, some were also belted to motors where electricity was available. Source: Rand Drill Company, 1904:12.

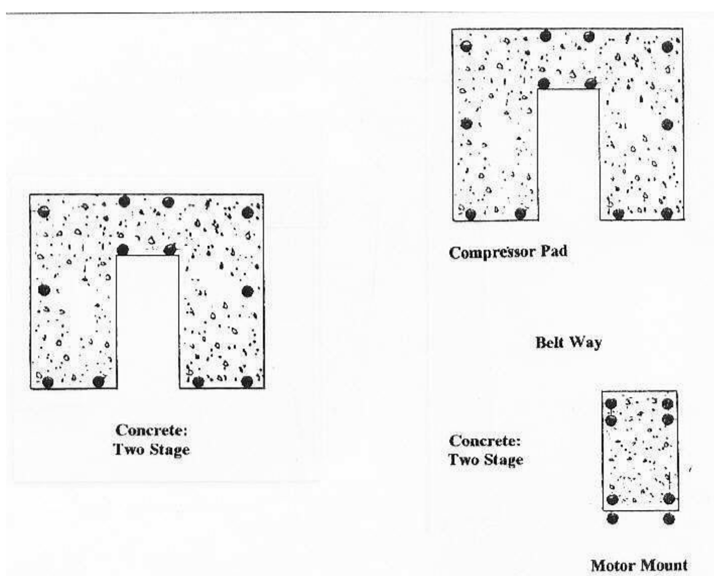

Figure E 5.2.34. The plan view depicts the common foundations for duplex compressors. The foundation at left anchored a steam-powered unit, and the one at right was for a belted version, which became popular by the 1910s. Source: Twitty, 2002:109.

Figure E 5.2.35. The V-cylinder compressor, similar to a large engine, became one of the most popular compressor types after the 1930s. Note the foundation. Source: Twitty, 2002:274.

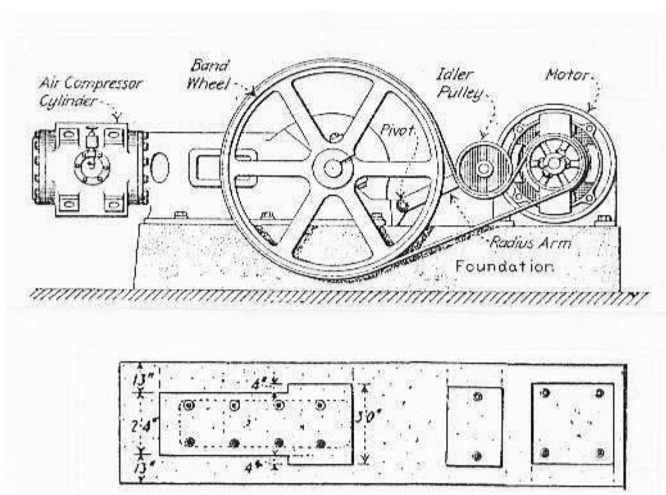

Figure E 5.2.36. The profile illustrates the type of small, belted compressor popular between the 1910s and 1940s. The plan view depicts the foundation, which features mounts for the compressor and motor. Source: Author.

Table E 5.2.7.1: Air Compressor Specifications: ***Type, Popularity Timeframe, and Capital Investment***

Compressor Type	Age Range	Capital Investment
Upright: 2 Cylinders, Belt Driven	1900s-1940s	Low
Upright: 3 to 4 Cylinders, Integral Gasoline Piston	1930s-Present	Moderate
V Pattern	1930s-Present	Moderate to High
Straight-Line, Single Stage, Gasoline Engine Driven	1900s-1930s	Low
Straight-Line, Single Stage, Steam Driven	1880s-1920s	Moderate
Straight-Line, Two Stage, Steam Driven	1890s-1920s	High
Straight-Line, Triple Stage, Steam Driven	1890s-1920s	Very High
Straight-Line, Single Stage, Geared to Electric Motor	1900s-1920s	Moderate
Straight-Line, Various Stages, Geared to Electric Motor	1900s-1920s	High
Straight-Line, Single Stage, Belt Driven by Electric Motor	1900s-1940s	Low
Duplex, Single Stage, Steam Driven	1890s-1920s	Moderate
Duplex, Two Stage, Steam Driven	1890s-1920s	High
Duplex, Triple Stage, Steam Driven	1890s-1920s	Very High
Duplex, Two Stage, Belt Driven	1900s-1940s	Moderate
Duplex, Three Stage, Belt Driven	1900s-1940s	Moderate to High

(Adapted from Twitty, 1999:130).

Compressor makers also developed economically attractive gasoline units ideal for remote and inaccessible operations. The gasoline compressor, introduced in practical form in the late 1890s, consisted of a straight-line compression cylinder linked to a single cylinder gas engine. Most mining engineers considered gas compressors to be for sinking duty only. Large gasoline machines were capable of producing up to 300 cubic feet of air at 90 pounds per square inch, permitted mining companies to run up to four small rockdrills.[49]

The noisy gasoline machines had needs similar to their steam-driven cousins. Gasoline compressors required cooling, a fuel source, and a substantial foundation capable of withstanding intense vibration, and they came from the factory either assembled or in large components for transportation into the backcountry. The cooling system often consisted of no more than a water tank, and the fuel system could have been simply a large sheet iron fuel tank connected to the engine by one-quarter to one-half inch metal tubing.

By the 1920s, the use of rockdrills had rendered hand-drilling uneconomical except for special applications. The trend continued through the 1930s as rockdrill makers offered an ever widening variety of machines that accomplished even the limited specialized work previously

[49] Twitty, 1999:126.

completed by hand-drilling. Mining during and after the Great Depression was no exception, and miners had come to rely on drills more than ever to achieve production.

The motor-driven duplex and straight-line compressors introduced during the 1900s and 1910s maintained supremacy among mining operations through the 1940s. Well-financed mining companies requiring high volumes of air at high pressures continued to favor belt-driven duplex compressors, while companies with slightly reduced air needs relied on relatively inexpensive single-stage belt-drive straight-line compressors.

Despite the common reliance on older designs, compressed air technology had undergone dynamic changes since the 1910s. Mechanical engineers began to experiment with unconventional designs beginning in the 1900s, and during the 1910s several of these models experienced commercial production. By the 1930s, mining companies in Colorado became interested some of the modern designs in hopes of maximizing efficiency.

The popularization of automobile engines gave rise to several alternative forms of compressors based on engine mechanics. By the 1910s, an *upright two-cylinder compressor* with valves and a crankshaft like an automobile engine had become popular. Used on an experimental basis as early as the 1900s by prospect operations, these units were inexpensive, adaptable to any form of power, and weighed little. Further, mining machinery makers had mounted them onto four-wheel trailers or simple wood frames for mobility. *V-cylinder compressors*, also known as *feather valve compressors*, were adaptations of large-displacement truck engines and featured 3 to 8 cylinders arranged in a "V" configuration. The new design relied on a grossly enlarged radiator for cooling and was powered by an electric motor directly coupled onto the crankshaft.

In most cases, when a mine was abandoned the compressor was removed, leaving the foundation as the machine's only representation, and based on a foundation's footprint, the researcher can often determine the exact type of compressor. Following are descriptions of the foundations for the common types of compressors. Straight-line steam compressors usually stood on foundations that featured a rectangular footprint and a flat top-surface studded with two rows of anchor bolts. In general, workers used masonry or concrete, although they bolted some machines less than 12 feet long to timber foundations. Foundations for large compressors often featured individual blocks for the steam and compression cylinders and a separate pedestal adjacent to one end for an outboard flywheel bearing.

Foundations for duplex steam compressors manufactured between the 1870s and 1890s consist of a pair of rectangular pads spaced several feet apart. Workers almost always used masonry or concrete, and both pads feature a symmetrical arrangement of anchor bolts. Foundations for large machines often featured individual stone blocks for the steam and compression cylinders, and the flywheel, which rotated in the gap between. The smaller, compact duplex compressors introduced during the late 1890s were bolted to foundations easily identified today. Foundations for these machines are U-shaped, slightly rectangular, and tend to be several feet high.

Straight-line belt-driven compressors were bolted to foundations similar in appearance and size to those for their steam-driven counterparts. Because belt-driven compressors usually featured a heavy, large flywheel, their foundations often featured a separate pedestal adjacent to one end for the flywheel's outboard bearing. A second, rectangular foundation for the drive motor, usually 3 by 3 feet in area or less, should be located nearby.

Compact duplex belt-driven compressors were bolted to the same type of foundation as their steam-driven cousins. A small, rectangular foundation for the drive motor should be located nearby and directly aligned with the open end of the compressor foundation.

Due to severe vibrations, petroleum compressors were usually bolted to stout concrete foundations often several feet high. The foundation is almost always rectangular, several feet wide, less than 9 feet long, and features two rows of anchor bolts.

Upright compressors, small in size, could have been bolted to either timber or concrete foundations rectangular in footprint. A pad for the engine or motor should be adjacent and aligned.

Foundations for V-cylinder compressors tend to be fairly distinct and often feature an adjacent mount for a motor or engine. Compressors that featured several cylinders were often bolted to rectangular foundations between 4 by 5 feet and 3 by 3 feet in area, while the foundations for machines with numerous cylinders were several feet wide and up to 10 feet long. Workers often constructed foundations with a series of closely spaced timbers bolted to either an underlying concrete pad or buried timber footer.

E 5.2.7.2: Electricity

Mining engineers in the West began experimenting with electricity as early as 1881 when the Alice Mine & Mill in Butte, Montana attempted to illuminate its perpetually dim passages and buildings with light bulbs. At that time, electric technology was new and its practical application was limited primarily to lighting. During the 1880s, visionary inventors demonstrated that electricity was able to do mechanical work as well, which interested progressive mining engineers.[50]

During the late 1880s and into the early 1890s, engineers working for profitable and well-capitalized companies in technologically advanced mining districts attempted to turn their curiosity into practical use. They made their first attempts to run machinery in locations that featured a combination of water and topographical relief where they could generate hydro-power. In 1888, the Big Bend Mine on the Feather River in California experimented with electricity, and the Aspen Mining & Smelting Company, in Aspen, Colorado, used electricity to run a custom-made electric hoist that served a winze underground. Two years later, progressive mining companies in Telluride and Rico adapted electricity to run machinery and illuminate the darkness. Colorado, and especially the San Juan Mountains, continued to be a proving ground

[50] Twitty, 1998.

for the application of electricity through the 1890s, although electric plants were a rarity in the greater West until the late 1890s. Inherent limitations in electrical technology were the main reason why the mining West was slow to embrace the power source at first.

Several factors came into play that excited interest in electrification during this time. First, the nation's economy and the mining West were recovering from the severe economic depression associated with Silver Crash of 1893, and mining companies once again had capital to work with. Second, electrical and mining engineers had made great strides in harnessing electricity for the unique work of mining. The earliest electrical circuits wired during the 1880s and early 1890s were energized with Direct Current (DC) which had a unidirectional flow, and during this time mining engineers were experimenting with Alternating Current (AC), which oscillated.

Neither power source, as they existed during the 1890s, was particularly well suited for mining. AC current had the capacity to be transmitted over a dozen miles with little energy loss, but AC motors were incapable of starting or stopping under load. Therefore AC was worthless for running hoists, large shop appliances, and other machines that experienced sudden drag or required variable speed. AC electricity was effective, however, for running small air compressors, ventilation fans, and mill equipment because they were constant-rotation machines that offered little resistance. DC electricity, on the other hand, had the capacity to start and stop machinery under load, but the electric current could not be transmitted more than several miles without suffering debilitating power loss. Therefore DC current had to be used adjacent to its point of generation. In addition, DC motors were incapable of running the massive production-class machines that mining companies had come to rely on for profitable ore extraction.[51]

Based on the above, electrical technology as it existed during the 1890s offered mining companies little incentive to junk even small pieces of steam equipment. However, enough progressive industrialists and engineers saw the benefits offered by electricity to keep the movement of application going. As a result, in the mid- and late 1890s a few capitalists formed electric companies that wired well-developed mining areas such as Cripple Creek, Telluride, Silverton, Central City, and Creede. More electric companies formed in districts of similar magnitude during and shortly after 1900. The characteristics that these mining districts shared was that they were compact and limited in area, lending themselves to DC power distribution, and they encompassed a high density of deep, large, and profitable mines, which constituted a potentially significant consumer base.

Around 1900, electrical appliance manufacturers made several important breakthroughs that rendered the power source useful for mining. Electricians developed the three-phase AC motor, which could start and stop under load while using a current that could be transmitted long distances. They also invented practical DC/AC converters, which permitted the use of DC motors on the distribution end of an AC electric line. The net result was that electricity became an attractive power source to a broad range of electric consumers.

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[51] International Textbook Company, 1899:A23:5; Peele, 1918:1126; Twitty, 1998.

Still, many Colorado mining companies were not yet willing to relinquish traditional steam technology because even the new three-phase AC motors were capable of only driving sinking-class hoists and small compressors. In addition, voltage, amperage, and current had not yet been standardized among machinery manufacturers or among the various power grids, which discouraged engineers from embracing the use of motors for critical mine plant components. Many pragmatic, professionally educated mining engineers felt that while electricity indeed offered benefits during the 1900s and 1910s, it was no where near ready to replace steam power.[52]

The rigors of mine hoisting proved to be one of the greatest obstacles electricity had to overcome, but by the 1900s mining machinery manufactures had developed a variety of small AC and DC models that were reasonably reliable. The early electric hoists were similar in design to sinking-class geared steam hoists, and they were manufactured by mining machinery makers with motors wholesaled from electric appliance companies such as General Electric. Even though the electric hoists were able to start and stop under load, they were very slow and had a limited payload capacity.[53]

By the 1910s, the application of electricity progressed to the point where mining engineers could not deny the potential savings in operating costs, and that the performance of electrical machinery was rapidly approaching that of all but the titanic direct-drive steam hoists. As steam machines began showing wear after years of use, the engineers in charge of large and medium-sized mines began replacing them with electric models, and some of the new apparatuses demonstrated that electricity was more efficient than steam. One engineer asserted that in well-developed mining districts, a steam-driven compressor cost up to $100 per horsepower per year to run while an electric model cost only $50. The cost savings were probably even greater for hoisting.[54]

Mining machinery makers had made the greatest advances with electric hoists during the 1910s. Not only had electrical engineers and machinery makers improved the performance and reliability of single-drum electric hoists, but also they introduced effective double-drum units for productive mines interested in achieving economies of scale through balanced hoisting. Within ten more years, except for remote and poorly capitalized operations, much of Colorado adopted electric power for hoisting as well as running other types of mining machinery.

Curiously, Boulder County's mining industry lagged behind much of Colorado in embracing electricity. Historic newspapers and mining journals occasionally note the installation of electric hoists and more often electric compressors during the 1910s, but the county's mining industry did not embrace the power source until the 1930s. Even then, some mining companies still relied on the same steam equipment that had been on specific properties for decades.

The construction of Barker Dam made electricity available at the relatively late date of 1907, and had there been enough of a demand, perhaps a powerplant would have been built

[52] Twitty, 1999:269.
[53] Twitty, 1999:270.
[54] Twitty, 1999:270.

earlier. Several reasons explain the slow acceptance of electricity. First, the mountainous portion of Boulder County lacked enough of a customer base. Most of the mines were relatively small and operated intermittently, and hence their operators were unwilling to spend the capital necessary to convert to electricity. Second, the county's mining industry did not offer enough large, productive mines to interest power companies. Third, because the mines that were productive enough to justify the expense of converting to electricity were disbursed over a wide geographic area, installing a service grid would have been costly.

E 5.2.7.3: Architecture

Once a mining company had proven the existence of ore the investors, who often had influence over management policy, fully expected the operation to perform throughout the year, during good weather and bad, until the ore had been exhausted. Attempting to comply with company wishes, mining engineers responded by using available capital to erect structures that sheltered important surface plant components against the weather. To this end, engineers understood that buildings served two purposes: mollifying the physical needs of the mine crew, and sheltering plant components that were intolerant of or performed poorly when exposed to adverse weather. The engineer and the mining company also had a tacit understanding that mine buildings possessed the ability to inspire investors and prominent figures in the mining industry. Large, well-built, and stately structures such as those at Caribou conveyed a feeling of permanence, wealth, and industrial might while small and poorly constructed buildings aroused little interest from investors and promoters.

Building materials, architectural styles, and structure layouts for mine buildings in Boulder County evolved between the 1870s and the 1920s. Perhaps small mining outfits in remote areas realized the greatest gain from changes in conventional construction practices as the expanding network of roads and railroads reduced the costs of importing building materials. Regardless of a mine's location, the buildings erected by well-financed, profitable, and large mining companies tended to be substantial and well-built while the buildings belonging to poorly funded and limited mining companies were crude, small, and rough.

Professionally trained mining engineers considered four basic costs that influenced the type, size, and constitution of the buildings they chose to erect. First, time had to be spent designing the structure. Second, basic construction materials had to be purchased and some items fabricated. Third, the materials had to be hauled to the site, and fourth, the mining company had to pay a crew to build the structure. Between the 1870s and around 1900, well-capitalized companies attempted to meet the above considerations by erecting wood frame structures sided with dimension lumber. In a few cases, small and poorly funded operations working deep in the mountains substituted logs, but they understood that the log structures were intended to be impermanent, either to be replaced by dimension lumber should the mine prove a bonanza or totally abandoned should the mine fail.

The introduction of steel and iron building materials to the mining industry in the1890s changed the structures erected by mining companies. A number of steel makers began selling iron siding for general commercial and residential construction nation-wide in the 1890s. While much of the siding was decorative, a few varieties were designed with industrial applications in mind. One of these types, corrugated sheet iron, found favor with the mining industry and its use spread rapidly. Engineers increasingly made use of the material through the 1900s, and by the 1910s it had become a ubiquitous siding for all types of mine and many commercial buildings in Boulder County's mining districts. The advantages of corrugated sheet iron were that it cost little money, its light weight made it inexpensive to ship, it covered a substantial area of an unfinished wall, the corrugations gave the sheet rigidity, and it was easy to work with. These qualities made corrugated sheet steel an ideal building material where remoteness rendered lumber a costly commodity.[55]

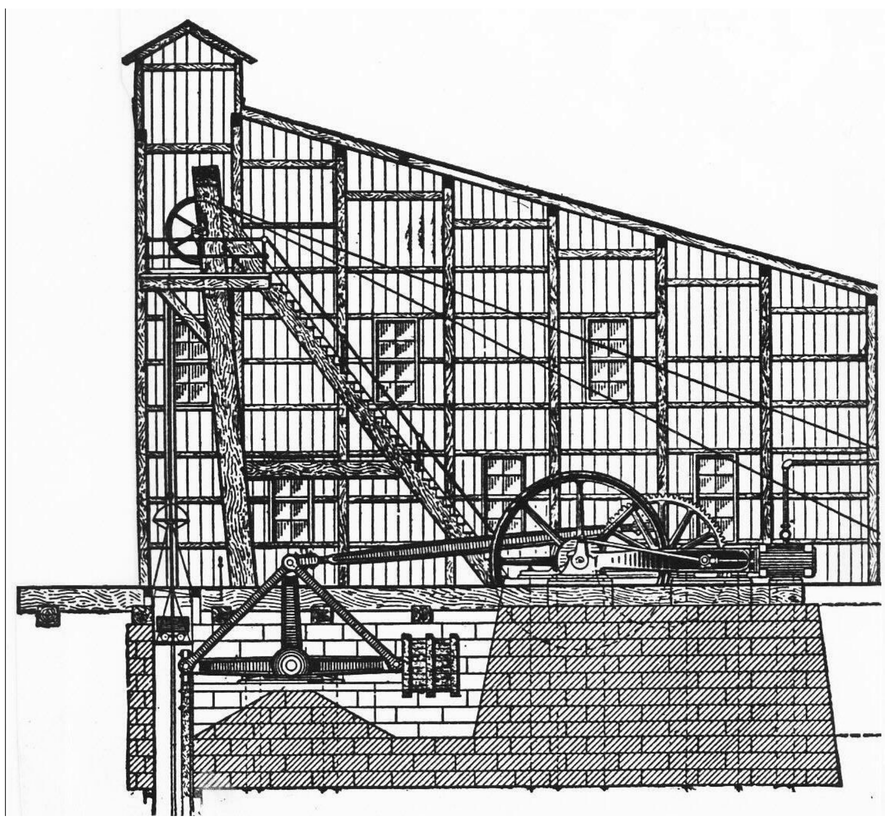

Figure E 5.2.37. Shaft houses enclosed the shaft collar, headframe, hoist, power system, and usually the blacksmith shop. The shaft house in the profile also features a Cornish pump and steam engine. Source: International Textbook Company, 1899, A43:3.

[55] Twitty, 1999:304.

Figure E 5.2.38. Most of Boulder County's mining companies erected shaft houses similar to this modest one at the Snowbound Mine, pictured above. The building is well-built and is based on a balloon frame. Common at one time, shaft houses are now important and rare structures. Source: Author.

Figure E 5.2.39. After shaft houses were outlawed during the 1910s, mining companies erected hoist houses to enclose critical facilities. The Blue Jay Mine's hoist house, near Jamestown, is a typical example. The left roofline features an angled cupola for the hoist cable, which ascended to a headframe left and out of view. Source: Author.

The other significant use of steel in mine buildings occurred during the 1890s when a few prominent companies began to experiment with girders for framing large buildings such as mills. Architects began using steel framing to support commercial and industrial brick and stone masonry buildings as early as the mid-1880s, but mining companies in general found that wood framing met their needs as well and for less money. By the 1890s architectural steelwork had improved and steel makers offered lightweight beams which mining engineers adapted to the framing of large buildings. Further, engineers found that steel not only offered a sound structure able to rebuff high winds, but also it often cost less money than the thousands of board-feet of lumber required to erect the massive and imposing buildings, and steel had the added benefit of being fire-proof.

The general forms, types, and layouts of mine structures followed a few general patterns, regardless of the building materials. Between the 1870s and 1910s, most mining engineers enclosed the primary surface plant components clustered around the shaft in an all-encompassing *shaft house*, and the plant components associated with a tunnel in a *tunnel house*. These buildings contained machinery, the shop, the mine entrance, and a workspace under one roof. The buildings therefore tended to be large, tall, and unmistakable edifices. Relatively small shaft houses in Boulder County were often constructed of stout post-and-girt frame walls, gabled rafter roofs, and informal or no foundations. Particularly spacious shaft houses required a square-set timber skeleton capable of supporting the roof independent of the walls. Regardless of the type of frame, carpenters clad the walls with board-and-batten siding, several layers of boards, and, by the 1900s, corrugated iron siding. Prior to the 1910s, electric lighting was virtually unheard of, and mining engineers designed large multi-pane windows at regular intervals in the walls for lighting.

Most shaft houses conformed to a few standard footprints influenced by the arrangement of the mine machinery. Overall, the structures tended to be long to encompass the hoist, which the engineer had usually anchored some distance from the shaft, and they featured lateral extensions that accommodated the shop, a water tank, the boilers, and either coal or cord wood storage. Professionally educated mining engineers recommended that at least the boiler, and ideally the shop as well, be partitioned in separate rooms because they generated unpleasant soot and dust which took a toll on lubricated machinery.[56]

The roof profile typical of most shaft houses featured a louvered cupola enclosing the headframe’s crown and a sloped extension descending toward the hoist to accommodate the hoist cable and the headframe’s backbraces. Tall iron boiler smokestacks pierced the roof proximal to the hoist, the stovepipe for the forge extended through the roof near the shaft collar, and the shaft house may have also featured other stovepipes for the stoves that heated the hoistman’s platform and the carpentry shop. The tall smokestacks and stovepipes usually had to be guyed with baling wire to prevent being blown over by strong winds.

[56] Twitty, 1999:306.

The mining engineer working at high elevations often had the shaft house interior floored with planks to improve heating. In some cases the shop and boiler areas, where workers dropped smoldering embers, hot pieces of metal, and nodules of fresh clinker were surprisingly also floored with planking, which presented an enormous fire hazard. Customarily the mining engineer designed the flooring to be flush with the top surfaces of the machine foundations, permitting the steam, air, and water pipes to be routed underneath and out of the way.

Shaft houses colossal enough to cover a bank of boilers, a large hoist, air compressor, and a shop were extremely costly to build and they required expensive upkeep. In addition, the heat generated by the shop forge, boilers, and a few woodstoves proved no match for the frigid winds of winter. In response to such an economic drain, during the 1900s and 1910s many mining companies began sheltering key surface plant components in individual buildings. The appearance of the surface plants of many mines changed to consist of a cluster of moderate-sized buildings surrounding the exposed headframe. Instead of a shaft house, particularly large and well-equipped mines featured a *hoist house* for the hoist and boilers, a *compressor house* for the compressor, and the shop in its own building. The mine plant may have also featured a miner's *change house* also known as a *dry*, a storage building, a stable, a carpentry shop, and an electrical substation.

After a number of catastrophic fires where burning shaft houses trapped miners underground and suffocated them, during the 1910s the U.S. Bureau of Mines outlawed shaft houses made of flammable materials. Most mining companies were forced to dismantle their shaft houses, leave their headframes in the open, and enclose the surface plant components in separate buildings. Small and medium-sized mines often combined the hoist, compressor, change area, and shop in one large hoist house or several structures. Exceptions were made, however, for headframes enclosed in buildings limited only for that function.

The general construction methods and architectural styles of the 1930s and afterward changed slightly from the practices of the late nineteenth century. Mining companies with funding tended to erect buildings that were spacious with lofty gabled or shed-style roofs, and appeared more formal and tidy than the structures built by companies with little capital. Engineers continued to take advantage of natural light and they provided broad custom-made doors at important points of entry. Engineers either floored principle structures with poured portland concrete, which was inexpensive due in part to the proliferation of the truck, or they stood the buildings on proper foundations and used wood planking. The construction materials of preference included virgin lumber, virgin sheet iron, and factory-made hardware. The workers, often skilled in their trade, built lasting structures with a solid, tidy, and orderly industrial appearance. In most cases, mining engineers emphasized function and cost in their designs and added little ornamentation.

Poorly funded mining outfits, by contrast, were economically forced to keep construction within a tight budget, and within their skills. These outfits could not afford quality construction materials and tools, they were not able to hire experienced engineers or architects, and they lacked the funding to hire skilled workers. As a result, the buildings that many marginally funded companies erected tended to be small, low, made with high proportions of salvaged materials, and poorly constructed overall. Such buildings were personal and unique to each mining operation, being a true expression of the outfit's nature, and assembled as the builder saw fit.

The structures erected by poorly capitalized mining companies during and after the Great Depression can be divided into two categories. Small outfits with at least some capital and a crew with modest carpentry skills built structures that consisted of a crude but sound frame, often of the post-and-girt variety, sided with salvaged, mismatched lumber and sheet iron. Doors and windows also were salvaged from elsewhere such as abandoned residences. Some structures even had mismatched walls, each face of the building having been sided differently from the others. Overall, these buildings appeared rough and battered even when relatively new, but they were fairly well-built and offered miners and equipment shelter.

For the second category, the mine buildings appeared even cruder, were poor quality, and had dubious structural integrity. Laborers frequently built such buildings with no formal frames. Instead, the workers often preassembled the walls, stood them up, and nailed them together, or established four corner-posts, added cross braces, and fastened siding to the boards. The builders may have used a patchwork of planks and sheet iron for siding, which was often layered to prevent being ripped apart by high winds. Many mining outfits favored the shed structural style, which featured four walls and a roof that slanted from one side of the building to the other, because it was simplest to erect. The architectural style of the mine buildings erected by such mining companies during the 1930s may be termed *Depression-era Western mining vernacular*.

E 5.2.7.4: Ore Storage

While capitalists, mining engineers, and miners often held differing opinions as to how to set up and run a mine, all were in agreement that the primary goal was the production of ore. Those mines with any measurable output usually featured an ore storage facility to accommodate production, and two basic types of facilities were popular among Boulder County's hardrock mines. *Ore bins* were functionally different from *ore sorting houses*, and the mining engineer based his choice on which structure he built on the type of ore being mined. Some ores in the county were fairly consistent in quality and rock type, and they warranted storage in an ore bin. The quality and consistency of some of the ores, on the other hand, varied widely in any single given mine, and they required sorting, separation from waste rock, and rudimentary concentration in an ore sorting house. Both types of structures required a means of inputting ore from the mine and a means of extracting it for shipment to a mill for finer concentration.

Mining engineers recognized three basic types of ore bins: the *flat-bottom bin*, the *sloped-floor bin*, and a structure which was a hybrid of the above two known as a *compromise bin*. Mining companies with regular ore production often erected large sloped-floor ore bins. These structures were lasting, strong, and had a look of permanency and solidity that inspired confidence. Well-built sloped-floor bins, which cost more than twice to build than flat-bottomed bins, typically consisted of a heavy post and girt frame sided on the interior with planking. The structures generally stood on foundations of posts tied to heavy timber footers placed on terraces of waste rock. To ensure the structure's durability in the onslaught of the continuous flow of sharp rock coming from the mine, construction laborers often armored bin floors with salvaged plate iron. Small mines used sloped-floor bins consisting of a single-cell, while large mines erected structures that included numerous bins to hold either different grades of ore, or batches of payrock produced by multiple companies of lessees working within the same mine.

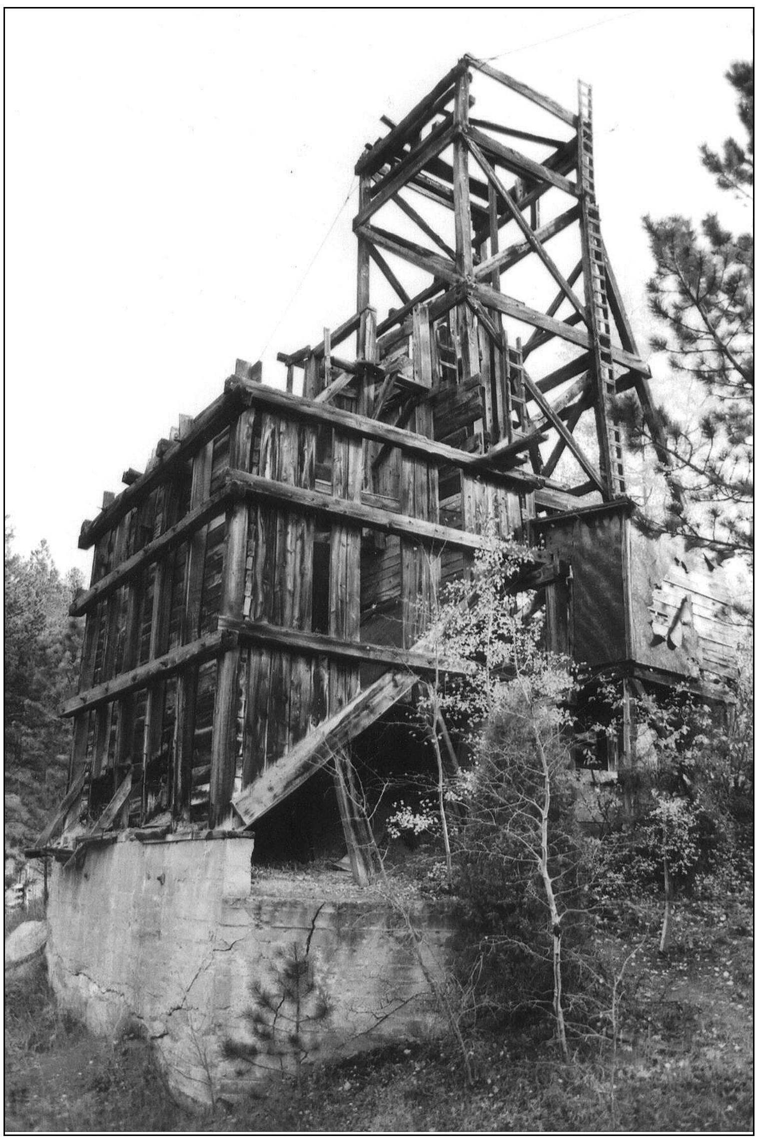

Figure E 5.2.40. The Blue Jay Mine featured a sloped floor ore bin adjacent to the headframe. Most ore bins stood on the shoulder of a mine's waste rock dump. Source: Author.

Mining companies with limited financing and minor ore production erected flat bottom bins because such structures were inexpensive to build. Rarely did these ore storage structures attain the sizes and proportions of their large sloped-floor cousins because the walls were not able to withstand the immense lateral pressures exerted by the ore. Flat-bottomed bins had to contend with pressures on all four walls, while sloped-floor bins directed the pressure against the front wall and the diagonal floor.

Ore sorting houses were generally more complex and required greater capital and engineering to erect than ore bins. The primary functions of ore sorting houses were both the concentration and the storage of ore. In keeping with gravity-flow engineering typical of mining, engineers usually designed sorting houses with multiple levels for the input, processing, and storage of ore. These structures usually featured a row of receiving bins located at the top level, a sorting floor under the receiving bins, and a row of holding bins underneath the sorting floor. Receiving bins usually had sloped floors, and in most cases the holding bins below did too. A cupola sheltered the top level and the sorting floor was fully enclosed and heated with a wood stove. The holding bins at bottom were similar to the sloped-floor ore bins discussed above, and the structure usually stood on a foundation of heavy timber pilings, or a combination of pilings and hewn log cribbing walls.[57]

Like the processes associated with ore milling, mining engineers utilized gravity to draw rock through ore sorting houses. The general path the ore followed began when miners underground characterized the nature of the ore they were extracting. They communicated their assessment of the ore's quality to the trammer via a labeled stake, a message on a discarded dynamite box panel, or a tag. The trammer subsequently hauled the loaded car out of the mine and pushed it into the sorting house, which stood on the flank of the waste rock dump. He emptied the car into one of several bins, depending on how impure the ore was. High-grade ore went into a small and special ore bin at one end of the structure, run-of-mine ore, which was not particularly rich but required no sorting, went into another bin at the opposite end of the structure. Mixed ore that was combined with considerable waste rock went into one of several bins located in the center of the ore sorting house. When released from the car, the mixed ore slid into a receiving bin that featured a heavy grate at the bottom known as a *grizzly*. The principle behind the grizzly was that the rich portions of telluride and silver ores fractured into fines and the large cobbles that remained intact through the blasting, shoveling, and unloading contained waste rock that needed to be cobbed, or knocked off by surface laborers. The valuable fines dropped through the grizzly directly into holding bins at the bottom of the structure, while the waste rock-laden cobbles rolled off the grizzlies and into holding chutes that fed onto sorting tables. There, laborers worked by daylight admitted through windows, and by kerosene or electric lighting, to separate the ore from waste.

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[57] Twitty, 1999:153.

E 5.2.7.5: Explosives Magazines

Explosives were a fundamental tool for mining because they were the prime mover of rock. Mining companies had to store enough dynamite and blasting powder to carry them through the several weeks spanning freight deliveries, and they often informally stacked 50 pound boxes, the standard shipping container, in shaft houses, compressor houses, storage sheds, and in vacant areas underground. Worse, during cold months, which spanned much of the year at high altitude, mine superintendents had boxes of dynamite stored near boilers, in blacksmith shops, and near hoists where it remained in a thawed and ready state. Such storage practices were absolutely dangerous, and in response, some mining engineers instituted explosives magazines where storage could have been carried out in a more controlled and orderly manner.

Well-built magazines came in a variety of shapes and sizes, but they all shared the common goal of concentrating and sheltering the mine's supply of explosives away from the main portion of the surface plant. Academically trained mining engineers felt that magazines should have been bulletproof, fireproof, dry, and well-ventilated. They also felt that magazines should have been constructed of brick or concrete and if of frame construction, the walls needed to be sand-filled and sheathed with iron. These structural features not only protected the explosives from physical threats, but also they regulated the internal environment which was important, especially in summer. Extreme temperature fluctuations and pervasive moisture had been proven to damage fuse, blasting caps, blasting powder, and most forms of dynamite. This in turn directly impacted the miners' work environment, because degraded explosives created foul and poisonous gas byproducts that vitiated mine atmospheres.

Proper magazines manifested as stout masonry or concrete buildings around 12 by 20 feet in area with heavy arched roofs and iron doors in steel jambs. Usually these magazines were erected a distance away from the main portion of the mine's surface plant. In other cases, mining engineers had construction crews built concrete, masonry, or timber-lined bunkers with stout iron doors. Well-built vernacular magazines, on the other hand, often appear similar to root cellars. Generally they took form as a chamber workers excavated out of a hillside, often 8 by 10 feet in area, and roofed with earth, rubble, and rocks. The interiors of well-built magazines had shelves for boxes of dynamite, while miners merely stacked the boxes up in vernacular magazines.

Regardless of degradation and the direct and obvious safety hazards, many small and medium-sized mining companies stored their explosives in very crude and even dangerous facilities. Miners erected sheds sided only with corrugated sheet-iron that offered minimal protection from fluctuations in temperature and moisture. In other cases, small, capital-poor operations took even less precaution and stored their explosives in sheet-iron boxes similar in appearance to doghouses, in earthen pits roofed with sheets of corrugated iron, or in abandoned prospect adits. Lack of funding appears to have been a poor excuse for improper storage practices, because most operations had the ability to erect fairly safe, inexpensive vernacular dugout magazines. Large mining operations, on the other hand, found it within their means to build proper magazines.

E 5.3: Beneficiation: Smelting, Ore Concentration, and Amalgamation

Mining companies in Boulder County, like the rest of Colorado, considered the ore that they produced to be a crude product that required treatment, known as beneficiation, to separate the metal content from the waste. Beneficiation in the county was not straightforward because the ore in the various mining districts was highly complex and resisted treatment. This forced regional metallurgists to apply advanced chemical and mechanical engineering. Most gold, silver, and tungsten ores consisted of a blend of metal compounds mixed with host rock that required a variety of treatment stages and processes. Ores of purity or simplicity required fewer steps, while complex, refractory ores required time-intensive treatment and numerous steps. In overview, the process began with crushing and grinding the ore, followed by separating metalliferous material from waste in a stage known as *concentration*. The resultant *concentrates* were roasted and smelted in a furnace, which furthered the separation and yielded a blend of metals known as *matte*. Advanced smelters located in Denver, Golden, Colorado Springs, and the Midwest refined the matte into pure metals termed *bullion*.

In Boulder County, a variety of facilities carried out one or all of the steps necessary to process crude ore, and they operated either as independent mills or in conjunction with a specific mine. Smelters were turnkey facilities that reduced crude ore to metals and matte, and several operated in the county between around 1870 and 1900. Unlike smelters, concentration mills did not reduce ore to matte and instead were designed to merely separate waste from an ore's metal content. Amalgamation stamp mills, successful for a relatively brief time in the county, crushed gold ore and relied on mercury to amalgamate with the gold.

E 5.3.1: Smelters

To produce metals, smelters incorporated mechanical, chemical, and roasting processes that a metallurgist had to tailor to a region's specific ore. Basic smelting began when wagons delivered crude ore to the facility, which workers dumped into receiving bins at the smelter's head. The ore had to be broken into consistently sized cobbles either by hand or with a mechanical crusher then loaded into the smelting furnace. If the ore contained high proportions of waste, then it was concentrated with mechanical methods prior to smelting.

The furnace was at the heart of a smelter facility, and two general types were popular. The earliest was a masonry structure with a chamber for ore, ducts to direct blasts of hot gases against the ore, and fireboxes with special ventilation to enhance fuel combustion. Troughs collected molten liquid as it ran off the ore and segregated the metal content from slag according to specific gravity. These early smelters varied by design and size, and nearly all shared the problem of being failures when treating ore from the greater Front Range.

The most successful smelting furnaces, adopted during the 1870s, were cylindrical steel vessels 4 to 12 feet in diameter and lined with fire bricks. They stood on stout rock or brick masonry foundations and featured tap spouts and tuyeres, which were ports that admitted air blasts, at graduated intervals. At center was a columnar charge of fuel, and workers dumped crude ore around the fuel column until the ore chamber was full. They usually admitted lead bullion, or lead or iron ore, first because the soft metal served as a flux, which, when molten, helped the rest of the ore to liquefy. After workers arranged layers of ore, sealed the spouts, and added more fuel, they started a blower that fed air to the smoldering fuel, bringing it to a great heat.[58]

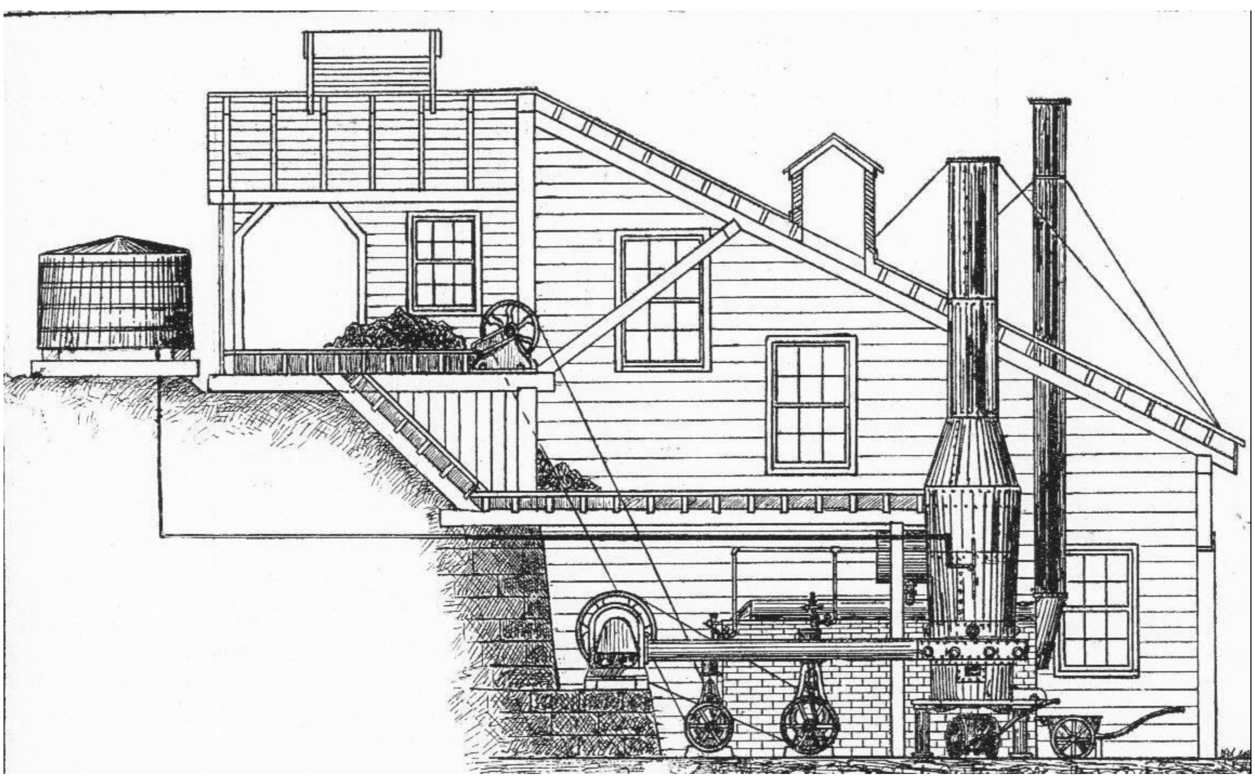

Figure E 5.3.1. The profile illustrates a small and simple smelter. Workers sorted and crushed crude ore at top left, stored the material on the floor at center, and periodically fed the crushed ore into the furnace at lower right. The furnace, which was free-standing and pre-fabricated, was common by the 1880s. Note the complex blower system in front of the brickwork. In many cases, smelters also had concentration machinery. Source: *Mining & Scientific Press* 4/28/83, p281.

[58] Bailey, 2002:80; Meyerriecks, 2001:173.

As the lead or iron ore melted and the temperature increased, these liquid metals came in contact with harder metals and minerals, causing them to soften, melt, and trickle down into the base of the furnace. Over time, the lot of ore became molten and the heaviest material, usually the metals, settled to the bottom while the lighter waste floated on top. At this point, workers opened the upper slag spouts and tapped the liquid waste into slag carts, then did likewise for intermediate slag spouts. After they drew the waste off, the workers added more ore and fuel until the pool of liquid metal rose to the height of a lower slag spout. At this time, workers opened the lowest spout at the furnace base and tapped the molten metal into pots or molds until liquid slag made an appearance, indicating an end to the metal. Workers then repeated the process, keeping the furnace in continuous operation for days or weeks.[59]

Because metallurgists used gravity to draw ore through the processing stages when possible, they usually sited smelters on a slope. Smelting facilities usually required flat space, a source of abundant water, and well-graded roads. In addition to the furnace, smelters often featured ore bins, large fuel bins, water tanks, storage, an assay office, and a vault. Successful smelters in productive mining districts usually had more than one furnace to process batches of ore simultaneously if the material was simple, or in stages if the ore was complex. Large smelters also featured roasters and mechanized concentration mills to prepare the ore and enhance separation prior to smelting.

E 5.3.2: Concentration Mills

Few mining companies in Boulder County possessed enough capital and produced enough ore to warrant the erection of a dedicated smelter. Instead, they shipped their ores to custom smelters, which extracted the metals for a fee. The shipping charges and smelting fees often constituted a heavy expense, and in response, well-capitalized mining companies attempted to save money by building *concentration mills* near their workings. Concentration mills relied on mechanical and some chemical processes to reduce the ore, separate the metalliferous materials, and prepare the resultant concentrates for shipment to a smelter for final roasting and refining. In so doing, mining companies accomplished many of the steps that smelters charged for, and they did not have to pay to ship the worthless waste usually integral with crude ore. Concentration mills were not equipped, by definition, to produce finished bullion.

Concentration mills were usually built over a series of terraces incised into a hillslope so that gravity could draw the ore through the various processing stages. Mills came in a variety of scales, and large facilities usually required stone masonry and concrete terraces to support the building and heavy machinery, while earthen terraces and substantial beamwork were sufficient for small facilities. Large mills were heavily equipped to process both high volumes of ore, and complex ore that resisted simple treatment. To do so, they often provided primary, secondary,

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[59] Bailey, 2002:82-83; Meyerriecks, 2001:174.

and even tertiary stages of both crushing and concentration, and they may have featured several parallel sequences. Small mills, by contrast, usually provided several stages of crushing and concentration in a single, linear path.

Engineers and metallurgists tended to follow a general pattern when designing concentration mills. An ore bin stood at the mill's head and it fed crude ore into a *primary crusher*, usually located on the mill's top platform. The crusher reduced the material to gravel and cobbles ranging from 1 to 4 inches in size, which descended to a *secondary crusher* located on the platform below. The secondary crusher pulverized the ore to sand and slurry, which went through a screening system. Oversized material returned for secondary crushing and material that passed the screen went on for concentration at small mills, or tertiary crushing then concentration at large mills. By around 1900, engineers favored using *trommel screens* or *shaking screens* to sort the rock. A trommel consisted of a concentric series of cylindrical screens that rotated, allowing fine material to drop through while the oversized cobbles rolled out of an open end. A shaking screen was a stack of rectangular pans with screen floors.[60]

Machinery manufacturers offered a wide array of crushers and grinders, which metallurgists selected according to the ore's characteristics. Because no two mines featured the same ore and no two metallurgists were alike, each mill was a custom affair. However, engineers followed some patterns regarding the application of crushing machinery. Jaw crushers, also known as Blake crushers, provided primary crushing, while a few large operations employed gyratory crushers. Batteries of stamps were commonly employed for secondary crushing. A stamp battery consisted of a timber gallows frame with guides for heavy iron rods featuring cylindrical iron shoes. A cam lifted the rods in sequence and let them drop on the gravel being crushed. Crushing rolls often carried out secondary and tertiary crushing, and they consisted of a pair of heavy iron rollers similar to wheels in a stout timber frame. A narrow gap between the rollers drew in clasts of sand and gravel and fragmented them. Grinding pans and Huntington mills were used for tertiary crushing, and both featured a heavy cast iron pan and iron shoes or rollers that dragged across the floor, grinding the ore. When the ore was free-milling gold or silver, the metallurgist introduced mercury into the pan to amalgamate with the metals. *Tube mills* and *ball mills* offered the finest grinding. Each appliance consisted of a large cylinder which mill workers partially filled with sand, gravel, and water. The cylinder slowly rotated, and the iron rods in tube mills or the iron balls in ball mills tumbled in the chamber, reducing the material to a slurry. Both types of grinding appliances rose to popularity around 1900, and by the 1930s they were used in place of crushing rolls and stamp batteries. The end product of crushing and grinding were *fines* and *slurry*.[61]

Following another screening, the ore descended to subsequent mill platforms for concentration. Several devices proved relatively popular for separating metals, and many metallurgists assembled a concentration sequence involving more than one appliance. The *jig*

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[60] Peele, 1918:1623, 1627; Tinney, 1906:191.
[61] Peele, 1918:1630.

relied on water currents and agitation to separate heavy metalliferous material and classify particles by size. The jig consisted of a wooden trough, often 4 by 9 feet in area and 4 feet high, divided into cells that opened onto a V-shaped floor featuring valves and drains. Plungers agitated the slurry of ground ore in the cells, causing the heavy or large fines to settle while a gentle current of water washed the waste away. Jigs were highly popular in Boulder County from the 1870s into the 1930s.

Vanners were a popular concentration appliance for silver ores between the 1880s and 1900s until they were replaced by vibrating tables. A vanner featured a broad rubber belt on rollers mounted to an iron frame that vibrated. The belt assembly, around 5 by 15 feet in area, was suspended by an oscillating mechanism from a chassis bolted to a timber foundation. The belt was kept wet and as the machine vibrated, the heavy metalliferous material settled against and stuck to the rubber while a jet of water washed off the waste. As the belt wrapped down around one of the rollers, the metalliferous material dropped into a flume and proceeded for further concentration.[62]

Vibrating tables were one of the most effective classes of concentration appliances and rose to prominence around 1900. Arthur Wilfley designed the first model for his mill in Robinson, Summit County, Colorado, and by the 1910s, metallurgists adapted the concept for nearly all types of metal ores. A vibrating table featured a tabletop, often 5 by 15 feet in area, clad with rubber or linoleum held down with fine riffles. The tabletop was mounted at a slant on a mobile iron frame that rapidly oscillated, and the vigorous action caused heavy metalliferous material to settle against the higher riffles while the waste worked its way downward. Water playing across the tabletop washed the waste away.[63]

By the 1920s, *flotation cells* were proving their worth and operated according to principals that seemed to defy traditional concentration technology, and by the 1930s flotation became common. A flotation machine consisted of a large rectangular tank divided into cells filled with water and slurry. Oils or detergent were introduced, which compressed air or agitators worked into a froth. In contrast to the above mechanical devices, the froth carried the metalliferous materials upward while wastes settled to the bottom of the cells. Revolving paddles then swept the metalliferous material into troughs.

While the above appliances proved highly effective for silver and industrial metal ores, they provided limited success for complex gold ores, such as telluride. During the 1900s, mining companies at first in Cripple Creek and then Boulder County began experimenting with *cyanidation* technology, which was pioneered in New Zealand. For cyanidation, the ore was crushed and ground as above, then concentrated as a slurry. A worker transferred the metalliferous material into *cyanide tanks*, which were large wooden vats that agitated the slurry in a dilute cyanide solution. The cyanide bonded with the gold, the waste was ejected, and a worker tapped the solution into *precipitating boxes* where he introduced zinc, which cyanide

[62] Bailey, 1996:64, 112; Tinney, 1906:204.
[63] Peele, 1918:1680; Tinney, 1906:204.

preferred over gold. The chemical reaction caused the precious metal to precipitate out. Cyanide mills could have featured one or a series of cyanide tanks, depending on the purity and volume of ore.

Most ore concentration processes required water to mobilize the material being worked and to allay dust. However, water had to be removed from the concentrates at the process end and the concentrates dried for shipment. To separate the water from the concentrates, engineers installed various dewatering devices that ranged from conical and pyramidal settling boxes to Dorr thickeners. Mill workers introduced watery slurries into settling boxes where the fines accumulated and were drawn out through spigots in the bottom. The Dorr thickener, devised for high volumes of material, featured a tank at least 20 feet in diameter with a conical floor. Radial arms rotated slowly within the slurry and forced the fines toward the tank's center, where the material passed through a large spigot.[64]

Gravity drew the metalliferous fines from one crushing and concentration stage to the next. However, each step had to make allowances for returning inferior material back for reprocessing, which meant defying gravity and sending heavy material uphill. To accomplish this, metallurgists used either bucket lines or spiral feeds. Bucket-lines were a series of closely spaced sheet iron pans stitched to an endless canvas belt, and they scooped material from one bin and deposited it into another. Spiral feeds, which were effective for moving fines short distances, typically featured an auger that rotated in a sheet iron shroud. As the auger turned, it moved the material upward and deposited it into a bin. Material handled in such a way had to be moist enough to act as a solid yet not emit dust.

Concentration mills relied on the same sources of power as mine surface plants, although the transition from steam to electricity at mills occurred slightly earlier. Most mills relied on a single, large steam engine that drove the various appliances through a system of overhead driveshafts and belts. The horizontal steam engine was most common, and small upright units powered additional appliances at large mills. By around 1910, when electricity was commonly available in Boulder County, engineers began using motors to drive constantly operating mill machinery.

E 5.4.3: Amalgamation Stamp Mills

Two definitions apply to the term *stamp mill*. As noted above, concentration mills employed batteries of stamps to crush ore prior to other processing steps. In this case the term stamp mill refers to the stamp battery, which is a component of a concentration mill.

However, under the right mineralogical conditions, companies based an entire facility around a stamp battery to recover metals without smelting or advanced concentration. Specifically, the ore had to feature relatively simple gold or silver compounds and be easily

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[64] Peele, 1918:1669.

crushed. A jaw crusher usually provided primary crushing, the stamps effected the rest of the physical reduction, and amalgamating tables at the battery's toe, coated with mercury, recovered the gold or silver. Workers periodically scraped off the amalgam and heated the mass in a retort, which volatized the mercury and left the gold or silver.

Because stamp mills featured a fraction of the equipment installed at the more complex concentration mills, they tend to be smaller and simpler. Regardless, stamp mills shared with concentration mills a few fundamental components. First, the various stages of crushing and metals recovery, as well as other facilities were arranged on a series of platforms to use gravity to advantage. Second, they usually featured a receiving bin above the primary crusher to hold crude ore destined for processing. Third, the mid- or lower platform featured the power source, which was often a horizontal steam engine and boiler. Last, the mill required a source of water. It should be noted that metallurgists installed tertiary crushing and possibly a concentration appliance in some stamp mills, which better prepared the ore for amalgamation. When this is the case, the mill was known as an *amalgamation stamp mill*.

E 5.4.4: Arrastras

An arrastra was a simple, inexpensive, labor-intensive, and inefficient means of recovering metals from ore. Arrastras were primarily employed during the first several years of hardrock mining in Boulder County to treat simple gold ore. While a few capital-starved outfits continued to employ the technology through the 1910s, the overall exhaustion of simple gold ore rendered these primitive treatment facilities obsolete by around 1865.

A typical arrastra featured a circular floor of carefully fitted stones, low sidewalls, and a capstan at center. They ranged in size from around 6 to 20 feet 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 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. The Spanish, credited with popularizing the arrastra, relied on slave labor as motive power, which draft animals replaced. With the improvement of technology, scarcity of labor, and the desire for greater production, in a few cases engineers harnessed waterpower and steam engines. The simplest form of arrastra cost around $150 to build, much of which went to the labor for dressing and assembling the rockwork.[65]

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

[65] Meyerreicks, 2001:194.

mortar. With the floor complete, he 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.[66]

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 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.[67]

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 either by 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. Here 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 large. Last, he filled a retort with the precious material and heated the vessel to volatize the mercury, leaving a sponge-like mass of metal. The retort 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.[68]

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[66] Young, 1987:69-71.
[67] Meyerreicks, 2001:143, 195; Young, 1987:71.
[68] Meyerreicks, 2001:143, 195; Young, 1987:71.

Section F: Property Types and Registration Requirements

F 1: INTRODUCTION

Section F provides a roster and descriptions of the historic Property Types common to Boulder County's mining industry. The Property Types are categorized according to prospecting, specific types of mines, the beneficiation of ores, and associated settlement. The objective is to bring order and standardization to cultural resource work and historic preservation in the county, and to format information for sound interpretation. To meet this goal, each Property Type features a list and description of archaeological, engineering, and architectural features that may be commonly encountered today. The researcher should review the description of mining methods and equipment in Section E for a better understanding of some of the Property Types.

The descriptions of the Property Types, as well the mining methods and technologies already discussed in Section E, will certainly help the researcher identify, define, and interpret specific resources. The descriptions are, however, necessarily brief. Cultural resource specialists unfamiliar with the nuances of mines, mills, and the mining industry are strongly urged to review existing popular literature for a greater understanding of mining-related sites. The following publications, listed in order of relevance, can provide insight.

Twitty, Eric *Riches to Rust: A Guide to Mining in the Old West* Western Reflections, Montrose, CO, 2002.
Discusses in detail the constitution, layout, development, and equipment of mining. Focuses on mine surface plants and how to interpret today's remains.

Meyerriecks, Will *Drills and Mills: Precious Metal Mining and Milling Methods of the Frontier West* Self Published, Tampa, FL, 2001.
Provides accurate and comprehensive coverage of common mining and milling practices.

Twitty, Eric *Blown to Bits in the Mine: A History of Mining and Explosives in the United States* Western Reflections, Montrose, CO, 2001.
Discusses conventional mining practices with an emphasis on underground work and artifacts.

Hardesty, Donald *The Archaeology of Mining and Miners: A View from the Silver State* Society for Historical Archaeology, 1988.
Discusses mining-related sites as archaeological resources.

Francaviglia, Richard *Hard Places: Reading the Landscape of America's Historic Mining Districts* University of Iowa Press, Iowa City, IA, 1991.
Focuses on reading and interpreting mining landscapes.

Young, Otis E. *Western Mining* University of Oklahoma Press, Norman, OK, 1989 [1970].

Discusses hardrock prospecting, mining, and milling methods employed prior to 1893. The timeframe is limited and discussion of methods broad.

Bailey, Lynn *Supplying the Mining World: The Mining Equipment Manufacturers of San Francisco, 1850-1900* Westernlore Press, Tucson, AZ, 1996.
Discusses various types of mill and mine machines.

Bailey, Lynn *Shaft Furnaces and Beehive Kilns: A History of Smelting in the Far West, 1863-1900* Westernlore Press, Tucson, AZ, 2002.
Presents a comprehensive history of smelters, charcoal manufacturing, and related technology.

Sagstetter, Bill and Sagstetter, Beth *The Mining Camps Speak: A New Way to Explore the Ghost Town of the American West* Benchmark Publishing, Denver, CO, 1998.
Discusses the examination of mine sites through remaining material culture. The authors make a few inaccurate generalizations and dates of artifacts.

F 2: PROPERTY TYPE: PLACER MINE

Placer mines were operations where interests ranging from individuals to capitalized companies processed stream gravel and soil for particles of gold. It should be noted that a difference exists between *placer workings* and *placer mines*. Some of Boulder County's waterways, such as Left Hand Creek, featured thousands of feet of unbroken placer workings as indicated by characteristic tailings piles, pits, and infrastructure features. A placer mine, by contrast, was a specific property, usually defined by claim boundaries, which an individual or company worked for gold. Extensive placer workings may actually include several individual placer mines, although all may be recorded today as a singe historic resource. Archival research and the physical examination of extensive workings may be necessary to identify specific mines in extensively worked areas.

F 2.1: Placer Mine Subtypes

Stream Placer: Both organized companies and individual miners created stream placers when they worked a streambed for gold. Streams are small waterways that usually flowed all year across broad, gently sloped drainage floors. Individual miners often dug pits down to bedrock in streambeds and used any combination of gold pans, cradles, and small sluices to recover gold from the excavated gravel. Organized companies often installed lengthy sluices and created trenches or other large excavations when removing gravel. Pits, trenches, piles of gravel and stream cobbles, and braided stream channels often denote placer mines today. If the stream flowed all year, miners may have piled tailings along the stream banks to maintain the waterway. Companies with lengthy sluices may have left rock piles and posts that supported the sluices and small, adjacent platforms that served as workstations. At substantial mines, companies often engineered networks of ditches and added other aspects of infrastructure such as residential buildings and blacksmith shops, usually represented today by earthen platforms.

Gulch Placer: Companies and individual miners created gulch placers when they worked a gulch, which was a narrow drainage, for gold. Because gulches tended to be confined and steep, miners had to pile tailings in a linear fashion along one or both sides, and over time, erosion reduced the piles to short linear segments, isolated mounds, and hummocky deposits. As erosion re-deposited the tailings along the gulch floor, the associated stream channel often became braided. Extensive gulch placers operated by organized companies may offer the same infrastructure features as stream placers.

Hydraulic Placer: Because hydraulic mining operations used jets of water to mobilize high volumes of gravel in economies of scale, most sites remaining today tend to be expansive and feature broad deposits of tailings, deep incisions and gullies, and abrupt, precipitous cut-banks. Hydraulic mining required an infrastructure to deliver water both for the monitors and for washing gravel through sluices. Ditches, pipelines, and flumes often directed water from regional drainages to a reservoir upslope from the site. Pipelines then carried the water under pressure to the monitors, and ditches and flumes directed the runoff through the workings into sluices, where workers recovered gold. To support industrial activity, hydraulic mines also usually included a shop, other buildings, supports for pipelines, and roads. If the mine was more than one mile from the nearest settlement, the mining company often provided residences for the workers. In general, engineering and archaeological features represent most hydraulic mine sites today.

Features Common to Placer Mine Resources

Boom Dam: A dam intended to impound water for booming operations. Boom dams often featured a spillway or other form of breach that directed water into a boom ditch or drainage.
Boom Ditch: A ditch that directed water from a boom dam directly into placer workings.
Building Platform: A flat area that supported a building.

Building Remnant: The collapsed remains of a building.
Collection Ditch: A ditch that collected runoff from a placer mine for secondary uses or to impound sediments. A collection ditch should be located downstream from a placer mine.
Cut-Bank: The headwall of an excavation.
Dam: A water impoundment structure. Some dams for placer mines are earthen while others may consist of log cribbing filled with earth.
Ditch: An excavation that carried water to or from a placer mine. Ditches often tapped streams in adjacent drainages and featured a gentle gradient.
Flume: A wooden structure that carried water to or from a placer mine, or carried a stream around a placer mine.
Flume Remnant: The structural remnants of a flume.
Monitor Station: A platform, tongue of earth, or perch where a hydraulic monitor was stationed. Monitor stations were usually strategically located amid hydraulic workings.
Penstock: A wooden or masonry structure, usually far upslope from a hydraulic mine, that directed water into a pipeline featuring a steep descent. The penstock's elevation and the pipeline's descent provided enough pressure for hydraulic mining.
Placer Pit: An excavation circular or ovoid in footprint where miners sought deep gravel.
Placer Trench: A linear excavation where miners sought deep gravel.
Placer Tailings: The hallmark of placer mining, tailings usually consist of ovoid or linear piles of gravel and rounded river cobbles.
Refuse Dump: A collection of industrial and structural debris cast-off during operations.
Reservoir: A void behind a dam for water storage.
Shop Platform: An earthen platform that supported a shop building, which can be defined by artifacts such as shop refuse and coal.
Shop Remnant: A collapsed shop.
Shop Refuse Dump: A deposit of shop refuse such as anthracite coal, forge-cut iron scraps, hardware, and forge clinker, which is a scorious residue generated by burning coal.
Sluice: Similar to a flume, a sluice was a lengthy wooden structure with a plank floor and walls, and the floor featured riffles for collecting gold. Piles of rocks and timber piers typically supported the sluice, which was usually located at the bottom of a drainage.
Sluice Remnant: The remnants of a sluice, usually denoted by piers, posts, rock supports, and planks.
Supply Ditch: A ditch that delivered water to a placer mine.

Work Station: A platform alongside a sluice where workers supervised operations and maintained the sluice.

F 2.2: Placer Mine Significance

On a broad level, placer mining was of great significance to Boulder County between 1859 and around 1865. The discovery of placer gold in most of the county's principal mountain waterways brought the first large numbers of Euro-Americans to the region. They established the county's first settlements, economy, government entities, and baseline understanding of the county's geography. While the initial government entities were primitive, they resulted in two contributions important to Colorado and Boulder County. One was the official designation of Boulder County in 1861, along with Colorado's other 16 original counties. The other was the organization of Mountain District No.1 by placer miners at Gold Hill on March 7, 1859. Mountain District No.1 was the first mining district in the Rocky Mountains, and it set a precedent and served as an example for other mining districts organized elsewhere through the 1860s. In general, mining districts were an important frontier entity that brought order to mining and associated behavior. In a district, a governing body created and enforced laws regarding claim type and size, requirements for staking and owning a claim, construction of infrastructure, records-keeping, and crime and punishment. Ultimately, Colorado's earliest mining districts, including those organized in Boulder County, formed a foundation for mineral claim laws, which were adopted across the Rocky Mountain west and modified for the 1872 Mining Law.

As a general category, placer mining holds significance to Boulder County in several other arenas. First, during the 1860s, experienced miners sought the hardrock sources of placer gold, and their successful discoveries began the county's hardrock mining industry. Second, when miners exhausted the placer gold in most areas by around 1865 at the latest, many descended to the plains and established farms and ranches, which became a foundation for the county's agricultural industry. Third, placer mining created a lasting cultural and social climate that emphasized physical and economic mobility, opportunity, cooperation, and egalitarianism.

After the mid-1860s, placer mining remained important to Boulder County, but the significance narrowed to specific types of placer mines, Periods of Significance, and geographic locations, which are discussed below.

Steam and Gulch Placers: As a Property Subtype, stream and gulch placers were similar types of operations and therefore share many aspects of significance. The geographic regions where these placer mines continued to be important after the mid-1860s include Left Hand, James, Four Mile, and Beaver creeks. Most of these areas, however, have different Periods of Significance, which are defined in the discussions of their respective mining districts. The first is 1880 to around 1905, when primarily Chinese and several organized companies mined placer gold, contributing to local economies and communities. The second is 1929 to 1942, when impoverished people reworked old placers to eke out an income during the Great Depression. This movement maintained populations, contributed to local economies, and allowed individuals and families to survive in the mountainous portion of the county.

Hydraulic Placer: In general, hydraulic placer mining required a combination of deep and broad gravel deposits, consolidations of mining claims, capital, engineering, water, and a workforce. Because Boulder County offered few areas with the necessary sedimentology, however, hydraulic mining was not practiced to a great degree. John H. Kemp's Happy Valley Placer at Eldora was the only documented operation, although others may have existed

Because hydraulic placer mining was uncommon in the county, it can be argued that its importance was local instead of county-wide. Given this, the Periods of Significance and specific arenas of importance for hydraulic placer mining are relevant to the county's individual mining districts.

F 2.3: Placer Mine Registration Requirements

Steam and Gulch Placers: These placer workings must possess physical integrity relative to the county-wide Period of Significance described above, or, if the workings post-date 1865, to the Periods of Significance of their host mining districts. Because structures were either removed or destroyed after stream- and gulch placers were abandoned, the integrity will probably be archaeological in nature. For a resource to retain archaeological integrity, the material evidence must clearly represent activities, work areas, engineering features, and structures. Placer mines operated by organized companies may possess remnants of engineering features such as ditches, flumes, pipelines, and dams.

A few of the seven aspects of historical integrity defined by the NRHP are likely to be relevant for stream- and gulch placers. The most applicable aspects will probably be Setting, Feeling, and Association. The Setting around the resource, and the resource itself, must not have changed to a great degree from its Period of Significance. In terms of Feeling, the resource should convey the sense or perception of placer mining, both from a historical perspective and from today's standpoint. For Association, the site's sum of features and artifacts should permit the researcher to reconstruct the historic operation.

In addition to possessing integrity, stream- and gulch placers must meet at least one of the Criteria defined by the NRHP. Placer mines eligible under

Criterion A must be associated with at least one arena of significance noted above, as well as the events, trends, and themes important to the specific mining district. Placer mines may be eligible under Criterion B provided that they retain integrity from an important person's period of occupation or participation. Most small placer mines will not qualify, although mines operated by organized companies may. For a placer mine to be eligible under Criterion C, the resource must clearly represent a type of placer mine and retain integrity from the Period of Significance. By nature, placer mine resources tend to be located in unstable physical environments prone to erosion, floods, and constantly shifting streambeds, leaving relatively few sites with integrity. Intact examples may be important because they represent one of Boulder County's and Colorado's most fundamental types of mines. Few stream- and gulch placer mines will be eligible under Criterion D because most information can be collected by detailed recordation of surface features. Several exceptions, however, may exist. Studies of the infrastructure features of large mines, including networks of ditches, sluice beds, and work areas, may enhance the current understanding of engineering applied to placer mining. If the resource possesses building platforms, testing and excavation of buried archaeological deposits may reveal information regarding workers' lifestyles and social structures of the workforce, as well as the functions of ancillary buildings.

Hydraulic Placer: These placer workings must possess integrity relative to the Period of Significance, which may vary by mining district. Because structures were usually removed when hydraulic placer mines were abandoned, the integrity will probably be archaeological, which is defined as the material evidence representing activities, work areas, engineering features, and structures. Hydraulic mines are expected to possess remnants of engineering features such as cut-banks, ditches, flumes, pipelines, sluice beds, penstocks, and reservoirs. For archaeological remains to constitute integrity, the material evidence should permit the virtual reconstruction of the mining operation.

A handful of the seven aspects of historical integrity defined by the NRHP are likely to be relevant for hydraulic placer mines. The most applicable aspects will probably be Design, Setting, Feeling, and Association. For Design, the resource must represent engineering, organization, and mining operations from the Period of Significance. A resource's overall feature assemblage, individual feature systems, and the landscape can represent Design, and most of these characteristics will be archaeological in nature. The Setting around the resource, and the resource itself, must not have changed to a great degree from its Period of significance, excepting the removal of structures and equipment. In terms of Feeling, the resource should convey the sense or perception of hydraulic mining, both from a historical perspective and from today's standpoint. For Association, the resource's sum of features and artifacts should permit the researcher to reconstruct the historic operation.

In addition to possessing integrity, hydraulic placers must meet at least one of the Criteria defined by the NRHP. Hydraulic mines eligible under Criterion A should be associated with aspects of engineering, economics, and social structure, as well as events, trends, and themes important to their host mining district. Hydraulic mines hold a high potential to be eligible under Criterion B since they were usually designed and supervised by trained mining engineers. For a hydraulic mine to be eligible under Criterion C, the resource must clearly represent a hydraulic placer mine and retain integrity from the Period of Significance. The systems of water allocation and distribution must be represented, the workings should resemble those developed by hydraulic methods, and the locations of sluices should be evident. In general, hydraulic mines were uncommon in Boulder County and resources are therefore rare today, which poor preservation conditions have ensured. For this reason, relatively intact examples may be important representations of this key type of formally engineered placer operation. Hydraulic mines can offer contributions under Criterion D. Studies of the infrastructure features, including water allocation and distributions systems, sluice beds, and work areas may enhance the current understanding of engineering adapted to hydraulic mining. If the resource possesses building platforms, testing and excavation of buried archaeological deposits may reveal information regarding workers' lifestyles and social structures of the workforce, as well as the functions of ancillary buildings.

F 3: PROPERTY TYPE: HARDROCK PROSPECT

A prospect is a manifestation of an effort to locate economic ore, and a lack of significant production serves as a unifying definition, although some prospects may have yielded small volumes of ore. Prospects ranged in scale from shallow pits to extensive underground operations, and the absence of ore storage facilities, minimal property development, inexpensive and portable equipment, and the investment of little capital often are hallmarks of such operations.

While most prospects tended to be simple, shallow, and lacked machinery, some were fairly advanced and possessed surface plants that required formal engineering and equipment. Given this, the researcher is likely to encounter a variety of prospect sites today with varying degrees of archaeological, engineering, and architectural integrity. While the researcher may be able to cipher out simple sites, interpreting the remnants of substantial operations can pose challenges. The substantial operations were usually centered around an adit or a shaft with an associated waste rock dump of some volume, which represents deep workings. While most prospects lacked machinery and were labor-intensive, deep operations employed some power appliances. Buildings, machinery, and other facilities usually shared the same orientation as the shaft or adit, and were clustered together around the opening. Because equipment for deep prospecting was intended to be portable, items were usually removed, leaving primarily archaeological evidence such as building platforms, machine foundations, and artifacts. Prospect sites can be grouped into three general subtypes:

F 3.1: Hardrock Prospect Subtypes

Prospect Complex: When prospectors attempted to locate mineral formations underlying the soil, they often excavated groups of pits and trenches to expose bedrock. If the prospectors uncovered a promising lead, they drove adits and shafts to explore and sample the formation at depth. Collectively, the groups of pits, trenches, adits, and shafts can be termed prospect complexes. Pits and trenches will be surfacial, shafts and adits should be shallow, and the sum represents mineral sampling and a search for ore. It should be noted, however, that some prospectors drove shallow adits and shafts merely to fulfill assessment obligations to retain title to their mining claims. Experienced prospectors often followed an organized, strategic pattern when excavating their workings, which may become apparent when the features of a prospect complex are mapped.

If a prospector invested an appreciable amount of time in a complex, which was necessary to drive an adit or a shaft, he usually constructed a few infrastructure components to support his work. One of the most common was a field forge where the prospector maintained his tools and fabricated basic hardware. Field forges were usually in the open and made with dry-laid rock masonry or small logs. Another was a residence, often either a simple log cabin or wall tent, unless a settlement lay nearby. Shafts required a hoist, and prospectors favored hand windlasses for their portability and low cost. A hand windlass was basically a wooden spool with a crank handle set in a frame over the shaft collar. Adits required wheelbarrows or ore cars to haul rock out. Because prospectors usually removed their equipment when they abandoned a site, archaeological features and excavations tend to represent prospect complexes.

Prospect Shaft: When prospectors discovered a mineral formation of promise, they often elected to sink a shaft to explore and sample it at depth. Initially, the prospectors would have installed a hand windlass to raise rock out of the shaft, and this primitive type of hoist had a depth capacity of around 100 feet. If they determined to continue sinking, the prospectors were forced to install a mechanical hoist, which is discussed in detail in Section E. At this point, most prospectors either sought capital for improvements or sold their property to an organized prospect outfit.

If the prospectors continued to sink the shaft, they may have installed a horse whim, which was inexpensive and provided adequate depth capacity for further underground exploration. However, whims were too slow and limited in performance for many organized prospect outfits, which often installed power hoisting systems driven by steam or, by the 1900s, petroleum engines. It is important for the researcher to note, however, that whims were popular at small, shallow, and productive mines in Boulder County from the 1860s through the 1890s. The reason was that prior to around 1880, steam equipment was very costly and afterward, the ore reserves in many small mines were too limited to justify the expense. If a suspected prospect was equipped with a whim, archival research is necessary to determine whether the resource was actually a small mine.

When organized prospecting outfits installed steam hoists for deep shafts, they usually erected other facilities. Blacksmiths maintained tools and fabricated hardware in shops, miners shuttled waste rock away from the shaft in ore cars on mine rail lines, and portable boilers provided steam power. The surface plant components were usually clustered around the shaft, and if the shaft was in a remote location, a residence stood nearby. All structures and equipment met what the greater mining industry recognized as temporary-class criteria, which it defined as low cost, portability, impermanence, and ease of construction. By definition, prospect shafts lacked evidence of ore storage or processing facilities.

If the shaft failed to encounter ore in economical volumes, the outfit usually abandoned the site and removed all items of value. Given this, archaeological features and artifacts tend to represent prospect shaft sites today. The decay of timbering caused most shaft collars to collapse, leaving areas of subsidence that can appear similar to large prospect pits. For a site to be defined as a shaft, the volume of waste rock should exceed the area of subsidence.

Prospect Adit: When prospectors discovered a mineral formation of promise, they often elected to drive an adit to explore and sample it at depth. An adit was a horizontal entry underground usually 3 by 6 feet or less in-the-clear, and prospectors drove adits instead of sinking shafts because adits required less capital and effort. Prospect adits often featured surface plants equipped with little more than a blacksmith shop and a means of hauling waste rock out of the workings. Wheelbarrows were the simplest and least expensive device, and if the prospectors determined to continue driving, they may have used an ore car on a mine rail line. As the adit's length exceeded the penetration of fresh air, the prospectors may have installed either a hand-powered blower, a bellows, or a windsock to force air underground through tubing. All the equipment noted above is discussed in detail in Section E.

The surface plant components were usually clustered around the adit portal, and if the adit was in a remote location, a residence usually stood nearby. All structures and equipment met temporary-class criteria, including low cost, portability, impermanence, and ease of construction. By definition, prospect adits lacked evidence of ore storage or processing facilities.

If the adit failed to encounter ore in economical volumes, the outfit usually abandoned the site and removed all items of value. Given this, archaeological features and artifacts tend to represent prospect adit sites today. The decay of timbering caused most adit portals to collapse, leaving areas of subsidence that can appear similar to lengthy trenches. For a site to be defined as an adit, the volume of waste rock should exceed the area of subsidence.

Features Common to Hardrock Prospect Resources

Boiler: A boiler was a vessel that generated the steam which powered machinery. Most boilers at prospect sites will be temporary-class upright, locomotive, or Pennsylvania types.

Boiler Foundation: Because portable boilers were self-contained and free-standing, prospect outfits usually stood them on platforms located near the hoist. Occasionally, however, workers erected rock or brick foundations or pads to support the boiler. The artifact assemblage around a foundation or platform can help the researcher identify it as that for a boiler. The assemblage should include clinker, which was a scorious, dark residue, as well as unburned bituminous coal, ash, water-level sight-glass fragments, boiler grate fragments, and pipe fittings.

Some prospect outfits installed upright boilers on square or circular dry-laid rock pads or excavated a shallow pit underneath the boiler to allow ashes from the firebox to drop through. The pad's size should approximate the boiler's diameter.

Pennsylvania boilers and locomotive boilers stood on skids, which usually required no support. However, where the ground was soft or uneven, workers often laid parallel rock alignments to prevent the boiler from settling. In the absence of rock supports, the skids occasionally became embedded in the ground and left two parallel depressions the length and width of the boiler. For locomotive boilers without skids, which were rare, workers erected a rock or brick pylon to support the high rear, and laid a rock or brick pad that supported the firebox end.

<u>Claim Marker:</u> Prospectors erected claim markers at the corners of their claims, which were usually 500 by 1,500 feet in area. Markers ranged from cairns to blazes on trees to up-ended boulders. When a surveyor mapped and registered a claim, he usually etched the mineral survey number into a corner rock.
<u>Claim Stake:</u> A claim stake was the universally recognized form of claim marker. Claim stakes were usually 4x4 posts 4 feet high, although prospectors often substituted logs.
<u>Draft Animal Track:</u> A track walked by a draft animal that encircles a horse whim. Draft animal tracks tend to be around 20 feet in diameter and were cleared of major obstacles. Prospectors often graded semi-circular platforms adjacent to a shaft for a track.
<u>Forge Remnant:</u> Can manifest as a mound of gravel and rocks or the remnants of a gravel-filled wood box, usually impregnated with coal and forge clinker. When coal burned at high temperatures, it left a scorious, dark residue known as *clinker*.
<u>Headframe:</u> A frame made of timber or logs that stood over a shaft. Headframes associated with horse whims were often large tripods or tetrapods. Power hoisting systems usually employed two-post gallows headframes.
<u>Headframe Remnant:</u> The collapsed remnants of a headframe.
<u>Headframe Foundation:</u> Headframe foundations usually manifest as parallel timbers that flank a shaft and extend toward the area where a hoist was located.
<u>Hoist:</u> Hoists at prospects were usually horse whims, steam, petroleum, or small electric models, as described in Section E.
<u>Hoist Foundation:</u> Nearly all mechanical hoists were anchored to foundations to keep them in place, and a foundation's footprint can reflect the type of hoist. Foundations are common at prospect shaft sites and can usually be found aligned with and at least 20 feet from the shaft. Because of the ease of construction and low cost, prospectors usually assembled hoist foundations with timbers, and occasionally with stone or concrete. Timber foundations decay and become buried over time, and often manifest today as rectangular groups of four to six anchor bolts projecting out of a hoist house platform.

Horse whims were usually bolted to timber foundations 2 by 2 feet in area at the bottom of a shallow pit. The trench for the cable and linkages often extends from the pit to the shaft.

Foundations for single drum steam hoists are usually rectangular, flat, and feature at least four anchor bolts. They can range in size from 6 by 6 feet to as little as 2 by 3 feet in area. Foundations for single drum electric hoists appear very similar to those for steam hoists. Steam hoists often left behind plumbing and gaskets, and the site should possess evidence of an associated boiler. The use of electric hoists often generated electrical insulators and wires.

Foundations for gasoline hoists are fairly distinct. Their footprint is that of an elongated rectangle at least 2 by 6 feet in area oriented toward and aligned with the shaft. Due to the engine's severe vibrations, prospectors often bolted hoists to concrete foundations at least one foot high. Gasoline hoist foundations usually feature at least two rows of three anchor bolts, with the rear two closer together than the rest. Gasoline hoists can leave distinct artifact assemblages including thin wires, spark plugs, small pipes, and fine machine parts.

Hoist House: A structure that enclosed a hoist, the hoist's power source, and often a blacksmith shop. Hoist houses were usually located at least 20 feet away from the shaft.

Hoist House Platform: An earthen platform, usually graded with cut-and-fill methods, which supported a hoist house. The platform often features evidence of a hoist and a shop.

Hoist House Remnant: The collapsed remnants of a hoist house.

Horse Whim Pit: Prospectors often placed horse whims in shallow pits so the cable could pass through a trench to the headframe and pose no obstacle to the encircling draft animal. They often lined pits with planks or logs to retain soil, and over time these collapsed, leaving a concave depression. The pit should be at the center of a draft animal track, aligned with and at least 20 feet from the shaft, and feature the remnants of the cable trench.

Mine Rail Line: A track for ore cars.

Mine Rail Line Remnant: When prospectors dismantled a track, they often left in-situ ties, impressions of ties, and sections of rails.

Pack Trail: A path less than 8 feet wide that provided access to prospect workings.

Prospect Adit: A horizontal entry underground denoted by a waste rock dump. When collapsed, adits appear as trenches.

Prospect Pit: A circular or ovoid excavation surrounded by a small volume of waste rock.

Prospect Shaft: A vertical or inclined opening underground. When intact, shafts tend to be rectangular and when collapsed, they manifest as circular areas of subsidence.

Prospect Trench: A linear excavation flanked by a small volume of waste rock.

Shop: A building that enclosed facilities where a worker fabricated and maintained tools and hardware. Simple shops usually featured a forge, a workbench, and possible hand-powered appliances such as a drill-press.
Shop Platform: An earthen platform that supported a blacksmith shop. Shop platforms may feature forge remnants and often possess artifacts such as forge-cut iron scraps, anthracite coal, and clinker, which is a scorious, ashy residue created by burning coal.
Shop Remnant: The collapsed remnants of a shop.
Waste Rock Dump: The waste material removed from underground workings.

Figure F 3.1. An abandoned horse whim stands adjacent to a collapsed prospect shaft near Summerville. The whim is an important historic resource because few currently remain. Source: Author.

F 3.2: Hardrock Prospect Significance

Boulder County's hardrock mining industry was founded on and a function of prospecting, and because economic ore could only be found through prospecting, this activity was a cornerstone of the county's history. Prospectors first began subsurface exploration in 1859 around Gold Hill and were rewarded with the discovery of the Scott, Horsfal, Twins, and other lodes. From that time through World War II, the county saw a number of definable prospecting movements focused on specific types of ore that were concentrated in certain mining districts.

Only one Period of Significance for prospecting applies to the entire county, while additional Periods of Significance have been defined in the individual mining districts. These are discussed in detail by mining district in Section E.

The county-wide Period of Significance began with the discovery of hardrock gold at Gold Hill in 1859 and ended around 1865, when the mining industry temporarily collapsed. This Period of Significance is important for several reasons. In concert with the gulch- and stream placer mining discussed above, early hardrock prospecting brought the first large numbers of Euro-Americans to the county. They established the county's first settlements, economy, government entities, and baseline understanding of the county's geography.

While the initial government entities were primitive, they resulted in two contributions important to Colorado and Boulder County. One was the official designation of Boulder County in 1861, along with Colorado's other 16 original counties. The other was the reorganization of Mountain District No.1 as the Gold Hill Mining District in the summer of 1859, and the organization of the Ward, Sugar Loaf, Gold Lake, Grand Island, Snowy Range, Utilla, and Bald Mountain districts between 1860 and 1864. These were some of the earliest mining districts in the Rocky Mountains, and they set a precedent and served as examples for prospectors who organized districts elsewhere during the 1860s. In general, mining districts were an important frontier entity that brought order to mining and associated behavior. In a district, a governing body created and enforced laws regarding claim type and size, requirements for staking and owning a claim, construction of infrastructure, records-keeping, and crime and punishment. Ultimately, Colorado's earliest mining districts, including those organized in Boulder County, formed a foundation for mineral claim laws, which were adopted across the Rocky Mountain west and modified for the 1872 Mining Law.

Another important aspect of early prospecting was that the county served as a training ground of sorts where the methods for finding, identifying, and developing ore veins were honed. Between 1859 and 1865, economical geology was poorly understood, prospecting was in a developing state, and few precedents for finding ore veins existed. Given this, the prospecting that occurred in the county became an important contribution to the general body of knowledge.

As a general category, prospects hold significance to Boulder County in several other broad arenas. First, prospecting was important to the county's social development. In one sense, prospecting provided an opportunity for successful individuals to realize income and even ascend to elevated social and economic statuses. For example, some prospectors such as Hiram Fullen and Anthony Arnett found enough profitable ore formations to rise into Boulder's upper socioeconomic stratum. In another sense, prospecting contributed to the culture of the mountainous portion of the county. Prospectors were an unusual cast of society. To search and labor in the wilderness, they had to be adventuresome, independent, curious, physically robust, and skilled at survival. Most prospectors also possessed at least some formal education and many learned through a combination of experience and academics about geology and mineralogy. The very nature of wandering the mountains in search of wealth required individuals who did not conform to traditional Victorian cultural values. Prospecting distributed these individuals throughout the mountainous portion of the county, and they imparted some of their values and behaviors that persist to the present.

A second category of significance is that prospecting was fundamental to the development of the county's mining industry because the activity was the principal means for identifying economic ore formations. As alluded to above, each mining district had different Periods of Significance for prospecting, which were in part a function of the interest in a district's ore types. Third, prospecting was important for the understanding of the county's economic geology. Through mineral exploration, prospectors, mining company officials, mining engineers, and geologists learned enough about the distribution and the characteristics of ore formations to efficiently bring them into production. Fourth, during the 1860s and 1870s, when the field of mineral exploration was still under development, prospectors in the county contributed to the improvement of techniques and technology. During this time, experienced prospectors employed systematic, strategic sampling methods and applied just enough vernacular engineering to enhance the successful discovery of ore. Over time, the organization, sampling, and functional technology applied for prospecting in Boulder County became common throughout the Rocky Mountains.

F 3.3: Hardrock Prospect Registration Requirements

Prospect Complex: As a Property Subtype, prospect complexes tend to be common and few retain important characteristics or features. Given this, most will be ineligible for the NRHP, although several exceptions exist. Eligible resources must possess physical integrity relative to the exploration and discovery Period of Significance for a given mining district. Because prospect complexes possessed few structures, most of which were usually removed when the site was abandoned, the integrity will probably be archaeological. For archaeological remains to constitute integrity, the material evidence should permit the virtual reconstruction of the prospect operation.

Not all seven aspects of historical integrity defined by the NRHP are likely to be relevant for prospect complexes. The most applicable aspects will probably be Setting, Feeling, and Association. The Setting around the resource, and the resource itself, must not have changed to a great degree from its Period of Significance, excepting the removal of structures and equipment. Usually, this requires a preserved natural landscape and environment. In terms of Feeling, the resource should convey the sense or perception of prospecting from a historical perspective and from today's standpoint. For Association, the resource's sum of features and artifacts should permit the researcher to reconstruct the prospect operation.

In addition to possessing integrity, prospect complexes must meet at least one of the Criteria defined by the NRHP. Resources eligible under Criterion A must be associated with at least one area of significance noted above, as well as the events, trends, and themes important to a specific mining district.

Prospect complexes may be eligible under Criterion B provided that they retain integrity from the important person's period of occupation or participation. Because it is extremely difficult to directly attribute a given complex to an important person, few complexes will be eligible under Criterion B.

Most prospect complexes will also not be eligible under Criterion C because they manifest as random groups of pits, adits, and shafts. Such resources are common and offer few important characteristics and attributes. However, if the organization pattern is clearly evident, then the resource may be eligible under Criterion C as a representation of a discernable, organized, and planned effort. Prospect complexes many also be eligible under Criterion C if the resource possesses intact architectural or engineering features, since these were important aspects of prospecting and few survive today.

Few prospect complexes will be eligible under Criterion D because most information can be collected by detailed recordation of surface features. Several exceptions, however, may exist. If a single group of workings appears to follow a pattern, then recording the surrounding groups may enhance the current understanding of the sampling methods that prospectors used. If the resource possesses building platforms, testing and excavation of buried archaeological deposits may reveal information regarding prospectors' lifestyles and social structures, which is important because these were not heavily documented in the past.

Prospect Shaft: As a Property Subtype, prospect shafts tend to be common while examples retaining high degrees of archaeological, engineering, or architectural integrity are uncommon and may be important. For a prospect shaft site to be eligible, it must possess integrity relative to the host mining district's exploration and discovery Period of Significance. Because structures and equipment were usually removed when shafts were abandoned, the integrity will probably be archaeological. For archaeological remains to constitute integrity, the material evidence should permit the virtual reconstruction of the operation.

Not all seven aspects of historical integrity defined by the NRHP are likely to be relevant for prospect shafts. The most applicable aspects will probably be Design, Setting, Feeling, and Association. For Design, the resource must represent engineering, organization, and operations from the relevant Period of Significance. A resource's overall feature assemblage and individual feature systems can represent Design, and most of these characteristics will be archaeological in nature. The Setting around the resource, and the resource itself, must not have changed to a great degree from its Period of Significance, which usually requires an intact natural environment. In terms of Feeling, the resource should convey the sense or perception of underground operations, both from a historical perspective and from today's standpoint. For Association, the resource's sum of features and artifacts should permit the researcher to reconstruct the historic operation.

In addition to possessing integrity, prospect shafts must meet at least one of the Criteria defined by the NRHP. Resources eligible under Criterion A must be associated with at least one area of significance noted above, as well as events, trends, and themes important to the specific mining district.

Prospect shafts may be eligible under Criterion B provided that they retain integrity from the important person's period of occupation or participation. Because it is extremely difficult to directly attribute a given prospect shaft to an important person, few resources will be eligible under Criterion B.

Most prospect shafts will also not be eligible under Criterion C because they are common, offer few important characteristics and attributes, and usually possess integrity impaired by natural decay and modern disturbance. However, a resource may be eligible under Criterion C if it possesses intact structures and equipment, a high degree of integrity, or important engineering or architectural features. Important engineering and architectural features include intact buildings, structures, machinery, and shaft collars. Under Criterion C, the resource should represent deep prospecting, which was an important phase of mining.

Few prospect shafts will be eligible under Criterion D because most information can be collected by detailed recordation of surface features. Several exceptions, however, may exist. Accessible and intact underground workings are important because few formal studies have been carried out regarding the underground work environment, engineering, equipment, and practices of drilling, blasting, and removing rock. Currently, historical documentation is the principal body of information that researchers rely on for studying the above aspects of prospect development. If the resource possesses building platforms, testing and excavation of buried archaeological deposits may reveal information regarding prospectors' lifestyles and social structures, which is important because they were not heavily documented in the past.

Prospect Adit: As a Property Subtype, prospect adits tend to be common, while examples that retain high degrees of archaeological, engineering, or architectural integrity are uncommon and may be important. For a prospect adit to be eligible, it must possess integrity relative to the host mining district's exploration and discovery Period of Significance. Because structures and equipment were usually removed when adits were abandoned, the integrity will probably be archaeological. For archaeological remains to constitute integrity, the material evidence should permit the virtual reconstruction of the operation.

Not all seven aspects of historical integrity defined by the NRHP are likely to be relevant for prospect adits. The most applicable will probably be Design, Setting, Feeling, and Association. For Design, the resource must represent engineering, organization, and operations from the relevant Period of Significance. A resource's overall feature assemblage and individual feature systems can represent Design, and most of these characteristics will be archaeological in nature. The Setting around the resource, and the resource itself, must not have changed to a great degree from its Period of Significance, which usually requires an intact natural environment. In terms of Feeling, the resource should convey the sense or perception of underground operations, both from a historical perspective and from today's standpoint. For Association, the resource's sum of features and artifacts should permit the researcher to reconstruct the historic operation.

In addition to possessing integrity, prospect adits must meet at least one of the Criteria defined by the NRHP. Resources eligible under Criterion A must be associated with at least one area of significance noted above, as well as the events, trends, and themes important to the specific mining district.

Prospect adits may be eligible under Criterion B provided that they retain integrity from an important person's period of occupation or participation. Because it is extremely difficult to directly attribute a given prospect adit to an important person, few resources will be eligible under Criterion B.

Most prospect adits will also not be eligible under Criterion C because they are common, offer few important characteristics and attributes, and usually possess integrity impaired by natural decay and modern disturbance. However, a resource may be eligible under Criterion C if it possesses intact structures and equipment, a high degree of integrity, or important engineering or architectural features. Important engineering and architectural features include intact buildings, structures, machinery, and adit portals. Under Criterion C, the resource should represent deep prospecting, which was an important phase of mining.

Few prospect adits will be eligible under Criterion D because most information can be collected by detailed recordation of surface features. Several exceptions, however, may exist. Accessible and intact underground workings are important because few formal studies have been carried out regarding the underground work environment, engineering, equipment, and practices of drilling, blasting, and removing rock. Currently, historical documentation is the principal body of information that researchers rely on for studying the above aspects of prospect development. If the resource possesses building platforms, testing and excavation of buried archaeological deposits may reveal information regarding prospectors' lifestyles and social structures, which is important because they were not heavily documented in the past.

F 4: PROPERTY TYPE: HARDROCK MINE

Hardrock mines were underground operations that produced ore. Usually company endeavors, mines ranged in scale from small and labor-intensive to extensive, mechanized operations. Many mines may have yielded ore but they remained unprofitable due to various reasons, and despite this most shared a few basic characteristics such as ore storage facilities, more than one structure, substantial waste rock dumps often at least 125 by 125 feet in area, and roads for the transportation of materials and ore.

While small, marginal mines were similar in scale and content to the advanced prospects discussed above and in Section E, many mines featured substantial surface plants to support intensive work underground. To facilitate the extraction of ore, to expedite materials-handling, and to accommodate various activities, mining companies often employed machinery and erected buildings larger than those at prospects. Some companies attempted to produce ore in economies of scale while minimizing energy consumption and costly labor, and such operations usually relied on advanced machinery and efficient ore handling systems.

Because small mines and deep prospects had the same basic needs, their surface plants consisted of similar facilities. The actual production of ore, however, required additional facilities not found at prospects, and these are discussed in detail in Section E. Ore storage or processing facilities were one of the most fundamental. Ore bins permitted mining companies to store ore between shipments, and companies that mined complex ore often erected ore sorting houses where workers manually separated waste and segregated the ore according to quality. Some mines that were either highly productive or in remote locations featured concentration mills, which separated metalliferous material from waste.

Substantial, productive mines differed from both deep prospects and small mines in the scale and content of their surface plants. Shaft operations in particular featured power-driven hoisting systems that raised high tonnages of payrock from deep workings. While these are clearly discussed in Section E, it should be noted that many of Boulder County's mining companies relied on steam hoists through the 1930s. By contrast, most companies in Colorado's other major mining areas employed electric and gasoline models during the 1930s. The continuation of steam in Boulder County at this time was an uncommon and important practice because it allowed mining companies with little capital, which was difficult to secure during the Great Depression, to maintain production. Without this, some of the county's mining communities may not have survived.

Both highly productive, large-scale shaft- and tunnel mines featured additional surface plant components not found at most small operations. The compressed air system was among the most common, and it permitted miners underground to use mechanical rockdrills to bore blast-holes. Prior to the 1910s, steam powered most compressors, while electric motors became common afterward.

The shop was another key facility that differed for large operations. In general, the employment of machinery created a heavy demand for advanced metalwork and carpentry. To meet such needs and to increase the volume and scale of work, substantial mining companies erected spacious shops equipped with power-driven appliances. Some companies even constructed separate buildings for blacksmithing and drill-steel sharpening, machine work, and carpentry. Where possible, companies located the shop adjacent to the mine opening to minimize the undue handling of heavy materials. Many shops featured a basic array of power appliances including drill-presses, lathes, trip hammers, and pipe cutters. The 1910s saw a number of mining companies employ electric motors to power their shop appliances, while they used upright steam engines in prior years. Most power appliances had to be anchored to foundations, which ranged from timbers to concrete pads.

The need for efficient transportation gave rise to another form of facility which productive companies constructed. To overcome the impediments of winter weather, snow, and hostile terrain, a handful of companies in the county built aerial tramways that descended from the mine to a shipping point or a concentration mill. Small, impoverished operations installed single-rope reversible systems, which were the simplest. Companies with moderate financing strung double-rope reversible systems, which consisted of two track cables and a pair of tram buckets linked by a cable loop. The Bleichert double-rope system, with its endless loop of buckets, was the most efficient and most costly, which limited the system to heavily capitalized companies.

In many cases, the surface plants erected by advanced, highly productive companies required more than the several structures typical of small outfits. For efficient servicing, to minimize plumbing, and for better engineering, substantial companies generally clustered their mechanical components and shops together in either large tunnel houses or shaft houses. Ancillary facilities, such as separate shops, electrical transformers, explosives magazines, offices, and quarters for draft animals were enclosed in individual buildings. In general, the surface plants for substantial operations featured the primary shaft- or tunnel house surrounded by several smaller structures.

F 4.1: Hardrock Mine Subtypes

Shaft Mine: Shaft mines were operations that produced ore from vertical or inclined shafts. Companies almost always arranged critical surface plant components around the shaft collar. Large shaft mines possessed complex, mechanized surface plants with multiple structures, and small operations were simple and may have featured similar facilities to those erected at deep prospects. The presence of an ore bin or sorting house, or the evidence thereof, can distinguish a small mine from a deep prospect.

Small to moderate shaft mines retaining limited integrity are common while sites retaining high degrees of archaeological, engineering, or architectural integrity are uncommon and possibly important. Large, complex shaft mines are uncommon and those retaining any form of integrity are rare and important.

Tunnel Mine: Like shaft mines, tunnel mines were usually company endeavors that produced ore. The difference, however, is that the company drove a horizontal tunnel or adit (see Feature Descriptions below for definitions) to work an ore body. Companies almost always arranged critical surface plant components around the tunnel portal. Large tunnel mines possessed complex, mechanized surface plants with multiple structures, and small operations were simple and may have featured similar facilities to those erected at deep prospects. The presence of an ore bin or sorting house, or the evidence thereof, can distinguish a mine from a deep prospect.

Small to moderate tunnel mines retaining limited integrity are common while sites retaining high degrees of archaeological, engineering, or architectural integrity are uncommon and possibly important. Large, complex tunnel mines are uncommon and those retaining any form of integrity are rare and important.

Features Common to Hardrock Mine Resources

Mine sites often possess an array of archaeological, engineering, and architectural features that were originally components of the surface plant. To help researchers identify the components and organize their data, the Feature

Types below are arranged under the common systems that comprised mine surface plants. The feature types noted below are in addition to those also found at prospects, and so the researcher should review Prospect Site Feature Types and see Section E for complete context.

General Feature Types

Adit: A horizontal opening usually less than 3 by 6 feet in-the-clear. Collapsed adits manifest as linear areas of subsidence. Tunnels were larger horizontal openings greater than 3 by 6 feet in-the-clear.
Building Platform: A flat area upon which a building stood. If possible, the type of building should be specified in the feature description.
Cribbing: A latticework of logs usually intended to be filled with waste rock or earth. Some cribbing structures served as retaining walls for platforms and waste rock dumps.
Explosives Magazine: Organized mining outfits erected magazines to store explosives away from a mine's surface plant. Some magazines were dugouts, some were stout stone structures, while others were no more than small sheds much like dog houses.
Machine Foundation: A timber, masonry, or concrete foundation for an unknown type of machine.
Mine Rail Line: A track that facilitated the movement of ore cars around a mine site.
Mine Rail Line Remnant: When a mine rail line was dismantled, workers often left ties, impressions from ties, portions of rails, and the rail bed.
Pipeline: An assembly of pipes usually intended to carry water. Pipelines should not be confused with compressed air mains, which extended from a compressor into the underground workings.
Pipeline Remnant: Evidence of a disassembled pipeline.
Privy: Most mines of substance featured a privy for the crew's personal use. Privies usually are small frame structures with a door and a bench featuring between one and several cutouts for toilet seats.
Privy Pit: A pit that underlay a privy. Pits tend to manifest as depressions less than 5 feet in diameter, often with artifacts and other materials in their walls and bottoms.
Refuse Dump: A collection of hardware, structural materials, and other cast-off items.
Road: Roads were graded for wagons and trucks and were usually at least 8 feet wide.
Shaft: A vertical or inclined opening underground usually at least 4 by 8 feet in area. Some shafts were divided into compartments. The largest

compartment was the *hoisting compartment* and the smaller, usually less than 3 feet wide, was the *utility compartment*. Highly productive mines may have featured shafts with two hoisting compartments and one utility compartment. Evidence of a double-drum hoist should be associated with a three-compartment shaft. Collapsed shafts manifest as funnels of subsidence.

Shaft House: A shaft house was a large building that enclosed the shaft collar, the hoisting system, and usually a shop. Mine rail lines usually extended away from the shaft and passed out of the building. Large shaft houses may have also encompassed an air compressor.

Shaft House Platform: The platform that supported a shaft house. Large shaft houses often stood on rock foundations, which can define the structure's perimeter. Differences in soil types and consistencies can reflect a shaft house's footprint.

Shaft House Remnant: The collapsed remains of a shaft house.

Stable: A building that housed draft animals used for both underground and surface transportation. Stables were often crude and featured wide doorways, feed mangers, and oat boxes.

Stable Remnant: The collapsed remnants of a stable.

Timber Dressing Station: Timber dressing stations tend to be represented by collections of raw logs and numerous cut wood scraps, usually on flat or gently sloped ground near the mine opening.

Timber Stockpile: A stockpile of mine timbers, often located near the mine opening. Mine timbers are usually 6 to 7 feet long and notched at both ends.

Trestle: A structure that supported a mine rail line, walkway, or pipeline. Workers often built small trestles on the flanks of waste rock dumps to support dead-end rail lines.

Trestle Remnant: Posts, single piers, or partial stringers left from a trestle.

Tunnel: A horizontal opening underground usually more than 3 by 6 feet in-the-clear. Collapsed tunnels often manifest as linear areas of subsidence, possibly with pipes or rails projecting outward.

Tunnel House: A tunnel house was a structure that enclosed the tunnel portal and usually a shop. A mine rail line usually passed out of the tunnel portal and through the tunnel house, as did a trench or flume to divert drainage water. Large tunnel houses often encompassed a mechanized shop and work area where miners dressed timbers.

Tunnel House Platform: The platform that supported a tunnel house. Workers usually graded a cut-and-fill platform around the tunnel portal for the building, and large versions often stood on rock foundations, which

can define the structure's perimeter. The platform, as well as differences in soil types and consistencies, can reflect a tunnel house's footprint.
Tunnel House Remnant: The collapsed remains of a tunnel house.
Utility Pole: A pole that supported an electrical or communication line.
Ventilation Blower: Many operations employed ventilation blowers to force fresh air underground. They usually located the blower adjacent to the mine opening and attached an assemblage of ventilation tubes that extended underground. Large blowers had to be anchored to foundations, and most were belt-driven by an adjacent motor or steam engine.
Ventilation Blower Foundation: Blower foundations usually consisted of timbers, were 3 by 4 feet in area or less, and featured four anchor bolts. The foundations were embedded in the ground adjacent to the mine opening. A motor or small steam engine that powered the blower was usually bolted to an adjacent foundation.

Compressed Air System Feature Types

Air Compressor: An air compressor was a machine that compressed air that was piped underground to power rockdrills. Mining companies employed a variety of types that rose and fell in popularity between the 1870s and 1940s. For a list of types, their descriptions, and popularity age ranges, see Section E.
Air Compressor Foundation: Because of their great weight and powerful motion, air compressors had to be anchored to solid foundations. Workers often constructed timber foundations for small compressors and used either rock or brick masonry, or concrete for large models. Based on a foundation's footprint, the researcher can often determine the exact type of compressor. The foundations for the types of compressors are described in Section E.
Compressed Air Main: A pipeline that carried compressed air from a compressor into the underground workings.
Compressor House: Mines with expansive surface plants occasionally built a compressor house to enclosed an air compressor and receiving tank. If the compressor was steam-driven, then the building also usually enclosed a boiler, unless the mine featured one elsewhere.
Compressor House Platform: The platform that supported a compressor house. Compressor house platforms should feature a compressor foundation, a motor mount or boiler setting remnant, and an artifact assemblage consisting of machine parts and pipe fittings.
Compressor House Remnant: The collapsed remains of a compressor house.

Figure F 4.1. While the Fourth of July Mine was never profitable, it was equipped with a production-class surface plant. The shaft house is long gone, but the hoist and boiler currently remain and can be accessed via the Fourth of July Trail west of Caribou. Source: Author.

Hoisting System Feature Types

Headframe: Mining operations erected four general types of headframes to meet the needs of ore production. The first is an enlarged version of the two-post gallows discussed above with Prospect Shafts. The second was the *four post derrick*, which consisted of four posts joined with cross-braces and diagonal beams, all supported by two backbraces. The third is the *six post derrick*, which featured six posts instead of four. The last is a large *A frame*. Production-class headframes were more than 30 feet high and stood on well-built timber foundations.

Headframe Foundation: Foundations for production-class headframes consisted of a timber frame usually embedded in the waste rock surrounding a shaft. The timbers flanked the shaft and extended toward

the area where the hoist was located. The foundation's length usually equaled the headframe's height.
Headframe Remnant: The collapsed remnants of a headframe.
Hoist: To meet the needs of ore production, mining companies engaged in production almost always employed power hoists. See Section E for types, descriptions, and age ranges for hoists.
Hoist Foundation: Few shaft mines retain their hoists and instead feature foundations, which are distinct today. The foundations for specific types of hoists are discussed in Section E.
Hoist House: See Prospect Site Feature Types.
Hoist House Platform: See Prospect Site Feature Types.
Hoist House Remnant: See Prospect Site Feature Types.

Power System Feature Types

Boiler: Many small, marginal mining operations employed portable boilers to power hoists and minor pieces of equipment, as did prospect outfits. However, mining companies wishing for a permanent, efficient source of steam usually installed return-tube boilers. For descriptions of boilers, see Section E.
Boiler Foundation: When small mining operations removed portable boilers, they occasionally left simple rock or brick supports for the unit, which are discussed under Prospect Site Feature Types. Dismantling a return-tube boiler and its masonry setting, however, resulted in more substantial, distinct structural remnants in the form of a foundation. Return-tube boiler foundations were usually flat, 10 by 18 feet in area, and consisted of rock or brick masonry. In many cases a foundation may retain the bridge wall, which was a low row of bricks between the walls that forced flue gases against the boiler's belly. If more than the rock or brick pad remains, such as collapsed brick walls, then the feature is a boiler setting remnant.
Boiler Setting Remnant: When salvage efforts extracted a return-tube boiler shell, they almost always left the masonry setting in some degree of collapse, which can be described as a boiler setting remnant. Collapsed settings range in appearance from mostly intact masonry walls to piles of rubble. If the walls are intact, setting remnants may feature the cast iron façade or the masonry bolts that anchored the façade, and they may also feature the posts that supported the boiler shell. Most setting remnants also feature a bridge wall, which was a low brick divider in the setting's interior. Most return-tube boiler settings consisted of red bricks or rocks and featured a cleaning port near ground-level at the rear.

Boiler Clinker Dump: When workers shoveled residue out of a boiler's firebox, they usually dumped the material on the waste rock dump near the boiler. Boiler clinker dumps tend to be distinct and consist primarily of boiler clinkers, which are dark, scorious, ashy clasts created by burning coal. Boiler clinker dumps also usually include charred slate fragments, unburned bituminous coal, and structural and industrial hardware.
Motor: The common motor consisted of a cylindrical body, a belt pulley, and electrical wiring. Most motors were less than 4 by 5 feet in area.
Motor Foundation: Due to great weight and stresses created by motion, workers anchored motors to stout concrete foundations usually less than 4 by 5 feet in area. Foundations tend to be slightly rectangular, feature four to six anchor bolts, and are aligned with the machine that the motor powered.
Transformer House: Companies that employed electricity for lighting and power circuits often erected transformer houses to shelter electrical equipment. They usually located the structures away from the rest of the surface plant in case of fire. Transformer houses are relatively small, rarely exceeding 30 by 30 feet in area, and usually feature brackets and mounts on posts for the transformers, as well as ports in the walls and numerous insulators for wires.
Transformer House Platform: Workers usually erected transformer houses on cut-and-fill platforms that appear to be generic, except for a telltale artifact assemblage consisting of a high proportion of electrical items. Examples include cast iron transformer cases, porcelain or slate switch panel fragments, fuses, porcelain insulators, high-voltage porcelain insulators, glass insulators, and wires.
Transformer House Remnant: The collapsed remnants of a transformer house.

Ore Storage and Processing Feature Types

Ore Bin: Mining outfits erected ore bins to contain payrock for shipment. Ore bins could be of the sloped-floor variety or open, flat-bottom structures. For a description of ore bin types, see Section E.
Ore Bin Platform or Foundation: A platform or foundation that supported an ore bin. Open, flat-bottom bins usually stood on a platform located on the flank of a waste rock dump so workers could dump payrock from an ore car. Sloped-floor bins usually stood on a combination of a platform, which supported the bin's head, and log or timber pilings that supported the remainder.
Ore Bin Remnant: The collapsed or partial remnants of an ore bin.

Ore Chute: A chute that directed payrock into an ore bin or into a vehicle.
Ore Chute Remnant: The collapsed remnants of an ore chute.
Ore Sorting House: Ore sorting houses, discussed in Section E, were complex structures that featured an ore bin at bottom, an overlying sorting room, and bins or chutes at top to receive raw ore.
Ore Sorting House Platform or Foundation: Platforms and foundations for sorting houses usually appear similar to those built for ore bins. The difference can manifest as discrete piles of large waste cobbles flanking the foundation. The piles are often different in appearance from the rest of the mine's common waste rock, and often consist of rough cobbles uniform in size.
Ore Sorting House Remnant: The collapsed remnants of a sorting house.

Shop Feature Systems

Backing Block: Some shops featured backing blocks to help workers sharpen the drill-steels used by rockdrills. A backing block consisted of an iron rod 4 by 4 inches or less in cross-section and up to 8 feet long embedded in the shop floor near the forge. The block's surface featured a series of deep divots where the blacksmith rested the drill-steel's butt, and he leaned the drill-steel's neck against an anvil to brace the item for sharpening. Many mining outfits substituted a railroad rail for the iron rod.
Drill-Steel Sharpening Machine: Most sharpeners were upright units 2 by 3 feet in area, 3 to 5 feet high, and featured an assemblage of clamps and power hammers mounted on a cast iron pedestal. Sharpeners are always located in a shop or on a shop platform.
Drill-Steel Sharpening Machine Foundation: Because drill-steel sharpening machines destroyed unpadded concrete foundations over time, they were usually bolted to foundations consisting of timbers or timber footers over concrete. Sharpener foundations are always located in a shop or on a shop platform, are usually 2 by 3 feet in area, and possess four to five anchor bolts.
Forge: Almost every mine shop featured a forge where blacksmiths heated iron. Several types of forges proved popular, and most were 3 by 3 feet in area and 2 feet high. The *gravel-filled rock forge* consisted of dry-laid rock walls filled with gravel. The *wood box forge* consisted of plank walls retaining gravel fill. The free standing *iron pan forge* featured an iron pan supported by iron legs. Companies that required high volumes of work also installed cylindrical iron and square iron box forges usually 4 by 4 feet in area.

Forge Remnant: Over time, rock- and wood box forges decay, leaving mounds of gravel that often feature anthracite coal, clinker, and forge-cut iron scraps.

Lathe Foundation: Some mechanized shops featured a lathe to facilitate metal- and woodwork. Lathes were usually bolted to parallel timbers around 2 by 8 feet in area or less.

Power Hammer Foundation: Advanced, mechanized mining companies installed power hammers in their shops to expedite metalwork. Many power hammers consisted of obsolete rockdrills bolted to timber posts, and they pounded items clamped to an underlying table. When removed, power hammers can be denoted by a heavy timber post up to 6 feet high and an adjacent timber stump where the table was located.

Shop: Shops at mines featured facilities for the manufacture and repair of tools, hardware, and machinery. Some shops also facilitated carpentry. Nearly all shops included blacksmith facilities at the least and some were equipped with power-driven appliances.

Shop Platform: The platform that supported a shop. An artifact assemblage including forge clinker, pieces of hardware, forge-cut iron scraps, cut pipe scraps, and cut wood scraps can help identify a shop platform.

Shop Remnant: The collapsed remains of a shop.

Shop Refuse Dump: A deposit or scatter of forge clinker, forge-cut iron scraps, cut pipe scraps, and pieces of hardware. Carpentry shops left an abundance of cut wood scraps, sawdust, and hardware.

F 4.2: Hardrock Mine Significance

The great importance of hardrock mining to Boulder County seems to be an elementary conclusion. Hardrock mining began in 1859 with the discovery of gold veins at Gold Hill and spread to most of the county's mining districts by 1864. When miners exhausted the easily treated free-gold by around 1865, the mining industry temporarily collapsed. However, the discovery of rich silver at caribou in 1869, telluride gold around Gold Hill in 1872, and tungsten and fluorspar around Nederland and Jamestown around 1900 ensured a rich and diverse industry that thrived through the 1950s.

Like prospecting, only one Period of Significance for hardrock mining applies to the entire county, while the individual mining districts feature regional Periods of Significance. These are discussed in detail by mining district in Section E.

The county-wide Period of Significance began with the discovery of hardrock gold at Gold Hill in 1859 and ended around 1865 when the mining industry collapsed. This Period of Significance is important for several reasons. In concert with the placer mining and prospecting discussed above, early hardrock mining brought the first large numbers of Euro-Americans to the county. They established the county's first settlements, economy, government entities, and baseline understanding of the county's geography.

While the initial government entities were primitive, they resulted in two contributions important to Colorado and Boulder County. One was the official designation of Boulder County in 1861, along with Colorado's other 16 original counties. The other was the reorganization of Mountain District No.1 as the Gold Hill Mining District in the summer of 1859, and the organization of the Ward, Sugar Loaf, Gold Lake, Grand Island, Snowy Range, Utilla, and Bald Mountain districts between 1860 and 1864. These were some of the earliest mining districts in the Rocky Mountains, and they set a precedent and served as examples for prospectors who organized mining districts elsewhere through the 1860s. In general, mining districts were an important frontier entity that brought order to mining and associated behavior. In a district, a governing body created and enforced laws regarding claim type and size, requirements for staking and owning a claim, construction of infrastructure, records-keeping, and crime and punishment. Ultimately, Colorado's earliest mining districts, including those organized in Boulder County, formed a foundation for mineral claim laws, which were adopted across the Rocky Mountain west and modified for the 1872 Mining Law.

Another important aspect of early mining was that the county served as a training ground of sorts where the methods for identifying, developing, and exploiting ore veins were honed. Between 1859 and 1865, economic geology was poorly understood, hardrock mining was in a developing state, and few precedents for systematic and efficient production existed. Given this, the hardrock mining that occurred in the county became an important contribution to the general body of knowledge.

As a general category, hardrock mines hold significance to Boulder County in a variety of broad arenas. The first is the theme of the mining frontier. Prior to around 1880, those mining companies that were on the heels of prospectors were on the forefront of the frontier and brought social, economic, government, and transportation systems to the wilderness. If a region featured ore deposits that lasted more than a few years, a mining industry developed and it usually resulted in permanent settlement that outlived the industry.

The second arena of significance involves economic themes. On a broad scale, mining companies were part of and contributed to complex regional, statewide, and national economic and financial systems. For example, most of the capitalists who invested in the county's companies were of regional and statewide importance, while a few were based outside of Colorado. Implementation of investments, associated communication, banking, and the acquisition and shipment of supplies and food occurred on inter-state and intrastate levels. It should be noted that large mines had a greater association than the small operations.

As another example, mining companies diverted money into local economies by paying wages to their workers, hiring consultants for various services, and purchasing small items from sources mostly in Boulder. Productive companies acquired large machinery and other industrial goods from manufacturers primarily in Denver, and from outside of Colorado to a lesser degree. The manufacturers in Denver in turn purchased their materials from sources within and outside of Colorado. Given this, mining companies supported primarily Colorado's and secondarily other economies. Further, between the 1880s and 1930s, Denver hosted one of the nation's most prolific mine supply industries, and by acquiring goods and machinery from Denver, mining companies ensured the continued success of Denver's mine supply industry.

For a third example, the hundreds of workers employed by the county's mining companies consumed food and other domestic goods purchased from a variety of sources. Preserved food was shipped from packing companies in the Midwest and on the West Coast, while fresh foods came from the county's farms and ranches. By consuming preserved and fresh foods, mining company employees not only supported a complex national food transportation network, but also helped the development of farming and ranching in the county. Merchants in the major towns handled most of the food and goods, and the acquisition of such therefore contributed to local economies.

Large, highly profitable companies saw the consumption of volumes of goods, services, and machinery, and are therefore more closely allied with the above trends than small operations. Cumulatively, however, the small companies, which outnumbered substantial operations, had a significant impact.

Political themes constitute the third arena of significance. Mining in the county was integrally tied to and a direct function of political systems on statewide, national, and international scales. In terms of silver, Federal programs proved crucial for the metal's demand and inflated silver's values to levels that rendered mining economical. The Bland-Allison Act of 1878 and the Sherman Silver Purchase Act of 1890 instituted price supports and acquisition quotas for silver. In response, mining companies in the Grand Island, Central, and Gold Hill mining districts prospected for and some actually produced the metal. Repeal of the Sherman Silver Purchase Act in 1893 and the subsequent collapse of silver's value brought silver mining and prospecting to a temporary halt. Passage of the Pittman Act in 1918 and the Silver Purchase Act of 1934 increased the metal's value again, resuscitating mining. In terms of tungsten, Federal purchase programs instituted in 1942 and 1951 increased the metal's price high enough to revive what was a declining industry in the Nederland area, and the repeal of the programs in 1944 and 1956 caused mining to collapse.

On an international scale, until 1893 the British pursued a pro-silver policy, and many European nations followed the same trend during World War I, which stimulated silver mining in the county. When the Pittman Act was canceled in 1922, silver values toppled to low levels, which caused mining to return to a torpid state. International political events in the form of war impacted mining in the county. During both world wars and the Korean conflict, the value of tungsten and fluorspar increased to the point of stimulating significant booms in the Nederland and Jamestown areas.

On a regional scale, the workers, capitalists, and companies involved with the county's mining industry provided political and economic support for senators, representatives, and lobbyists who fought for the Federal programs that kept the value of metals high. Further, some of Colorado's mining elite who held interests in the county, such as David H. Moffat, Jerome Chaffee, and the Wolcotts, held public office and directly influenced Federal policy.

While few individual mine sites existing today can be directly tied to specific political acts and policies, as a whole, the county's mining industry influenced statewide and Federal policies.

The fourth arena of significance involves social themes. The participants in the county's hardrock mining industry contributed to the development and evolution of regional, statewide, and national social structures. One social structure was the development of classes in the county and greater Colorado. When mining companies began production during the 1860s, their profits contributed to the initial development of social classes in Colorado. Some owners and investors began their ascent to upper classes while the laborers, of whom there were many, formed a working class dependent on wages. As mining continued through the 1930s, two general categories of capitalists acquired the productive properties and financed exploration. The first and by far largest category consisted of local investors of limited means primarily in nearby commercial centers and Boulder, and the second category consisted of already wealthy elite based in Denver, the East, and in the Midwest. The profits realized from the mines reinforced the fortunes of the few elite while contributing heavily to the formation of a middle-class, which ultimately became one of the county's economic and political backbones. Because the mining companies depended on wage laborers, company operations ensured the continuation of a working class.

The very nature of the workforce that made mining in the county possible constituted another form of social structure. Activity in the various mining districts created an insatiable employment market that drew workers from points throughout Colorado and other areas in the nation. Some of those workers were immigrants, mostly from European countries. The cycles of boom and bust inherent to gold, silver, and industrial minerals mining required that the workers be mobile, which contrasted sharply with the county's sedentary farming and ranching culture. Each boom drew laborers from a variety of backgrounds while busts propelled them to other areas and economic sectors in Colorado and elsewhere in the nation. The result was a mobile, adaptable, and diverse society.

Large mine sites can be strongly allied with the themes of class, workforce, and demography because they supported major workforces. Small mine sites, on the other hand, tend to be associated primarily with mobility, lower classes, and a demography of independent individuals.

Engineering and mining methods constitute the last but not least arena of significance. In general, the county's mining industry was on the forefront of the evolution of mining from simple and labor-intensive to advanced and highly mechanized. In general, hoisting technology was in a primitive state during the 1860s and early 1870s, and typical shaft mines featured either hand windlasses or horse whims, which limited the depth of operations. During this time, steam hoists were revolutionary, experimental, and costly, and so were rare. Regardless, as early as 1865, the Niwot Mining Company at Ward installed a steam hoist over its shaft, and by 1870, a number of mines at Caribou, including the No Name and Caribou, also featured steam hoists. Given the nascent state of steam hoisting, these mines were proving grounds for the application of a technology that became standard throughout the world by the 1880s. Similarly, steam- and compressed air powered rockdrills had been introduced to the mining industry around 1874, and like steam hoists, rockdrill technology was in an experimental state. By 1876, several mining companies at Caribou and possibly elsewhere in the county employed these new boring apparatuses, making them among the first in Colorado.

During the 1860s and 1870s, the practices of mining engineering, the systematic development of ore bodies, and work at depth were in a nascent state, and haphazard underground workings, extracting ore as it was encountered, and building surface facilities on an as-need basis were the norm. In Boulder County, by contrast, mining companies primarily in Ward and Caribou quickly adopted new and efficient practices and sank large shafts to great depths. In so doing, some of the county's companies exemplified the establishment of those applications of engineering and technology that were effective.

F 4.3: Hardrock Mine Registration Requirements

The Property Subtypes of shaft and tunnel mines form a spectrum ranging from small, simple, and unimportant to large, complex, and significant. Small and simple mines were common in Boulder County and tended not to be involved with major engineering and technological contributions on an individual basis, although they could have been important to a specific mining district. In such cases, their significance will be local. Large and complex mines were uncommon and some participated in the development of engineering and technology, and they tend to be associated with multiple themes of importance. Most small mines will be ineligible for the NRHP, although exceptions certainly exist.

Eligible resources must possess physical integrity relative to the Period of Significance, which may vary by mining district. Because most small mines possessed few structures and little machinery, which were usually salvaged when a site was abandoned, the integrity will probably be archaeological. For archaeological remains to constitute integrity, the material evidence should permit the virtual reconstruction of the mining operation. Large and complex mines were subject to the same predation as small mines; however, at least a few engineering and architectural features may remain. Therefore, large mines often retain primarily archaeological and occasionally engineering and architectural integrity.

Most of the seven aspects of historical integrity defined by the NRHP apply to mine sites. Some mine sites may possess standing structures and intact machinery, which must retain the aspect of Location to contribute to a resource's integrity. To retain Location, the structure or machine must be in its original place of installation. For a resource to retain the aspect of Design, the resource's material remains, including the archaeological features, must convey the mine's organization, planning, and engineering. In many cases, mines were worked periodically and the surface facilities changed and adapted to new operations, leaving evidence of sequential occupation. In such cases, a resource can retain the aspect of Design if the material remains reflect the evolution of the surface facilities over time. By studying archival information and material evidence, the researcher can determine when specific surface facilities were built and abandoned, thereby establishing a chronology for the resource's evolution. To retain the aspect of Setting, the area around the resource, and the resource itself, must not have changed a great degree from its Period of Significance, excepting the removal of structures and machinery. If the resource is isolated, then the natural landscape should be preserved. If the resource lies in a mining landscape, then the surrounding mines and industrial features should retain at least archaeological integrity. In terms of Feeling, the resource should convey the sense or perception of mining from a historical perspective and from today's standpoint. For Association, the resource's sum of features and artifacts should permit the researcher to reconstruct the mining operation.

In addition to possessing integrity, mine sites must meet at least one of the Criteria defined by the NRHP. Resources eligible under Criterion A must be associated with at least one area of significance noted above, as well as events, trends, and themes important to the specific mining district.

Mines may be eligible under Criterion B provided that they retain integrity from an important person's period of occupation or participation. Some mines, especially large complexes, often can be traced to important individuals such as engineers, and in these cases, they can be eligible under Criterion B. It should be noted, however, that an important person's investment in a property or involvement with a company is too indirect an association for Criterion B. The individual of note must have either been present on-site or played a fundamental and direct role in its physical development.

Most small mines will probably not be eligible under Criterion C because they are common, usually lack integrity, and offer few important characteristics and attributes. However, if the organization pattern is clearly evident or structures and machinery are present, then the resource may be eligible under Criterion C. In general, intact structures and machinery are uncommon and important representations of engineering and technology. Those resources that clearly exemplify small or moderately sized mines may be important because they made up the bulk of the county's hardrock mining industry. Large mines can be eligible under Criterion C if the resource possesses intact archaeological, architectural or engineering features that clearly convey aspects of the mining operation. The features must represent the application of engineering, technology, and methods during the Period of Significance.

Few small mines will be eligible under Criterion D because most information can be collected by detailed recordation of surface features. Several exceptions, however, may exist, especially at large mines. If the resource possesses building platforms, privy pits, and boiler clinker dumps, testing and excavation of these buried archaeological deposits may reveal information regarding miners' lifestyles, social structures, and the workplace, which is important because these topics were not heavily documented in the past. Accessible and intact underground workings are important because few formal studies have been carried out regarding the underground work environment, engineering, equipment, and practices of drilling, blasting, and removing rock. Currently, historical documentation is the principal body of information that researchers rely on for studying the above aspects of mining. Detailed studies of structures and machinery can contribute information regarding engineering and architectural practices, and the application of technology.

F 5: PROPERTY TYPE: OPEN PIT MINE

Open pit mines were surface operations that produced ore. Almost always company endeavors, open pit mines ranged in scale from small and labor-intensive to extensive, mechanized operations. At small open pit mines, companies usually worked limited bodies of high-grade ore, primarily gold, fluorspar, or tungsten. At large mines, heavily capitalized companies employed advanced mechanization to produce low-grade ore in economies of scale. Most open pit operations shared a few basic characteristics such as exposed workings, substantial waste rock dumps, ore storage facilities, transportation systems within the workings, and support facilities similar to those at underground mines. Many open pit mines were parts of greater operations that included underground workings.

While small open pit mines were similar in scale and equipment to labor-intensive underground operations, large open pit mines were different. Small open pit mines usually featured surface workings limited in shape and size to the ore body. Prior to the 1930s, miners often worked the ore body in benches and hauled ore out of the pit in wheelbarrows and single ore cars. A shop where a blacksmith maintained tools and fabricated hardware stood near the pit entrance, and ore bins were often located nearby. To allow miners to push ore cars to the bin edge, the bin rim had to be concurrent in elevation with the pit floor. Mechanized operations may have included an electric or petroleum powered air compressor.

The introduction of earth-moving equipment during the 1930s and 1940s changed practices in open pits and required a revision of support facilities and ore handling. First, the scale of pits increased since earth-moving equipment reduced the costs of production. Drill rigs were able to bore deep blast-holes that contained high volumes of explosives, which brought down greater volumes of rock than with labor-intensive methods. As a result, the headwalls around pits increased in height. Second, loaders scooped the blasted material into trucks, and they required a broad, even floor and the maintenance of wide access avenues. Third, repair shops had to accommodate the complex equipment, and workers needed to be versed in vehicle mechanics. Last, productive open pit mines necessitated well-built roads for haul trucks. Like most mines, large open pit operations concentrated their facilities together for ease of servicing and coordination.

Open pit mining was not commonly practiced in Boulder County, although some of the relatively few sites remaining today may be important. Open pit mining apparently began at Gold Hill in 1859 when miners worked several gold veins from ground-surface downward, and miners engaged in similar practices elsewhere in the Gold Hill district during the 1870s in pursuit of telluride gold. As fluorspar became profitable during the 1900s, open pit mining spread on a limited basis to the Jamestown area and continued through the 1920s. In all cases, the surface workings remained small and most operations were labor-intensive. In the 1940s and 1960s, Jamestown saw what may have been the county's most extensive open pit mining at the Emmett and Burlington mines, which produced fluorspar. In comparison to open pit mines elsewhere in Colorado, the Emmett and Burlington operations were small.

Features Common to Open Pit Mine Resources

Open pit mine sites often possess an assemblage of archaeological, engineering, and architectural features that represent the mining operation and its support facilities. To help researchers identify system components and organize their data, the Feature Types below are organized under the common groups that comprised open pit mines. The feature types noted below are in addition to those also found at hardrock mines, and so the researcher should review shop, compressed air, electricity, and transportation feature types for both prospects and hardrock mines above.

General Feature Types

Access Road: A road that provided light-duty vehicles access in and around the workings.
Bench: Companies worked large and deep open pit mines in benches, which were discrete terraces subjected to drilling and blasting.
Conveyor: Some open pit mines featured conveyor belts that shuttled ore to a crusher, ore bin, or mill.
Crushing Station: By the 1950s, many small open pit mines featured trailer-mounted rock crushers that reduced boulders and large cobbles.
Fuel Tank: Heavy equipment and haul trucks required fuel, which was often stored in tanks elevated on steel frames. Some tanks also stood on platforms near the pit entry.
Generator: By the 1950s, some open pit mines featured generators to provide electricity for lighting and to run machinery. A generator was similar in form to a motor and many models were powered by petroleum engines.
Generator Station: A frame building that enclosed a generator and electrical substation.
Grizzly: A grizzly was a screening structure that separated blasted rock by size. Earth moving equipment dumped mixed rock onto the grizzly, which usually consisted of heavy iron rods, and fine material passed through while boulders rolled off.
Headwall: The exposed rock face in an open pit.
Haul Road: A road that accommodated dump trucks. Many mines featured at least one haul road through the pit and at least one other to the waste rock dump.
Loading Area: Two forms of loading areas existed. One was the location on a pit floor where heavy equipment loaded dump trucks with rock. The other was at the toe of an ore bin where trucks or wagons were loaded with ore.
Office: Most open pit mines featured an office where workers and superintendents administered to operational affairs.
Open Cut: A relatively small open pit or a narrow excavation where the surface expression of vein was removed.
Open Pit: A broad and deep incision in the ground where ore was removed.
Pit Floor: The floor in an open pit where workers loaded dump trucks or wagons and maneuvered and parked heavy equipment.
Portable Air Compressor: By the 1940s, portable compressors were popular in open pit mines because they could be towed to points of work.

Portable compressors usually featured an upright compressor, a petroleum drive engine, and an air receiving tank on a four-wheel trailer.

F 5.1: Open Pit Mine Significance and Registration Requirements

Because Boulder County featured relatively few open pit mines, their significance was not on a county-wide basis. Rather, the arenas of significance for open pit mines are limited to their host mining districts and their specific ore types. For example, the significance of most of the open pits around Jamestown will probably lie with that of fluorspar production.

Eligible resources must possess physical integrity relative to the Period of Significance, which will vary by mining district and ore type. Because most small mines possessed few structures and little machinery, which were usually removed when a site was abandoned, the integrity will probably be archaeological. For archaeological remains to constitute integrity, the material evidence should permit the virtual reconstruction of the mining operation.

Most of the seven aspects of historical integrity defined by the NRHP apply to open pit mines. Some resources may possess standing structures and intact machinery, which must retain the aspect of Location to contribute to a site's integrity. To retain Location, the structure or machine must be in its original place of installation. For a resource to retain the aspect of Design, the resource's material remains, including the archaeological features, must convey the mine's organization, planning, and engineering. By studying archival information and material evidence, the researcher can determine when specific surface facilities were built and abandoned, thereby building a chronology for the resource's evolution. To retain the aspect of Setting, the area around the resource, and the resource itself, must not have changed a great degree from its Period of Significance, excepting the removal of structures and machinery. Open pit mines usually lie in a mining landscape, requiring that the surrounding mines and industrial features retain at least archaeological integrity. In terms of Feeling, the resource should convey the sense or perception of mining from a historical perspective and from today's standpoint. For Association, the resource's sum of features and artifacts should permit the researcher to reconstruct the mining operation.

In addition to possessing integrity, mine sites must meet at least one of the Criteria defined by the NRHP. Resources eligible under Criterion A will most likely be associated with the events, trends, and themes important to the specific mining district, its Periods of Significance, and ore type.

Open pit mines may be eligible under Criterion B provided that they retain integrity from an important person's period of occupation or participation. Some mines may be traced to important individuals such as engineers, and in these cases, they can be eligible under Criterion B. It should be noted, however, that mere investment in a property or involvement with a company by an important person is too indirect an association for Criterion B. The individual of note must have either been present on-site or played a fundamental role in its physical development.

Most small open pit mines will probably not be eligible under Criterion C because they usually lack integrity and offer few distinguishing characteristics and attributes. However, if the organization pattern is clearly evident or structures and machinery are present, then the resource may be eligible under Criterion C. In general, intact structures and machinery amid the county's open pit mines are rare and important representations of engineering and technology. The features must represent the application of engineering, technology, and methods during the Period of Significance. However, because most equipment used in open pit mines was portable, little the machinery left little direct evidence, which dilutes the archaeological integrity.

Few open pit mines will be eligible under Criterion D because most information can be collected by detailed recordation of surface features. Detailed studies of structures and machinery can contribute information regarding engineering and architectural practices, and the application of technology.

F 6: PROPERTY TYPE: ORE CONCENTRATION FACILITY

One of the main objectives of mining was to reduce ore to its constituent metals. In general, the process began with crushing and grinding the ore, followed by separating metalliferous material from waste in a stage known as concentration. The resultant concentrates were roasted and smelted in a furnace, which furthered the separation and yielded a blend of metals known as matte. Advanced smelters located in cities along Colorado's piedmont and in the Midwest refined the matte into pure metals. In general, ores of purity or simplicity required fewer steps while complex, refractory ores required time-intensive treatment and numerous steps.

A variety of facilities carried out one or all of the necessary processing steps, and most in the county operated either as independent mills or in conjunction with a specific mine. Some mining companies erected *concentration mills* to complete the crushing and concentration steps ordinarily carried out by smelters, which saved the companies costs in two areas. First, mining companies did not incur the high transportation costs of shipping waste-laden ore, and second, they avoided paying the fees charged by smelters for complete treatment. Concentration mills, also known as *reduction mills*, produced only concentrates and no refined metals, and they processed gold, silver, tungsten, and industrial mineral ores.

Concentration mills ranged in scale from small facilities to sprawling industrial complexes, and metallurgists based the treatment processes on specific types of ore. The county saw the application of three general categories of concentration mills, which are described in detail in Section E. The historic mining industry termed the first and most popular the concentration mill, the second was the amalgamation stamp mill, and the third, rarely used after the 1860s, was the arrastra.

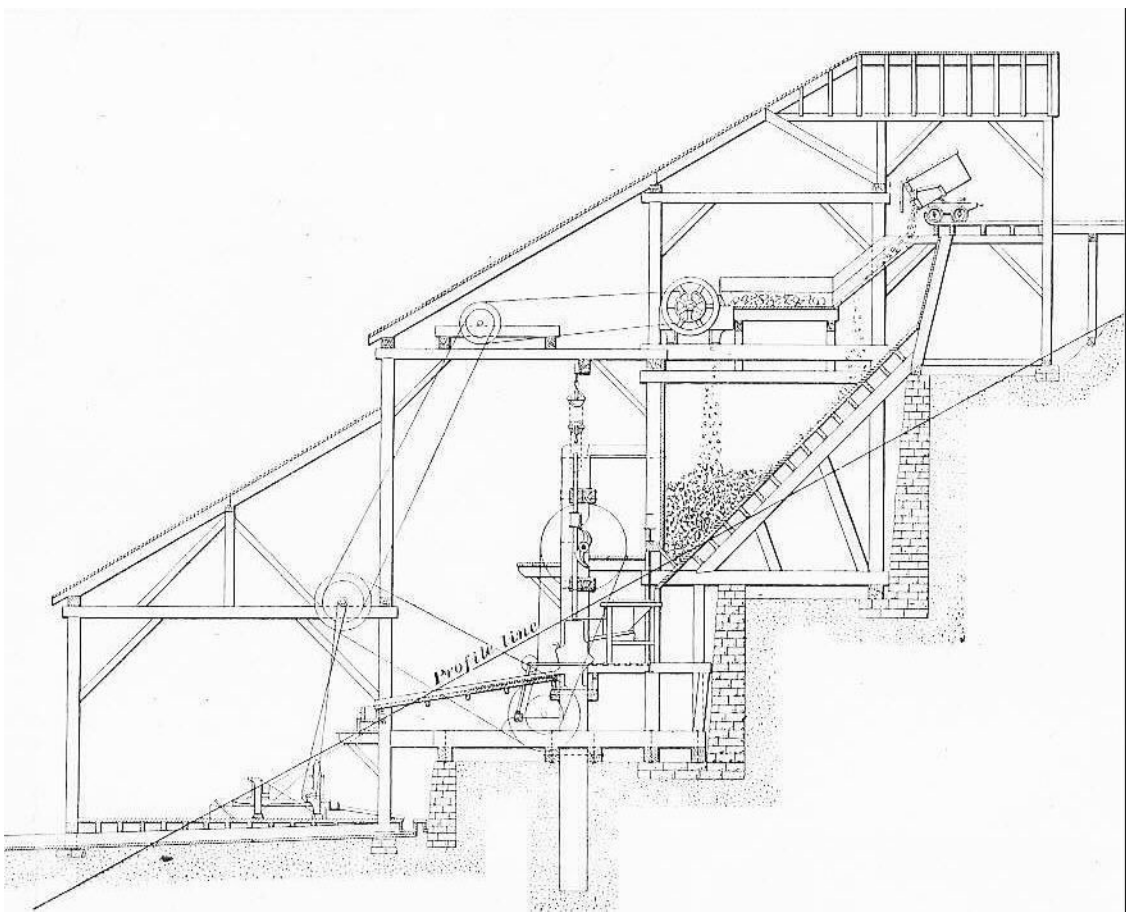

Figure F 6.1. The profile illustrates both the stairstep configuration of a typical concentration mill and the process flow path. Workers dumped ore onto a screen at top, and fine material passed through while course cobbles were diverted into a crusher. A stamp battery at center pulverized the ore into a slurry, which passed over amalgamating tables that extracted gold and silver. The slurry then descended to concentration machinery on the lower platform. Source: International Textbook Company, 1899, A43:214.

Often, concentration mills employed batteries of stamps to crush ore prior to other processing steps. However, under the right conditions, companies were able to employ what were categorically known as *stamp mills* as a simple means of recovering gold without smelting. Specifically, the easily crushed, free-milling gold ore mined in the county through the mid-1860s could be treated by a stamp mill. In this instance, a battery of stamps crushed the crude ore and amalgamating tables at the battery's toe recovered the gold. Because of its simplicity and relatively low cost, the amalgamation stamp mill was within economic reach of many mining companies. However, this type of mill proved ineffective for the county's complex ores, which miners encountered at depth by the mid-1860s, and as a result, the use of amalgamation stamp mills as a sole treatment facility was uncommon after this time.

F 6.1: Ore Concentration Facility Subtypes

Concentration Mill: A concentration mill was a facility that employed primarily mechanical and occasionally chemical means to separate metalliferous materials from waste. Concentration mills came in a variety of scales and were usually built over a series of terraces incised into a hillslope so that gravity could draw the ore through the processing stages. Small mills usually featured only several stages of crushing and concentration while large mills were heavily equipped to process both great volumes of ore and complex material that resisted treatment.

Engineers usually followed a general template when designing concentration mills. An ore bin stood at the mill's head and it fed crude ore into a primary crusher, usually located on the mill's top platform. The resultant gravel descended to a secondary crusher located on the platform below, then through a screening system. Oversized material returned for secondary crushing and material that passed the screen went on for concentration at small mills, or tertiary crushing at large mills. Following another screening, the ore descended to subsequent mill platforms for concentration.

On the concentration platforms, apparatuses such as jigs, vanners, vibrating tables, and settling tanks (discussed in Section E) separated waste known as gangue from the metalliferous material. Depending on the size of the mill and the complexity and volume of the ore, the apparatuses could have achieved the separation in numerous steps. The concentration platforms also usually featured the mill's power source and a drier to evaporate moisture from finished concentrates.

As can be surmised, concentration mills were complex facilities equipped with a variety of crushing and concentration appliances, and the specific flow path was a function of the type and volume of ore being treated. When intact, concentration mills were substantial industrial structures that descended a hillslope and enclosed the various terraces. When a mill was abandoned, the structures and machinery were usually removed, leaving stair-step platforms, machine foundations, and hardware. Tailings left from ore processing were usually flumed to an area downslope from the mill and today can manifest as substantial deposits of finely ground sand and rock flour. In Boulder County, many mills were no more than costly failures, which the absence of tailings from a site often reflects.

Every mining district in Boulder County except for Gold Lake featured at least several concentration mills, and the sites remaining today may be perceived as somewhat common. However, due to salvage efforts, tailings removal, alteration, and especially natural decay, very few mill sites remain intact. Given this, sites that retain a baseline of archaeological integrity, let alone engineering features, are important representations of the county's concentration industry.

Amalgamation Stamp Mill: Two definitions apply to the term *stamp mill*. Often, concentration mills employed batteries of stamps to provide secondary crushing prior to the separation of waste. In this case the term stamp mill refers to the stamp battery, which is a component of a concentration mill.

However, some types of ore lent themselves to being pulverized in a stamp battery then treated with mercury to recover gold without smelting. Specifically, the ore had to feature relatively simple gold compounds and be easily crushed. A jaw crusher usually provided primary crushing, the stamps effected the rest of the physical reduction, and the resultant slurry washed over amalgamating tables at the battery's toe. The tables were coated with mercury, which amalgamated with the gold and allowed the spent tailings to continue out of the mill. Workers periodically scraped off the amalgam and heated the mass in a retort, which volatized the mercury and left impure gold that had to be refined. These treatment facilities are generally termed *amalgamation stamp mills* and as such may be recorded as specific resources.

Because amalgamation stamp mills featured a fraction of the equipment installed at the more complex concentration mills, they tended to be smaller and simpler. Regardless, amalgamation stamp mills shared with concentration mills a few fundamental components. First, because they relied on gravity to draw the ore through stages of crushing and metals recovery, metallurgists usually erected stamp mill facilities over terraces cut out of a slope. Second, amalgamation stamp mills usually featured a receiving bin above the primary crusher to hold crude ore destined for processing. Third, the mid- or lower platform featured the power source, which was often a horizontal steam engine and boiler. Last, the mill required a source of water. It should be noted that engineers installed tertiary crushing and possibly concentration appliances in some amalgamation stamp mills, which better prepared the ore and recovered any gold that escaped amalgamation.

Arrastra: An arrastra was a simple and inefficient apparatus for recovering metals from ore. An arrastra consisted of a circular stone floor usually less than 30 feet in diameter with low sidewalls and a capstan at center. A draft animal, tethered to a harness beam fastened to the capstan, walked a path around the stone floor. Drag-stones, chained to the harness beam, ground the ore on the stone floor, where it amalgamated with mercury that a worker introduced. Some outfits substituted waterpower for draft animals.

Features Common to Ore Concentration Facility Resources

Mill sites often possess an array of archaeological, engineering, and architectural features that were components of the crushing, concentration, power, and support facility systems. To help researchers identify components and organize their data, the Feature Types below are arranged according to the general flow path employed at mills.

General Feature Types

Arrastra: An arrastra consisted of a circular stone floor ringed with low sidewalls, and a capstan at center. A draft animal tethered to a harness beam bolted to the capstan walked around the floor, dragging stones chained to the beam.
Arrastra Remnant: Arrastra remnants may retain portions of the floor, sidewalls, and capstan.
Assay Shop Platform: Mills usually featured assay shops to track the efficiency of metals recovery and concentration, and the buildings often stood on platforms. Such platforms may feature foundations or other remnants of an assay furnace, as well as clinker, bricks, assay crucibles, and laboratory artifacts.
Cistern: A concrete, masonry, or timber chamber that contained water for mill use. Because mills usually relied on gravity to pressurize plumbing, cisterns tend to be located upslope from a mill.
Conveyor: Conveyors lifted ore from one mill appliance or process to another. Early conveyors consisted of a bucket-line or spiral feed while later conveyors consisted of belts on rollers.
Conveyor Remnant: A partially disassembled conveyor.
Ditch: An excavation that carried water to a mill.

Flume: A wooden structure usually constructed with plank walls and a plank floor. Workers built flumes to convey water to or tailings away from a mill, and to transfer slurry from one process to another.
Flume Remnant: The collapsed or buried remnants of a flume.
Machine Foundation: A foundation that anchored an unknown mill machine.
Mill Building: The structure that enclosed a mill. Mill buildings tended to be large, based on stout frames, and conformed to stair-step terraces or foundations.
Mill Building Remnant: A collapsed mill building.
Mill Platform: One of the main platforms or flat areas that supported a stage of crushing or concentration. When recorded, platforms should be numbered from the top down and described according to function.
Mill Tailings Dump: A deposit of finely ground rock flour and sand usually downslope or downstream from a mill.
Pipeline: An assembly of pipes that carried water.
Pipeline Remnant: The evidence left by a disassembled pipeline.
Privy: Most mill complexes included a privy for the crew's personal use.
Privy Pit: The pit that underlay a privy. Privy pits are often less than 5 feet in diameter and may feature artifacts visible in the walls and floor.
Pump Foundation: Often of concrete, pump foundations are rectangular, less than 2 by 4 feet in area, and may feature pipes.
Receiving Bin: An ore bin located at the mill's head that received crude ore for processing.
Receiving Bin Platform or Foundation: Foundations and platforms for receiving bins can be similar to those for ore bins at mine sites.
Receiving Bin Remnant: Remnants of receiving bins can be similar to those for ore bins at mine sites.
Refuse Dump: A collection of hardware, structural materials, and other cast-off items.
Reservoir: Some milling operations erected dams in drainages to impound water for use.
Utility Pole: A pole that carried electrical or telephone lines.
Water Tank: A large vessel, usually cylindrical, made of planks or sheet iron. To pressurize plumbing, water tanks were usually located near the head of a mill.
Water Tank Platform: Often a circular or semi-circular platform for a tank. The platform's floor may feature a pipe.

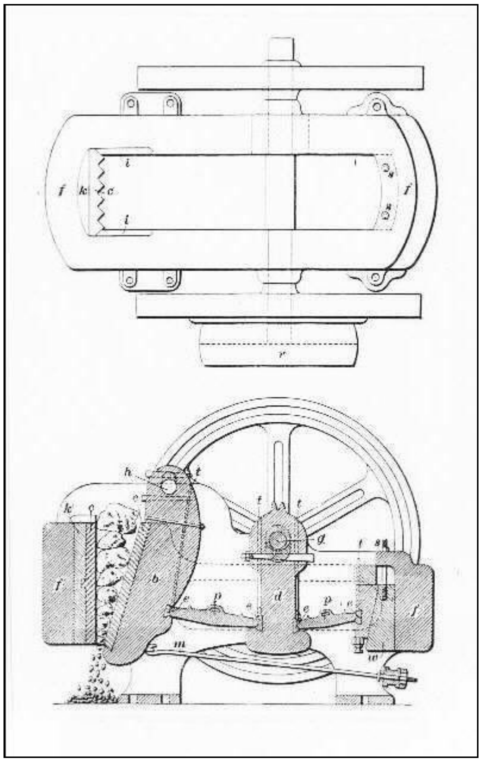

Figure F 6.2. The plan view, top, and profile, bottom, illustrate a jaw crusher, which provided initial crushing at most mills. Source: International Textbook Company, 1899, A43:2.

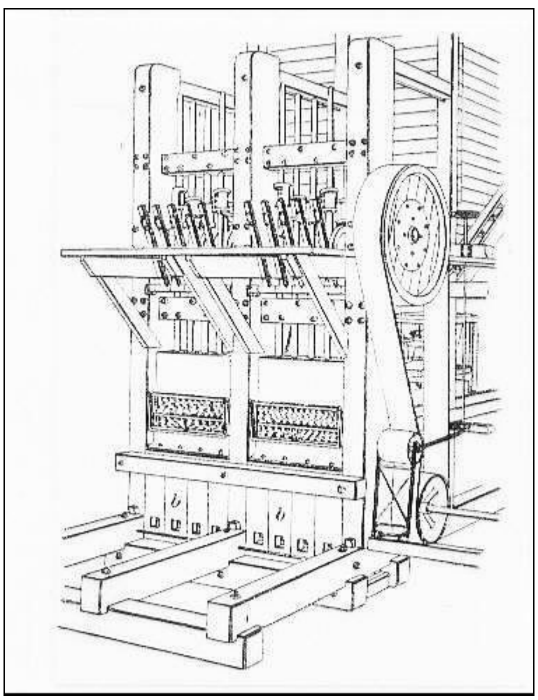

Figure F 6.3. The quarterview illustrates the front of a stamp battery, which provided secondary crushing at some mills. Stamp rods are visible between the timber posts, and heavy iron shoes pounded ore in the battery boxes below. The battery boxes are bolted to pedestals of upright timbers, which are often the only remnants of stamp batteries today. Source: International Textbook Company, 1899, A43:27.

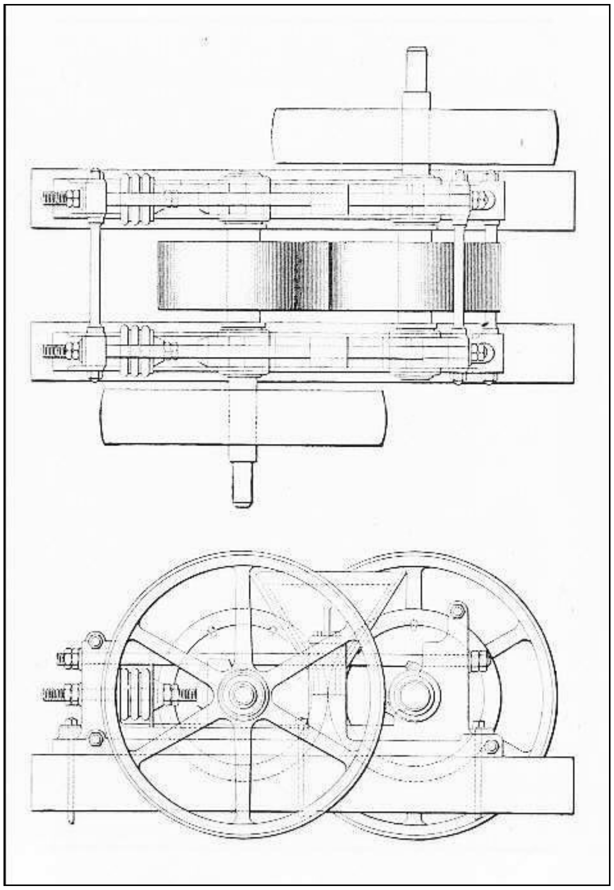

Figure F 6.4. The plan view, top, and profile, bottom, illustrate a device known as a crushing rolls, which was popular in Boulder County's mills for secondary and tertiary crushing. Source: International Textbook Company, 1899, A43:12.

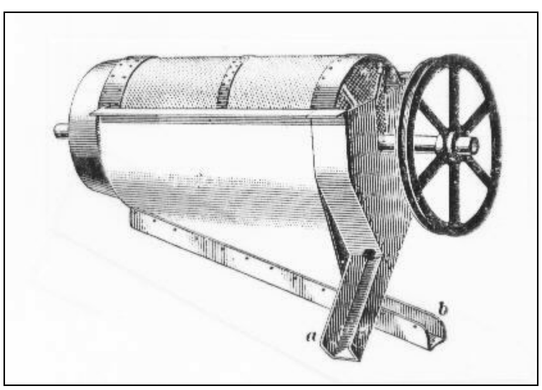

Figure F 6.5. Most mills relied on trommel screens to sort crushed rock between processing stages. Source: International Textbook Company, 1899, A43:12.

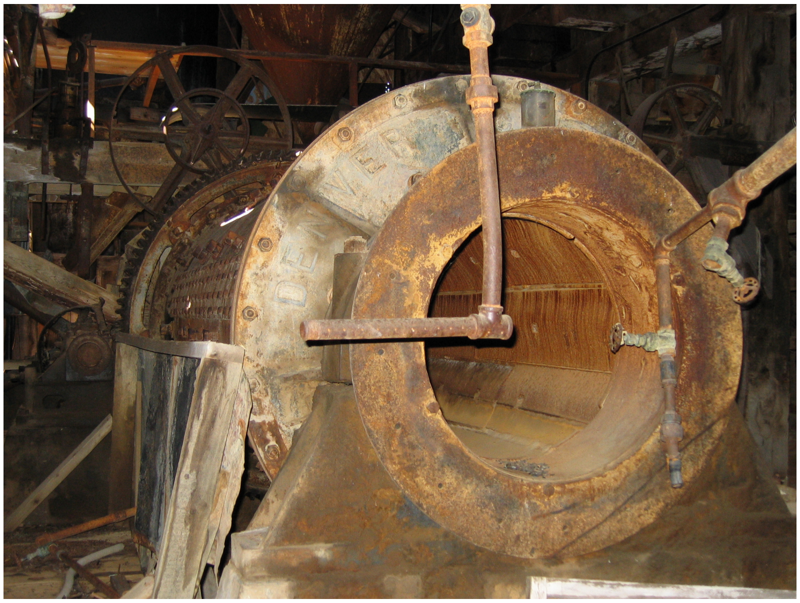

Figure F 6.6. Rod mills such as the one at the Cardinal Mill became popular for find grinding by the 1910s. As the entire cylinder slowly rotated, tumbling steel rods in the chamber ground screened ore into a slurry. A hatch covered the opening. Source: Carol Beam.

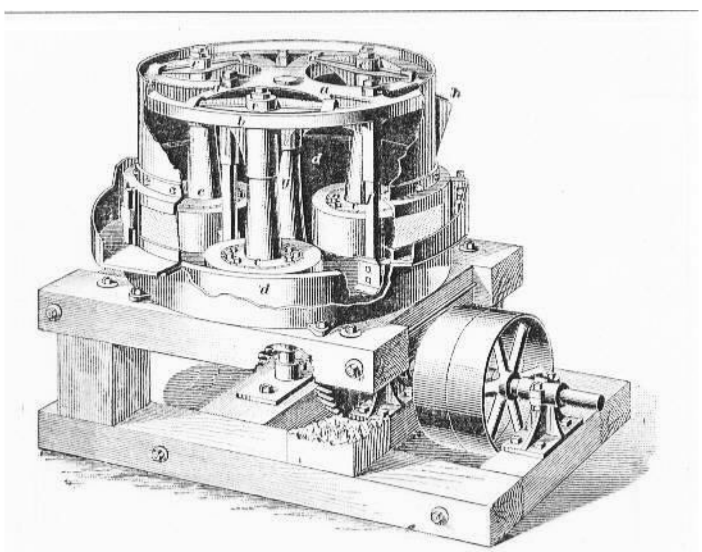

Figure F 6.7. The device known as the Huntington mill saw two applications. At concentration facilities, it provided secondary and tertiary crushing, and at amalgamation mills, the device simultaneously ground and amalgamated gold and silver ores. The driveshaft at right turned a capstan in the mill's pan, which caused the rollers to grind screened ore against the pan's cast iron walls. Note the foundation. Source: International Textbook Company, 1899, Z43:47.

Crushing System Feature Types

Jaw Crusher: A mill apparatus located on the mill's upper terrace that pulverized crude ore into gravel. Crushers usually featured jaws and dual flywheels powered by a belt. Small units were around 2 by 4 feet in area and large units were up to 4 by 8 feet in area.
Crusher Foundation: Due to severe vibrations, crushers were often anchored to stout timber or masonry foundations with timber footings. Small piles of crushed gravel often underlie crusher foundations.
Stamp Battery: A stamp battery consisted of a heavy timber gallows frame, stamps that dropped into a battery box, and a cam shaft that raised and let the stamps drop. Batteries usually featured stamps in groups of five, and so a fifteen stamp battery had three groups. The timber frame for a single group tended to be 7 feet wide, up to 15 feet high, and stood over a cast iron battery box bolted to a timber pedestal. The frame featured guides for the stamps and a cam shaft fitted with a large bull wheel.
Stamp Battery Frame: In many cases salvage efforts dismantled the iron hardware from a stamp battery, leaving the frame.
Stamp Battery Pedestal: Often, stamp mills were dismantled for use elsewhere, leaving a pedestal as the principal representation today. Stamp battery pedestals were rectangular, often 2 by 5 feet in area and 2 feet high, and consisted of timbers set on-end. The pedestal anchored a cast iron battery box in which the stamps crushed the ore.
Screening Station: Screens, often cylindrical trommels, were usually located below each crushing stage and classified the material by particle size.
Crushing Rolls: A crushing rolls was an apparatus that provided secondary or tertiary crushing for ore already reduced to gravel. The apparatus featured a pair of large iron rollers set slightly apart in a cast iron or heavy timber frame. As they rotated, the rollers drew gravel into the gap and fractured it. Small units were around 4 by 4 feet in area while common units were 6 by 6 feet in area. Crushing rolls were usually located on an upper mill terrace below the primary crusher.
Crushing Rolls Foundation: Crushing rolls were often anchored to a rectangular timber foundation consisting of heavy horizontal beams bolted to posts that leaned slightly inward.
Huntington Mill: A Huntington mill was an apparatus that finely ground previously crushed ore, and some were used for amalgamation. The machine was based on a cast iron pan approximately 6 feet in diameter and 3 to 4 feet deep ringed with a channel. A set of heavy iron rollers

rotated across the pan floor and ground the ore to a slurry. Fine particles passed through screens breaching the walls and left via the channel.

Huntington Mill Foundation: Huntington mill foundations were factory-made and the timbers often feature beveled edges. The foundation usually consisted of a rectangular timber footer 6 by 9 feet in area. The machine stood on heavy posts forming a 6 by 6 foot cube at one end, and the other end featured a raised block with a brace for the drive shaft.

Concentration System Feature Types

Amalgamation Table: Amalgamation tables were only used in mills that processed simple gold and silver ores. The tables stood on heavy timber frames at the toe of stamp batteries and sloped away from the battery box. The tabletops were usually copper, which workers coated with mercury, and were around 6 by 12 feet in area.

Amalgamation Table Frame: Amalgamation tables were usually removed from mills when the facilities were abandoned, leaving a heavy timber frame around 6 by 12 feet in area and at least 4 feet high.

Jig: A jig was an appliance that enhanced the separation of metalliferous particles from waste. Common jigs consisted of a wood body with a V-shaped bottom that featured drain ports, and wood walls dividing the interior into cells. Most tended to be around 4 by 9 feet in area and 4 feet high.

Vanner: A vanner was a concentration apparatus between 4 by 8 and 6 by 13 feet in area. The machine featured a broad rubber belt that passed around rollers at both ends of a mobile iron frame. An eccentric cam bolted to a chassis imparted a vibrating motion.

Vanner Foundation: Vanners were usually bolted to timber foundations that featured cross-members at both ends, stringers linking the cross-members, and additional braces. A flume that carried off slurry usually passed by the vanner's head.

Vibrating Table: A vibrating table was an apparatus that concentrated crushed ore. Vibrating tables featured a slanted tabletop, often 5 by 15 feet in area, clad with rubber and narrow wooden riffles. Tabletops were often mounted at a slant on a mobile iron frame set in motion by an eccentric camp. Vibrating tables were usually located on mid- or lower terraces.

Vibrating Table Foundation: Vibrating table foundations featured six pairs of anchor bolts projecting out of three timber footers totaling around 12 to 15 feet in length.

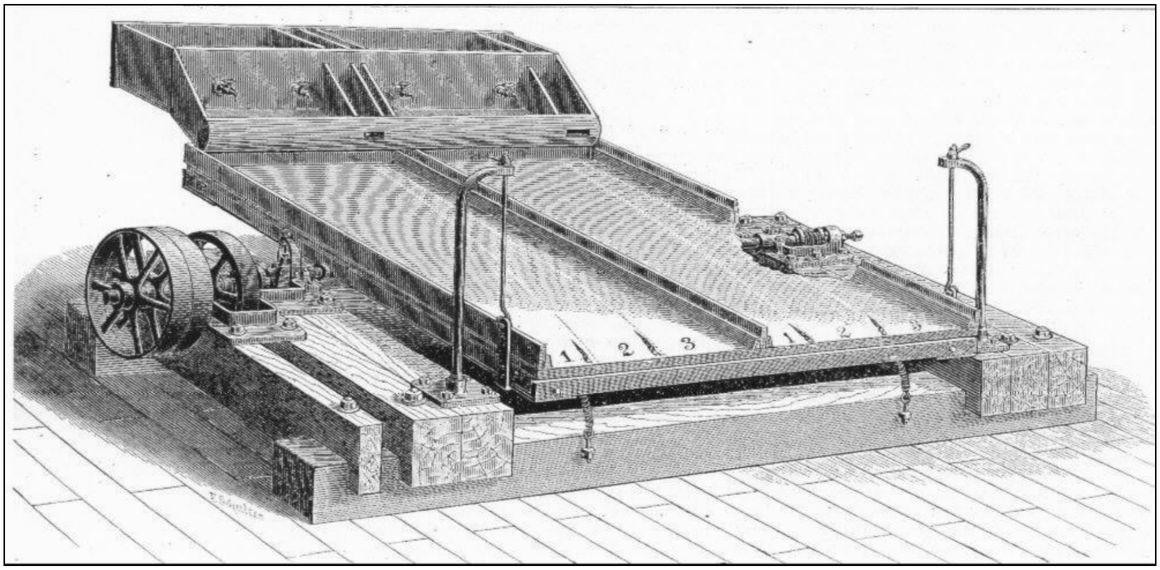

Figure F 6.8. Known as both a percussion table and a bumping table, this apparatus used vibratory action to concentrate finely ground gold and silver ores. The table was popular from the 1860s into the 1880s, and J.V. Pomeroy developed a version in his mill in Ward. Source: *Mining & Scientific Press* 8/9/90, p83.

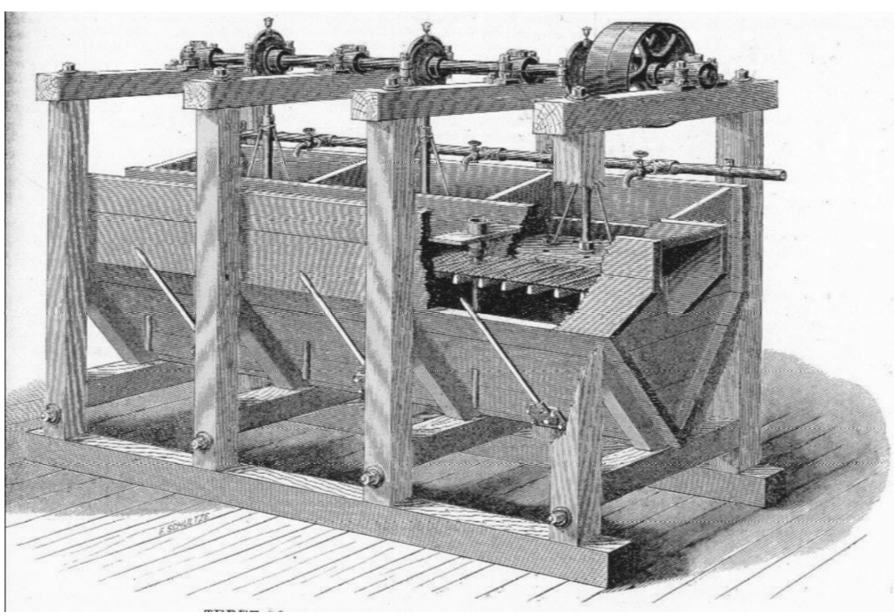

Figure F 6.9. The jig was an effective concentration device popular from the 1860s through the 1930s. The crank at top moved three screen plungers up and down in the water-filled cells, which the cut-away view illustrates. The agitating action classified crushed ore particles by size or weight, depending on the application. Source: *Mining & Scientific Press* 8/9/90, p83.

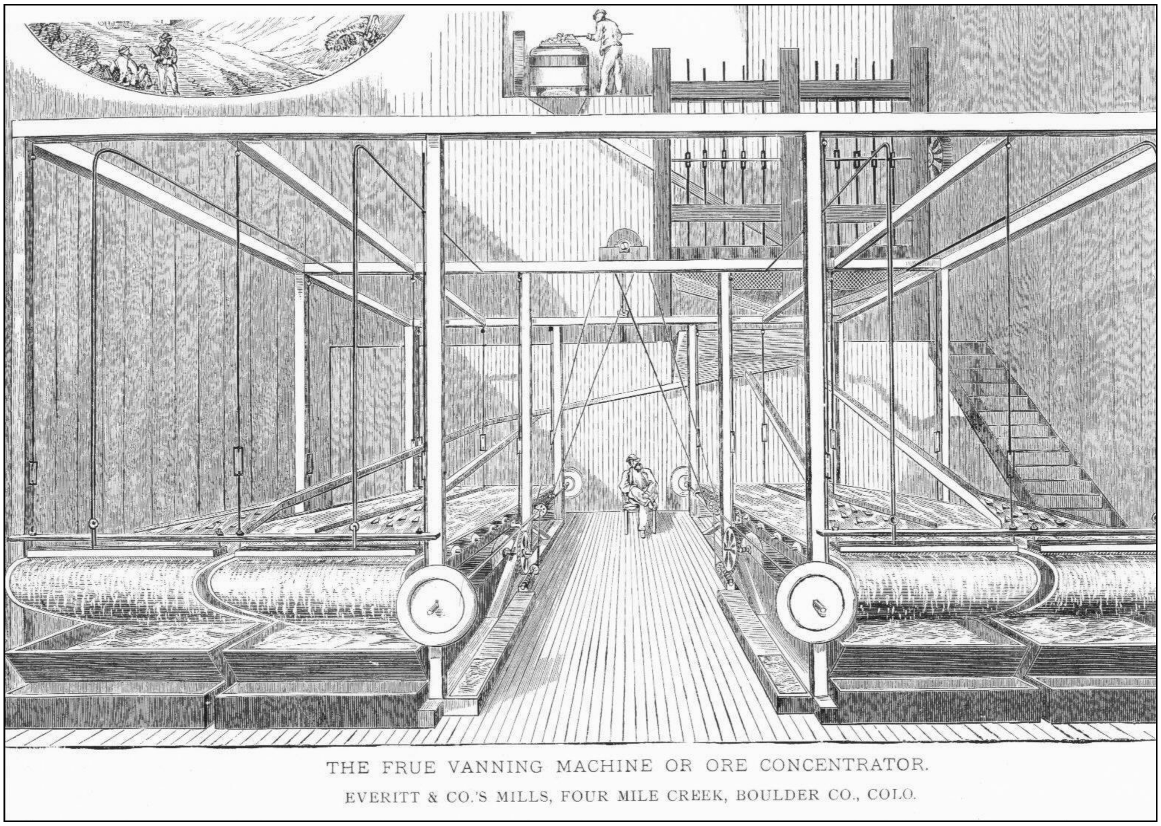

Figure F 6.10. The Everitt Mill, which operated near Salina during the late 1870s, employed several Frue vanners to concentrate local telluride ore. As the vanner vibrated, finely ground ore settled against the broad rubber belt while water jets and a scraper removed light waste material. Note the stamp battery at upper right. Source: *Engineering & Mining Journal* 11/24/77, p387.

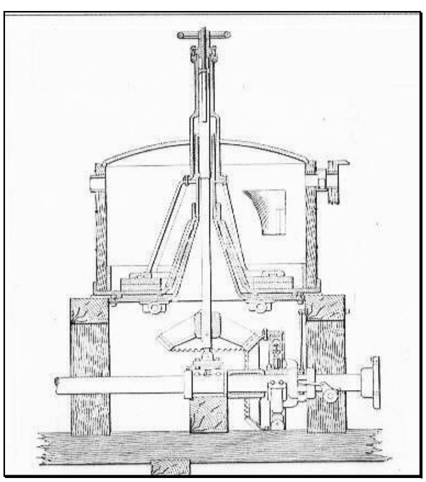

Figure F 6.11. The profile depicts a grinding pan, which provided tertiary crushing usually for silver ores. Some mills also used the pans for amalgamation. A belt drove the pan, which featured heavy shoes that rotated around the cast iron floor. Source: International Textbook Company, 1899, A43:172.

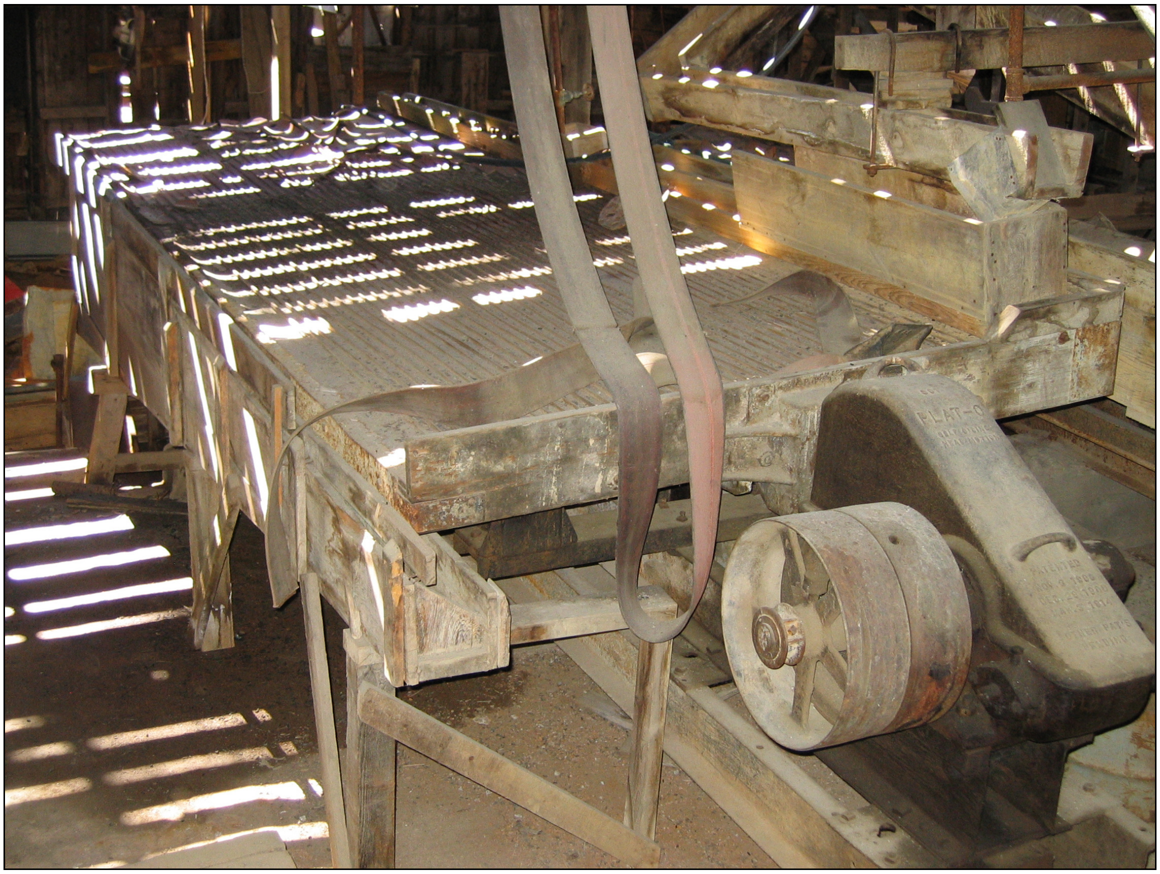

Figure F 6.12. Following its introduction around 1898, the vibrating table was one of the most popular and effective concentration appliances throughout the Rocky Mountain west. An eccentric cam under the guard at right imparted a vibrating motion to the tabletop, and the vigorous action caused heavy metalliferous material to settle against the riffles. Water currents washed the light waste off. This table remains in place in the Cardinal Mill. Source: Carol Beam.

Flotation Cells: Flotation cells were based on a large rectangular wooden tank divided into compartments. Paddles agitated a slurry solution in each cell and swept a froth of metalliferous material over the cell's sides. The froth either flowed into a flume or into a second set of cells for additional concentration. A plank walkway often extended along the tank, and the assemblage stood on timbers on one of the mill's lower terraces.

Cyanide Tank: Similar to a water tank, cyanide tanks were usually located on a mill's lowest terrace and were surrounded by mill tailings. In the tank, a cyanide solution leached gold out of finely crushed ore.

Settling Tank: Some concentration mills featured settling tanks on the lowest platform where heavy metalliferous fines gravitated out of spent slurry. Settling tanks were similar to wooden water tanks and often featured a revolving arm at center to exacerbate the settling process.

Power System Feature Types

Boiler: See Hardrock Mine Feature Types.
Boiler Foundation: See Hardrock Mine Feature Types.
Boiler Setting Remnant: See Hardrock Mine Feature Types.
Boiler Clinker Dump: See Hardrock Mine Feature Types.
Motor: See Hardrock Mine Feature Types.
Motor Foundation: See Hardrock Mine Feature Types.
Overhead Driveshaft: Sets of overhead driveshafts transferred motion from the engine or motor to the mill appliances. Overhead driveshafts featured belt pulleys over each mill appliance and rotated in bearings usually bolted to the mill building's frame.
Steam Engine: Prior to the 1910s, steam engines were a common source of power for mills. Usually located on the mill's lowest terrace, the engine transferred motion to a system of overhead driveshafts via a canvas belt. Most engines were horizontal units between 2 and 3 feet in width and 8 to 12 feet long. A steam engine required a boiler.
Steam Engine Foundation: Steam engine foundations are often rectangular, studded with anchor bolts, and between 2 and 3 feet in width and 8 to 12 feet long. Workers built engine foundations with heavy timbers, brick or rock masonry, or concrete, and the foundations often featured a pylon for the outboard flywheel bearing.
Transformer Station: See Hardrock Mine Feature Types.
Transformer Station Platform: See Hardrock Mine Feature Types.
Transformer Station Remnant: See Hardrock Mine Feature Types.

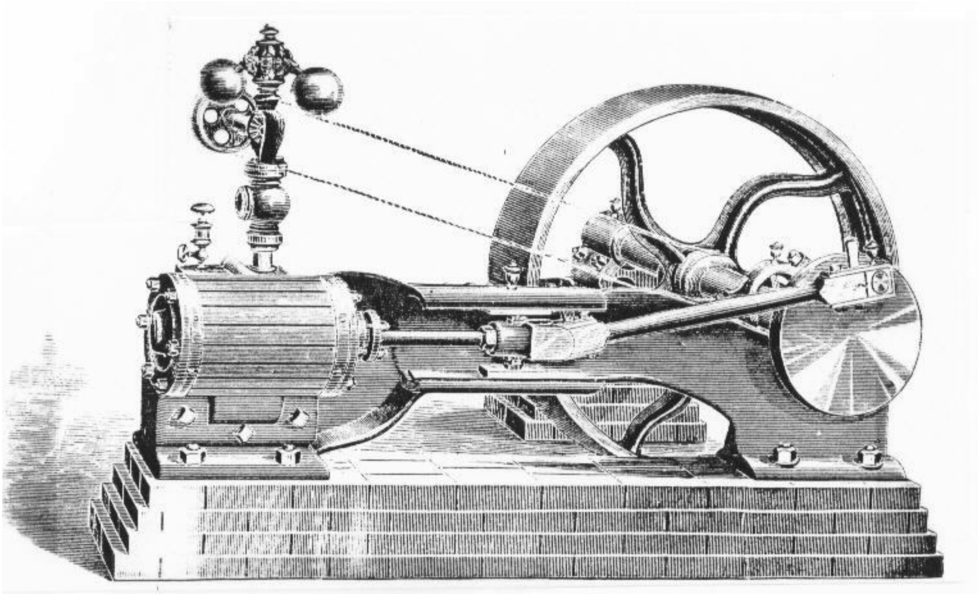

Figure F 6.13. Until electricity became popular during the 1910s, horizontal steam engines powered nearly all the concentration mills in Boulder County. A drive belt passed around the flywheel to a mill's system of driveshafts. Note the masonry foundation. Source: Ingersoll Rockdrill Company, 1887:53.

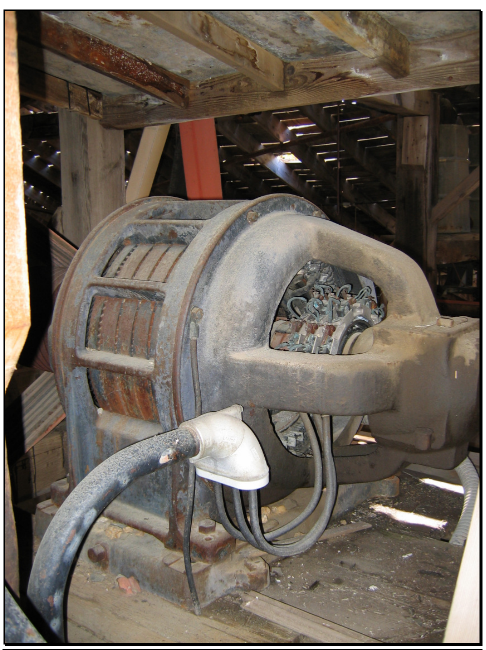

Figure F 6.14. By the 1910s, mining companies increasingly used electric motors to power their mills, provided electricity was available. This motor ran equipment in the Cardinal Mill. Source: Carol Beam.

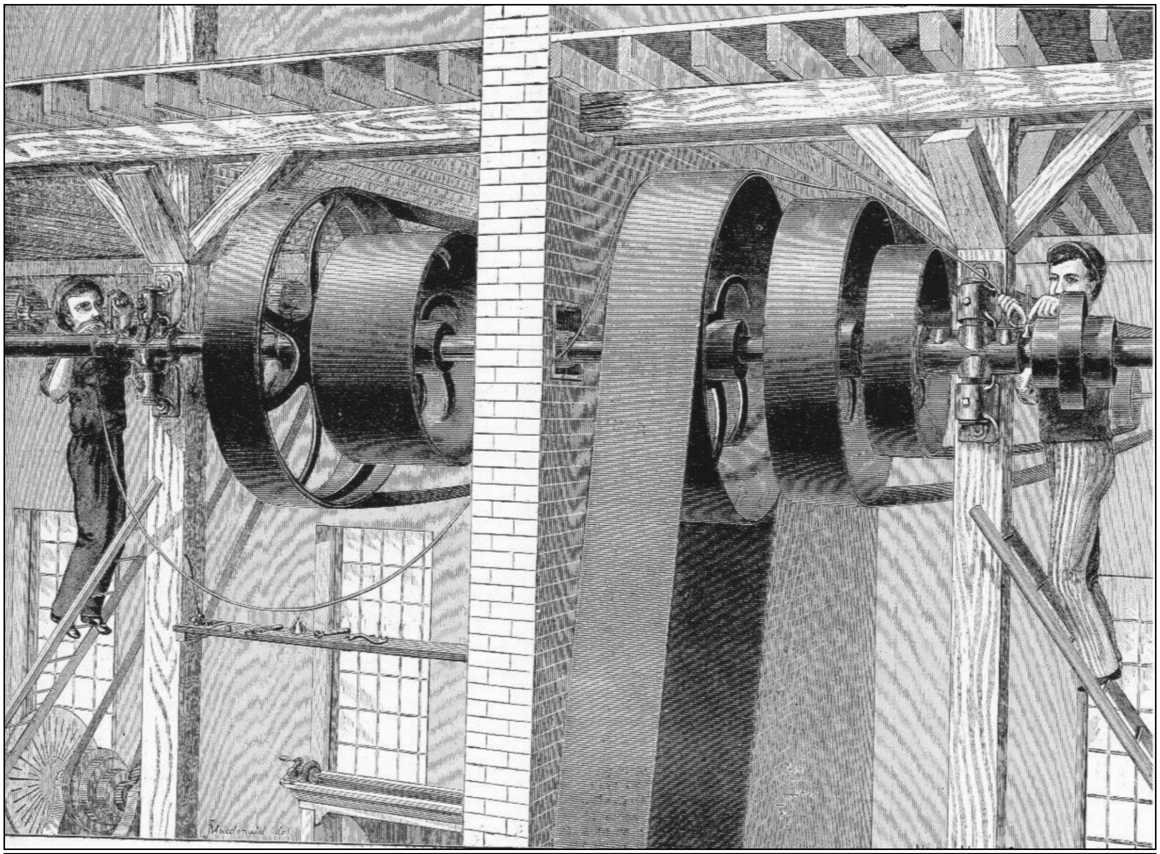

Figure F 6.15. A system of overhead driveshafts and belts was the most common means of transferring motion from a mill's engine to its various appliances. Source: *Mining & Scientific Press* 9/1/83, p129.

F 6.2: Ore Concentration Facility Significance

Ore concentration played a key role in the long-term success of hardrock mining in Boulder County. Without a local means for treating ore, mining companies would have been limited to only those grades of ores that were profitable enough to ship to distant smelters, and such ores were in limited supply. Concentration and amalgamation mills allowed mining companies to produce a variety of low-grade metals- and mineral ores in high volumes, which allowed the industry to remain profitable. Given this, the concentration industry directly supported the county's growth and settlement. Additional, narrow arenas of significance can be attributed to the concentration industry, which are best divided among the three principal categories of concentration facilities.

Concentration Mill: Several arenas of significance surround ore concentration mills and the associated resources remaining today, and metallurgical engineering may be the most pronounced and fundamental. Boulder County offered an unusually diverse array of metal- and mineral ores in economic volumes. Between 1859 and the 1950s, mining companies produced any combination of free-gold, pyretic gold, sulphide gold and silver, telluride gold and silver, several tungsten compounds, and fluorspar. It comes as no surprise that the above ores except for free-gold were complex, and they defied the conventional treatment practices that were effective for ores in other regions.

Because Boulder County was one of the first places where some of these ores were mined, no precedent for treatment existed. This left the metallurgists in the county with the difficult task of devising efficient and economical methods for concentrating the ore at the least and producing actual metals at best. In essence, the county became a proving ground where many metallurgical problems were not only first identified, but also solved, which laid the groundwork for milling industries elsewhere. As an example, during the 1870s, metallurgist J.V. Pomeroy invented a vibrating apparatus to treat Ward's pyretic gold ore, and during the 1890s and 1910s, Ira Monnell developed several vibrating canvas tables to improve the recovery of finely ground gold and tungsten ores. In addition, a few mills in the county, such as the Caribou at Nederland, the Slide and Prussian near Gold Hill, and the Primos at Lakewood, can be credited with specific and direct contributions to the field of silver, telluride gold, and tungsten ore processing.

The second arena of significance for concentration mills involves economic themes, which are similar to these for mines since the two Property Types were integrally tied. On a broad scale, mining and milling companies were part of and contributed to complex regional, statewide, and national economic and financial systems. For example, most of the capitalists who invested in the county's mills were of regional and statewide importance while a few were based outside of Colorado. Implementation of investments, associated communication, banking, and the acquisition and shipment of supplies occurred on interstate and intrastate levels. It should be noted that large mills had a greater association than the small operations.

As another example, mining and milling companies diverted money into local economies by paying wages to their workers, hiring consultants for various services, and purchasing small items from sources primarily in Boulder. Productive companies acquired large machinery and other industrial goods from manufacturers mostly in Denver, and from outside of Colorado to a lesser degree. The manufacturers Denver in turn purchased their materials from sources within and outside of Colorado. Given this, mining and milling companies supported primarily Colorado's and secondarily other economies. Further, between the 1880s and 1930s, Denver hosted one of the nation's most prolific mine supply industries, and by acquiring goods and machinery from Denver, mining and milling companies ensured the continued success of Denver's mine supply industry.

For a third example, the hundreds of workers employed in the county's mills consumed food and other domestic goods purchased from a variety of sources. Preserved food was shipped from packing companies in the Midwest and on the West Coast while fresh foods came from the county's farms and ranches. By consuming preserved and fresh foods, mill workers not only supported a complex national food transportation network, but also helped the development of local farming and ranching. Merchants in the major towns handled most of the food and goods, and the acquisition of such therefore contributed to local economies.

Large, highly profitable companies saw the consumption of volumes of goods, services, and machinery, and are therefore more closely allied with the above trends than small operations. Cumulatively, however, the small companies, which outnumbered substantial operations, had a significant impact.

The third arena of significance involves social themes. The participants in the county's hardrock mining and milling industry contributed to the development and evolution of regional, statewide, and national social structures. One social structure was the development of classes in the county and greater Colorado. When mining and milling companies began production during the early 1860s, their profits contributed to the initial development of social classes. The owners and investors began their ascent while the laborers, of whom there were many, formed a working class dependent on wages. As mining and milling continued into the 1940s, two general categories of capitalists acquired the productive properties and financed the construction of concentration mills. The first and by far largest category consisted of local investors of limited means primarily in Boulder, and the second category consisted of already wealthy elite based in Denver, the East, and the Midwest. The profits realized from the mines and mills reinforced the fortunes of the few elite while contributing heavily to the formation of a middle-class, which ultimately became one of the county's economic and political backbones. Because the mining and milling companies depended on wage laborers, company operations ensured the continuation of a working class.

The very nature of the workforce that made mining in the county possible constituted another form of social structure. Activity in the various mining districts created an insatiable employment market that drew workers from points throughout Colorado and other areas in the nation. Some of those workers were immigrants, mostly from European countries. The cycles of boom and bust inherent to gold, silver, and industrial minerals mining required that the workers be mobile, which contrasted sharply with the county's sedentary farming and ranching culture. Each boom drew laborers from a variety of backgrounds while busts propelled them to other areas and economic sectors in Colorado and the nation. The result was a mobile, adaptable, and diverse society.

Large mill sites can be strongly allied with the themes of class, workplace, and demography because they supported major workforces. Small mill sites, on the other hand, tend to be associated primarily with mobility, lower classes, and a demography of independent individuals.

Amalgamation Stamp Mill: These ore treatment facilities were among the earliest in Boulder County and it should be noted that the three-stamp mill built by Thomas Graham near the mouth of Lick Skillet Gulch in October, 1859 was apparently the first in Colorado. Because amalgamation stamp mills could only treat free-gold ore, they fell out of favor by the mid-1860s when miners exhausted this type of payrock. A few small amalgamation stamp mills did, however, operate in the county through the 1930s.

As a resource type, the amalgamation stamp mills in Boulder County were extremely important on several levels, but only during the 1860s. On a county-wide level, they were instrumental to the success of the county's early hardrock mining industry. During the early 1860s, Colorado lacked ore treatment centers, and shipping crude ore to the mills that existed in the East and California was prohibitively expensive. This rendered local mills as the only economical means of treating the gold ore mined in the county at this time, and in this capacity, the local mills directly fostered the transition from placer- to hardrock gold mining.

On a state-wide level, Boulder County's mills contributed to the understanding of how to win metals from Colorado's gold ores during the first years of hardrock mining. In the early 1860s, nearly all the mills in Colorado were located in Gilpin, Boulder, and Clear Creek counties, and through the various successes and failures, their operators pioneered the application of amalgamation technology to Colorado's free-gold ores.

Arrastra: These concentration facilities were Boulder County's first type of ore treatment facility, and while they were succeeded by amalgamation stamp mills within a few years, arrastras saw limited application through the 1900s. Because of an overlap in time and function, arrastras shared with amalgamation stamp mills similar arenas of significance. The arenas are narrow, however, because arrastras saw limited application and were important during the early 1860s.

The main arena of significance for arrastras is their role in the first years of mining in the county. Between 1859 and around 1865, a variety of mining interests, from partnerships to small companies, built arrastras to recover gold from hardrock ore. While most arrastras served specific mines, as a group they were instrumental in the success of the county's early mining industry and directly fostered the transition from placer- to hardrock gold.

Arrastras also facilitated the confirmation of ore and the initial development of most of the county's gold mining districts. Because arrastras required little capital or formal engineering and could be constructed with local materials, they were ideal for remote locations. The same characteristics also rendered arrastras ideal for prospectors and partnerships of limited means and permitted them to reduce simple gold ores to impure metal compounds that could be transported to commercial centers. Prospectors and partnerships also used arrastras to determine whether amalgamation was effective for specific ores, which was information important to subsequent milling enterprises.

Figure F 6.16. When capital and resources permitted, mining outfits constructed arrastras that were powered by water. This unit at the Death Valley Museum illustrates the drivetrain, capstan, and sidewalls typical of power-driven arrastras. Source: Author.

F 6.3: Ore Concentration Facility Registration Requirements

The Property Subtypes of concentration mills, amalgamation stamp mills, and arrastras form a spectrum ranging from small, simple, and unimportant to large, complex, and significant. Because Boulder County was on the forefront of metallurgical development, the importance of those mill resources existing today cannot be judged on size and complexity alone. For example, the Black Swan Mill site in Four Mile Canyon appears similar to sites representing moderate-sized concentration facilities elsewhere. However, in 1904, the Wolf Tongue Mining Company refitted the Black Swan into one of the first experimental tungsten concentrators in the nation, which was a very important event. This illustrates how archival research is absolutely necessary to determine whether a mill site in the county is associated with important events, trends, and themes.

Ore Concentration Mills: Eligible millsites must possess physical integrity relative to a Period of Significance, which may vary by mining district and ore type. Mills were prime targets for the salvage of structural materials and machinery when abandoned, and so their integrity will probably be archaeological. For archaeological remains to constitute integrity, the material evidence should permit the virtual reconstruction of the milling operation. Archaeological evidence can be expected to represent the general infrastructure and approximate the crushing and concentration processes, which may be sufficient for eligibility.

Most of the seven aspects of historical integrity defined by the NRHP apply to concentration mill sites. Some resources may possess standing structures and intact machinery, which must retain the aspect of Location to contribute to a resource's integrity. To retain Location, the structure or machine must be in its original place of installation. For a resource to retain the aspect of Design, the material remains, including archaeological features, must convey the ore crushing and concentration processes, the flow path of ore, the arrangement of buildings, and the infrastructure. In many cases, companies retrofitted mills with equipment that improved processing, and in such cases, resources can retain the aspect of Design if the material remains reflect the evolution of the facilities over time. By studying archival information and material evidence, the researcher can determine when specific facilities were built and abandoned, thereby building a chronology of the mill's evolution. To retain the aspect of Setting, the area around the site, and the site itself, must not have changed a great degree from its Period of Significance, excepting the removal of structures and machinery. If the mill was isolated, then the natural landscape should be preserved. If the mill operated in a mining landscape, then the surrounding mines and industrial features should retain at least archaeological integrity. In terms of Feeling, the resource should convey the sense or perception of mining and ore treatment from a historical perspective and from today's standpoint. For Association, the resource's sum of features and artifacts should permit the researcher to reconstruct the milling operation according to the Period of Significance.

In addition to possessing integrity, concentration mill sites must meet at least one of the Criteria defined by the NRHP. Resources eligible under Criterion A must be associated with at least one area of significance noted above, as well as the events, trends, and themes important to a specific mining district.

Concentration mills may be eligible under Criterion B provided that they retain integrity from an important person's period of occupation or participation. Some mills, especially large complexes, can be traced to important individuals such as engineers and metallurgists, and in these cases, they may be eligible under Criterion B. It should be noted, however, that the mere investment in a property or involvement with a company by an important person is too indirect an association for Criterion B. The individual of note must have either been present on-site or played a direct and fundamental role in its physical development.

Most mill sites in the county will probably not be eligible under Criterion C because they usually lack integrity and no longer represent the milling operation. However, if the organization pattern is clearly evident or structures and machinery are present, then the resource may be eligible under Criterion C. In general, intact structures and machinery are uncommon and important representations of metallurgical engineering and technology. Mills that have been reduced to archaeological features must represent the application of engineering, technology, and methods during the specified Period of Significance.

Few small mills will be eligible under Criterion D because most information can be collected by detailed recordation of surface features. Several exceptions, however, may exist, especially at large mills. If the resource possesses building platforms, privy pits, and boiler clinker dumps, testing and excavation of buried archaeological deposits may reveal information regarding workers' lifestyles, social structures, and the workplace, which is important because these were not heavily documented in the past. Detailed studies of structures and machinery can contribute information regarding metallurgical engineering and architectural practices, and the application of technology, which are poorly understood at present.

Amalgamation Stamp Mills: Eligible amalgamation stamp mill sites must possess physical integrity relative to a Period of Significance ranging from 1859 to 1865. Mills were prime targets for the salvage of structural materials and machinery when abandoned, and so their integrity will probably be archaeological. For archaeological remains to constitute integrity, the material evidence should permit the virtual reconstruction of the milling operation. Archaeological evidence can be expected to represent the general infrastructure and approximate the crushing and amalgamation processes, which may be sufficient for eligibility.

Most of the seven aspects of historical integrity defined by the NRHP apply to amalgamation stamp mill sites. Because of their age and brief life, few of any resources are expected to possess standing structures and intact machinery. In the unlikely event that these are miraculously present, the structures and machines must retain the aspect of Location to contribute to a resource's integrity. To retain Location, the structure, appliance, or machine must be in its original place of installation. For a resource to retain the aspect of Design, the material remains, including archaeological features, must convey the ore crushing and amalgamation processes, the flow path of ore, the arrangement of buildings, and the infrastructure. In many cases, companies retrofitted mills with equipment that improved processing, and in such cases, resources can retain the aspect of Design if the material remains reflect the evolution of the mill over time. By studying archival information and material evidence, the researcher can determine when specific facilities were built and abandoned, thereby building a chronology for the mill's evolution. To retain the aspect of Setting, the area around the resource, and the resource itself, must not have changed a great degree from its Period of Significance, excepting the removal of structures and machinery. If the mill was isolated, then the natural landscape should be preserved. If the mill operated in a mining landscape, then the surrounding mines and industrial features should retain at least archaeological integrity. In terms of Feeling, the resource should convey the sense or perception of ore treatment from a historical perspective and from today's standpoint. For Association, the resource's sum of features and artifacts should permit the researcher to reconstruct the milling operation according to the Period of Significance.

In addition to possessing integrity, amalgamation stamp mill sites must meet at least one of the Criteria defined by the NRHP. Resources eligible under Criterion A must be associated with at least one area of significance noted above, as well as events, trends, and themes important to hardrock mining in the county between 1859 and 1865.

Amalgamation stamp mills may be eligible under Criterion B provided that they retain integrity from the important person's period of occupation or participation. Some mills, especially large complexes, often can be traced to important individuals such as engineers and metallurgists, and in these cases they can be eligible under Criterion B. It should be noted, however, that the mere investment in a property or involvement with a company by an important person is too indirect an association for Criterion B. The individual of note must have either been present on-site or played a direct and fundamental role in its physical development.

Some amalgamation stamp mill sites will be eligible under Criterion D for several reasons. First, early stamp mill engineering was poorly documented in the past, leaving ample room for detailed studies of surface evidence to contribute meaningful information. Second, radar surveys, testing, and excavation of buried deposits, features, and soil strata hold a high potential to render meaningful information for similar purposes.

Arrastras: Eligible arrastras must possess physical integrity relative to a Period of Significance ranging from 1859 to around 1865. Arrastras were often dismantled and the surrounding ground excavated and processed for gold amalgam, leaving most resources as archaeological sites. For archaeological remains to constitute integrity, the material evidence should permit the virtual reconstruction of the operation. Archaeological evidence can be expected to represent the general infrastructure and approximate the arrastra floor and associated components, which may be sufficient for eligibility.

Several aspects of historical integrity defined by the NRHP can be expected to apply to arrastra sites. Arrastra sites may possess intact structures and components of infrastructure, which must retain the aspect of Location to contribute to a resource's integrity. To retain Location, the components must be in their original place of installation. In some cases, arrastras have been moved from their original location for public viewing, which has compromised the integrity of Location. For an arrastra to retain the aspect of Design, the material remains, including archaeological features, must represent the arrastra floor, portions of the power train, and waste disposal methods. To retain the aspect of Setting, the area around the arrastra, and the arrastra site itself, must not have changed a great degree from its Period of Significance, excepting the removal of structures and machinery. In general, arrastras were usually isolated, which requires the preservation of the surrounding natural landscape. For Association, the arrastra's sum of features and artifacts should permit the researcher to reconstruct the operation according to the Period of Significance.

In addition to possessing integrity, arrastra sites must meet at least one of the Criteria defined by the NRHP. Resources eligible under Criterion A must be associated with at least one area of significance noted above, as well as events, trends, and themes important to hardrock mining in the county between 1859 and around 1865. Arrastra sites tend to possess few clearly dateable artifacts and were not thoroughly documented in the past, rendering their dates of operation difficult to confirm. For these reasons, few arrastras will be eligible under Criteria A or B.

Because arrastras were important to the county, many resources with at least archaeological integrity may eligible under Criterion C. The material remains must clearly reflect the aspects of the arrastra floor, the power train, other infrastructure components, and waste disposal methods.

Some arrastras will be eligible under Criterion D for several reasons. First, arrastra engineering was poorly documented in the past, leaving ample room for detailed studies of surface evidence to contribute meaningful information. Second, radar surveys, testing, and excavation of buried deposits, features, and soil strata hold a high potential to render meaningful information for similar purposes.

F 7: PROPERTY TYPE: SMELTER

Smelters were some of the most important facilities for metals mining in Colorado. They were the final recipients for the crude ore and concentrates generated by mines and mills, and as the end point in the mining and ore treatment process, smelters were the facilities that ultimately converted the ore and concentrates into refined bullion. Colorado's smelting industry began in Gilpin County in the late 1860s in answer to the problematic gold ores there that resisted treatment in amalgamation mills, and over the course of ten years, smelters were built in most of Colorado's principal mining districts. Not all facilities, however, proved to be successful.

Boulder County, which hosted several of Colorado's significant mining districts, was no exception to the former and latter trends. Small smelters were built in the Gold Hill, Sugar Loaf, and Grand Island districts during the 1870s and around half were technological failures. A smelter was built at Ward as late 1898, but it proved ineffective. Given the checkered success of smelting in the county, it can be argued that the industry was not significant on a county-wide scale. Smelting was, however, vitally important in those specific mining districts where it was successful, such as Grand Island and Gold Hill.

Given the emphasis on local importance, the Periods of Significance for smelting in Boulder County are those for the host mining districts. During the 1880s, most of the Periods of Significance for smelting came to an end due to a conspiracy of factors. First, massive smelters built in Golden and around Denver posed serious competition and subsumed much of the ore generated along the Front Range. They had low operating costs and were able to process vast tonnages in economies of scale, which translated into low fees and high yields. Second, when mining companies began erecting concentration mills, they bypassed the local smelters and shipped their concentrates directly to the Denver facilities. Last, the Greeley, Salt Lake & Pacific Railroad provided an inexpensive transportation link directly to the Denver smelters. By contrast, the Boulder County smelters were plagued with high operating costs, limited capacity, and metals losses through inefficiency, and unable to compete, they either closed or adapted their processes to specific, difficult ores.

Boulder County's smelters used a combination of mechanical, chemical, roasting, and smelting processes to convert ores and concentrates into metals. Most of the facilities required flat space, a source of abundant water, and well-graded roads, and they tended to be limited in scale and variety of components. The smelters usually featured several large buildings, high-volume coal and coke bins, at least one characteristic furnace, and large facilities may have included several furnaces to smelt ore in stages. To organize the buildings and infrastructures, companies usually built smelter complexes according to a master datum, and as a result, the various components shared a common orientation. Slag, the waste produced by smelting ore, almost always lies around a smelter site and it manifests as fine-grained or glassy cobbles dark gray to black in hue.

Features Common to Smelter Resources

The features listed below are an abbreviated list of those expected at smelter sites. Smelters also included many of the same features as concentration mills, which are described in detail under Concentration Facility Property Types.

Blower: Smelters relied on blowers to force an air blast into a furnace. A typical blower featured a ring of vanes encased in a wood or sheet iron shroud with a port for the outflow. A motor or steam engine powered the blower, and it often stood nearby. Blowers ranged from 3 to 8 feet in diameter.

Blower Foundation: A foundation that anchored a blower. Foundations were usually rectangular, less than 6 by 8 feet in area, and consisted of masonry, concrete, or timbers.

Coal Bin: Because smelters consumed high volumes of fuel, they almost always featured substantial bins for coal or coke. The bins were usually sloped-floor structures that facilitated a gravity-drawn flow of fuel from the structure.

Coal Bin Remnant: The collapsed remnants of a coal bin.

Coal Bin Foundation: Due to their great weight, coal bins usually stood on masonry or timber foundations. Scatters of coal or coke strongly suggest that a given foundation supported a coal bin.

Furnace: The small smelters in Boulder County relied on two general types of furnaces. The earliest and least efficient was a brick or rock masonry structure lined on the interior with fire bricks or sandstone blocks. The masonry should feature evidence of intense heat and slag. The type of furnace most popular by the late 1870s was a free-standing, cylindrical steel vessel lined with fire bricks. These furnaces tended to be from 6 to 20 feet in diameter and as high, and workers input crushed ore in the top and drew out molten material through ports in the bottom.

Furnace Remnant: The collapsed remnant of a furnace.
Furnace Foundation: Furnaces stood on masonry foundations slightly larger than the heating chamber. The foundation often features slag and evidence of heat.
Furnace Platform: Furnaces usually stood on dedicated platforms within the smelter building. Free-standing steel furnaces often left little more than a foundation surrounded by slag flows while masonry units may have left structural remnants. Most furnace platforms should feature in-situ slag deposits and flows.
Slag Dump: Smelting companies disposed of their slag in dumps downslope from the smelting complex.
Slag Flow: Uncontrolled releases of slag from a furnace created flows that appear similar to lava or smooth concrete.

F 7.1: Smelter Significance

As noted above, the importance of smelting on a county-wide level is questionable, although the industry was a key to the success of several significant mining districts, including Grand Island, Sugar Loaf, and Gold Hill. On the other hand, the few, successful smelters in the above districts could be argued as important to the entire county because they helped the districts' mining industries to blossom, which in turn had far-reaching implications for the county.

The local importance of the successful smelters cannot be denied. For relatively brief periods of time, they provided local treatment for ores that were otherwise unprofitable to ship to Gilpin County, Golden, or Denver, and in so doing, the local smelters helped their associated mining industries survive until metallurgists were able to develop effective concentration processes. Once the ores could be concentrated, the concentrates then became economical to ship to the large smelters. The Periods of Significance for the county's local smelters are limited to the individual mining districts, and the local smelters share the same arenas of importance as the mining industries in those districts.

Some of the unsuccessful smelters can be argued as important in their host mining districts. While they may not have effectively treated ore, these smelters stimulated investor confidence and community morale, and contributed to local economies during construction.

F 7.2: Smelter Registration Requirements

Eligible smelter sites must possess physical integrity relative to a Period of Significance within the host mining district. Smelters were prime targets for the salvage of structural materials and machinery when abandoned, and so their integrity will probably be primarily archaeological. For archaeological remains to constitute integrity, the material evidence should permit the virtual reconstruction of the smelting operation. Archaeological evidence can be expected to represent the general infrastructure and approximate the smelting processes, which may be sufficient for eligibility.

Most of the seven aspects of historical integrity defined by the NRHP apply to smelter sites. While unlikely, some resources may possess standing structures and intact machinery, which must retain the aspect of Location to contribute to a smelter site's integrity. To retain Location, the structure or machine must be in its original place of installation. For a smelter site to retain the aspect of Design, the material remains, including archaeological features, must convey the flow path of ore, the arrangement of buildings, and the infrastructure. At sites with lengthy histories, companies retrofitted smelters with equipment that improved processing, and in such cases, smelter sites can retain the aspect of Design if the material remains reflect the evolution of the facilities over time. By studying archival information and material evidence, the researcher may be able to determine when specific facilities were built and abandoned, thereby building a chronology for the smelter's evolution. To retain the aspect of Setting, the area around the smelter site, and the site itself, must not have changed a great degree from its Period of Significance, excepting the removal of structures and machinery. If the smelter was isolated, then the natural landscape should be preserved. If the smelter operated in a mining or urban landscape, then the surrounding mines, industrial features, and urban aspects should retain at least archaeological integrity. In terms of Feeling, the smelter site should convey the sense or perception of mining and ore treatment from a historical perspective and from today's standpoint. For Association, the smelter site's sum of features and artifacts should permit the researcher to reconstruct the smelting operation according to the Period of Significance.

In addition to possessing integrity, smelter sites must meet at least one of the Criteria defined by the NRHP. Resources eligible under Criterion A must be associated with at least one area of significance noted above, as well as events, trends, and themes important to the host mining district.

Smelters may be eligible under Criterion B provided that they retain integrity from the important person's period of occupation or participation. Some smelters, especially large complexes, often can be traced to important individuals such as engineers and metallurgists, and in these cases, they can be eligible under Criterion B. It should be noted, however, that the mere investment in a property or involvement with a company by an important person is too indirect an association for Criterion B. The individual of note must have either been present on-site or played a direct and fundamental role in its physical development.

Large and small smelter sites may be eligible under Criterion C provided the organization pattern, the flow path for ore, the smelting processes, and aspects of the infrastructure are clearly evident. Clear representation through archaeological evidence may be sufficient, but they must reflect the application of engineering, technology, and methods during the Period of Significance. If structures and machinery are present, they reinforce the site's eligibility under Criterion C because structures and machinery are uncommon and important representations of metallurgical engineering and technology.

Few small smelters will be eligible under Criterion D because most information can be collected by detailed recordation of surface features. Several exceptions, however, may exist, especially at large smelter sites. If the resource possesses building platforms, privy pits, and boiler clinker dumps, testing and excavation of buried archaeological deposits may reveal information regarding workers' lifestyles, social structures, and the workplace, which is important because these were not heavily documented in the past. Detailed studies of structures and machinery can contribute information regarding metallurgical engineering, architecture, and the application of technology, which are poorly understood at present.

F 8: PROPERTY TYPE: MINING SETTLEMENT AND RESIDENCE

Between 1859 and around 1960, prospectors, miners, and mining industry participants examined nearly every, if not all, the canyons, gulches, hills, and mountains in western Boulder County. In those locations where industry participants spent appreciable amounts of time, they usually established residences. Every mining district in the county featured at least isolated prospectors' camps and collections of residences, and where the mines and prospects were numerous and closely spaced, the accumulation of residences formed what can be referred to as settlements. Many settlements in the county such as Orodelfan, Cardinal, Frances, and Salina never progressed beyond an informal status, but when a local mining industry showed signs of permanency and the population grew large enough, some of the settlements matured into formally organized towns.

Every mining district in the county except for Gold Lake and Snowy Range feature all of the above forms of residence. The definitions of the residential Property Subtypes are provided below.

F 8.1: Mining Settlement and Residence Subtypes

Prospector's Camp: When examining an area or developing a claim, prospectors usually established camps intended to be impermanent. Prospectors' camps were simple, may have lacked formal buildings, and were abandoned after brief occupation.

Because prospect camps were intended to be impermanent and were occupied briefly, they often left only the barest of material evidence remaining today. Camps inhabited by individual and pairs of prospectors tend to be represented by a single tent platform, a sparse scatter of food cans, and little else. In some cases groups of prospectors established camps that are represented today by several tent platforms. Occasionally, prospectors intending to spend time intensely examining an area erected a log cabin as a base of operations. For an assemblages of residential features to be defined as a prospectors' camp, they must be either directly associated with nearby prospect workings or be located in an area that was subjected to prospecting. If a prospector's camp is actually a component of a greater prospect complex, then the resource would qualify as a Prospect Complex Property Type.

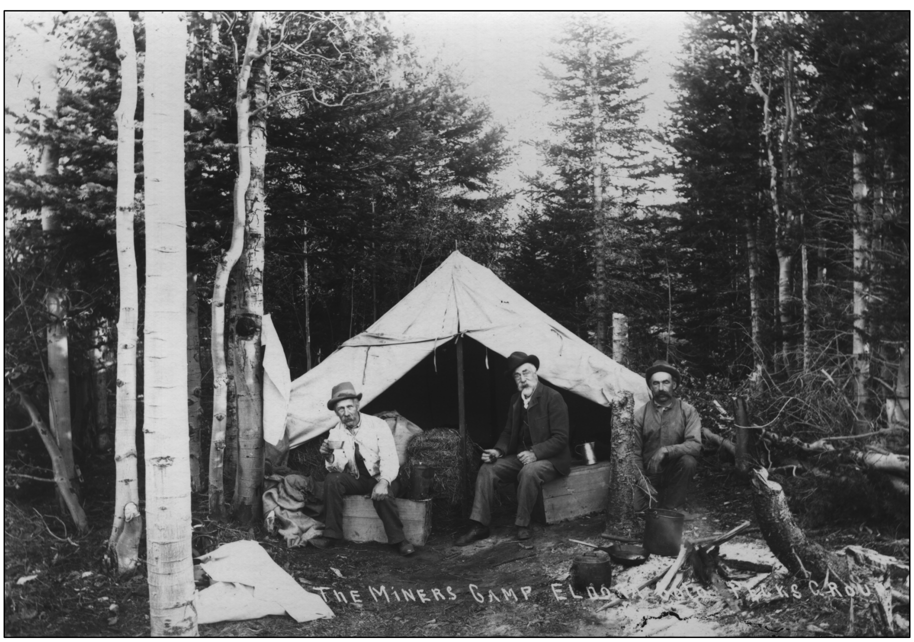

Figure F 8.1. These three prospectors pose in their camp during Eldora's late 1890s boom. The camp is typical and today would likely manifest as a platform for the tent, remnants of the fire ring at right, and a scatter of cans. Source: Boulder Carnegie Library, 219-10-15b.

Workers' Housing: By definition, workers' housing is almost always associated with, and a residential component of, one of the Property Types discussed above. When workers' housing can be attributed to a specific industrial or business entity, the workers' housing would not be a resource in of itself and would, instead, be part of the dominant resource type. Workers' housing may be classified as an independent resource under several conditions. 1) The associated industrial or commercial complex has been destroyed, leaving only the residential features. In this case, the lost or damaged industrial complex should be noted with the site description. 2) In the event that workers' housing features cannot be tied to a single industrial complex. For example, residential features may lie near a cluster of mines, yet far enough away so that the residential features cannot be attributed to one specific operation.

As a resource, workers' housing includes all features associated with inhabitation and other domestic activities. Such resources typically consist of at least one residential building or remnant, a refuse scatter or dump, a privy or privy pit, and, possibly, activity areas. When employed by a substantial industrial operation, workers often lived communally in a boardinghouse.

Isolated Residence: Isolated residences are places of developed inhabitation not clearly tied to, or associated with, an industry or other pattern of subsistence. Such resources would lack obvious characteristics that represent prospecting, mining, logging, transportation, or agriculture. Determining whether a resource in a mining district is an isolated residence can be somewhat subjective since it may have served as base of operations for prospectors, hunters, or homesteaders. Isolated residences are very simple and usually consist of a few residential features with no industrial or commercial attributes. Since the resource is not directly tied to a form of subsistence, occupation was usually brief and the volume of artifacts low.

Unincorporated Settlement: Unincorporated settlements were often informal collections of residences that served a combination of purposes and grew in response to several stimuli. One of the most common was a mineral boom. Often, congregations of prospectors and miners established residences in a common area that offered flat ground, open space, and water. Another stimulus was a primary industry that required a substantial workforce, such as a group of large mines or a mill. Mining companies and individual workers erected residences near points of employment, usually in the most favorable building environment possible.

Popularly known as mining camps, unincorporated settlements usually possessed no formal organization and their buildings tended to be disbursed. When enough of a population base existed, some unincorporated settlements featured a few basic services such as a post office, a mercantile, a saloon, and a combination restaurant and hotel. The architecture tended to be vernacular and emphasized local building materials such as logs and stone masonry in the absence of locally milled lumber. Mature unincorporated settlements often featured at least several frame buildings and log structures sided with planks or boards-and-battens for a formal appearance. Some buildings may have even had false-fronts, and nearly all possessed gable roofs. Typically, inhabitants installed privies behind their residences and places of business.

Unincorporated settlements featured crude, unimproved infrastructures. As centers for working populations, unincorporated settlements usually were the hub of a local transportation network that often consisted of several main roads and packtrails fanning out to points of employment. Sanitation was limited to privies, and water came from streams, springs, and wells. By the 1900s, some settlements enjoyed electricity for lighting, which was wired from nearby mines or mills.

Townsite: When a mineral boom evolved into a sustained mining industry that drew a stable population, unincorporated settlements often developed into organized towns often platted with lots and blocks laid out according to a grid. Large towns tended to be more complex and diverse than small boomtowns that were occupied for a short time, and both forms of settlement shared a few basic characteristics. An identifiable business district was the most elementary and offered an array goods and services proportional to the population and demography. Towns in early stages of growth may have featured a few mercantiles, saloons, restaurants, hotels, butchers, bakeries, assayers, and laundries, as well as a livery and blacksmith. As the population increased in number and sophistication, additional businesses arrived such as a newspaper, gaming houses, lawyers, confectioneries, dentists, barbers, tailors, shoe stores, doctors, and combination stationary and book stores. Although not heavily documented, women and families were an essential and present component of mining town demography, and they demanded institutions such as schools, churches, and public meeting halls. Towns with populations large enough to afford some anonymity and a clientele also drew prostitution.

The organization patterns of small and large towns were similar. Business districts, however small, usually served as town centers, and they were surrounded by formal residences usually occupied by members of an upper socioeconomic status. In many towns, business proprietors often lived in their commercial buildings, which could have been ore or two stories in height. Outlying residences may have been scattered and haphazard in organization, and they were usually inhabited by workers and other members of a low socioeconomic status. Additional workers often rented space in boardinghouses and family homes anywhere in town. As the town and population grew, both the business and residential districts divided among socioeconomic lines.

The architecture in towns was a function of several factors including community development, success of the mining industry, timeframe, and distance from shipping and manufacturing centers. In nascent towns, the architecture tended to be vernacular and utilitarian. Commercial buildings ranged from wall tents to frame structures with false-fronts, and residences were assembled from logs, lumber, or combinations of both. The buildings usually featured gabled roofs, informal foundations, and ranged from single- to two stories in height. Roofs tended to be sided with shingles and walls with boards-and-battens, planks, or clapboards. By the late 1890s, corrugated sheet iron became a popular construction material. Members of upper classes added some ornamentation to their buildings such as gingerbread trim as a display of their socioeconomic status and to render their structures like those in established cities. Contiguous business districts also often offered boardwalks to spare patrons from mud.

Architectural improvements were usually hallmarks of the maturation of mining towns. New buildings tended to be larger than the old, commercial structures were substantial, and elements of architectural style began to appear. Residents and business owners of upper socioeconomic statuses added the ornamentation necessary to impart Greek Revival, Italianate, and Queen Anne styles on both homes and commercial buildings. Even though some business owners did not attempt a specific architectural style, they still decorated their buildings with lathed columns, molding, ornamental brick- or woodwork, and polychromatic effects.

Towns in early stages of life usually featured a combination of log and frame buildings, but as the towns grew, standardized construction materials superseded the logs. An increase in value of building lots, the perceived obsolescence of logs, and the attraction of designed frame buildings of greater sizes all contributed to gradual architectural improvement. As a given town continued to grow, brick and stone masonry replaced lumber for some of the most important buildings, primarily in the business district. Fires, a widespread occurrence, expedited the transition from primitive to permanent forms of construction. In response to the popularity of masonry, sheet iron manufacturers introduced imitation brick and stone siding, which imparted the appearance of masonry from a distance.

Most mining towns possessed infrastructures of a sophistication that was relative to the success of the mining industry, the size of the population, and the expectation of permanency. On a base level, most infrastructures catered to transportation, communication, and some forms of public utilities. Transportation infrastructures usually featured trunk roads that accommodated freight and passenger traffic to the town, and feeder roads that extended to the surrounding mines. Streets and footpaths directed traffic within the town, and even though many towns were arranged according to a grid, the roads and paths did not always conform. The penultimate transportation system was the railroad, and it accessed the towns in Four Mile Canyon by 1883, Ward by 1898, and Eldora in 1904. While the principal mining towns in the county were certainly considered for service, topography dictated which ones received a direct link.

Early in the county's history, communication systems were limited primarily to the postal service and newspapers. By the 1870s, Caribou, Nederland, and a few other principal towns enjoyed the telegraph, which was followed by telephone systems during the 1880s. By around 1900, many towns of lesser importance also subscribed to telephone service.

Water systems were one form of public utility that saw application in both towns and workers' housing erected by mining companies. Water systems made an appearance in Caribou during the 1870s, and some of the other principal towns followed during the subsequent thirty years, although many small and moderately sized towns never saw water systems.

The introduction of flush toilets, bathtubs, and sinks during the 1900s and 1910s fostered a demand for sewer systems in the large towns. Common systems consisted of little more than pipes and culverts that drained into local waterways.

One of the most popular forms of public utility in the principal towns was electricity, which did not become common until the completion of Barker Dam in 1907. The ability to subscribe to domestic and commercial service was based on socioeconomic status, which excluded many residents until the 1940s.

Features Common to Mining Settlement and Residence Resources

The residential Property Subtypes offer a lengthy and diverse array of features, which are listed below. Because some of the Property Subtypes tend to be complex resources, only the most common features are defined. The researcher should review the entire list because most Property Subtypes share a few similar features.

Prospectors' Camp Features

Fire Hearth: An outdoor ring or rock structure where prospectors kept fires for cooking and heating.
Pack Trail: The traffic from a prospector's camp to areas under examination resulted in the development of pack trails, which are no wider than 8 feet.
Tent Platform: Prospectors often graded small platforms, usually less than 20 by 20 feet in area, for wall tents. In some cases, prospectors placed

rocks on the platform's edges or corners to support a tent's wood pallet floor and drove stakes along the edges to guy the walls. A paucity of structural artifacts, the presence of tarpaper washers, and disbursed domestic artifacts characterize tent platforms.

Workers' Housing Features

Boardinghouse: A large residential structure often greater than 20 by 25 feet in area that was intended to house more than several workers. The residents may have shared sleeping quarters and usually consumed meals together, which were prepared in the building. As a result, privies and domestic refuse dumps or scatters are usually associated with boardinghouses.
Boardinghouse Platform: A platform where a boardinghouse stood. The platform may feature a root cellar and often represents the structure's size and footprint.
Boardinghouse Remnant: The structural remnants of a boardinghouse.
Bunkhouse: A residential structure where workers slept and spent leisure time, but did not regularly prepare food. Given this, bunkhouses often feature few food-related artifacts relative to the size of the building and the number of inhabitants.
Bunkhouse Platform: A platform where a bunkhouse stood. The platform should feature few food-related artifacts, and the platform usually represents the structure's size and footprint.
Bunkhouse Remnant: The structural remnants of a bunkhouse.
Cabin: A small residential structure, often less than 20 by 25 feet in area. Workers built some cabins of logs and others with lumber. Because cabins were often self-contained households, they usually offer a wide array of domestic artifacts. Privies are also often associated with cabins.
Cabin Remnant: The collapsed remains of a cabin.
Cellar Pit: A pit excavated for storage, often surrounded by backdirt or a building foundation.
Chimney Remnant: A collapsed chimney, usually consisting of rocks or bricks. Chimneys are usually components of building platforms.
Cistern: Organized, well-capitalized residential complexes occasionally included cisterns that stored fresh water. Cisterns at residential complexes were like those at mill sites.
Corral: Due to a need for transportation, large residential complexes often included a corral. Corrals may feature formal and informal fences constructed from a variety of materials, and often utilize natural features.

Corral Remnant: Fences, fence remnants, linear rock piles, linear arrangements of stumps, and changes in vegetation often represent corrals.
Domestic Refuse Dump: A substantial volume of domestic refuse, usually located downslope from a residential feature. Domestic refuse dumps consist primarily of food-related and other domestic artifacts, including food cans, fragmented bottles and tableware, and personal articles.
Domestic Refuse Scatter: A disbursed scatter of domestic refuse, usually located downslope from a residential feature.
Privy: The structure that served as a toilet facility. Privy buildings were like those at mine sites.
Privy Pit: The pit that underlay a privy. Privy pits often feature a small pile of backdirt and some domestic refuse in the pit, and may be surrounded by more refuse. Privy pits are often less than 5 feet in diameter and may retain footers for the privy structure.
Residential Building: A building, confirmed by artifacts, which served as a residence. Buildings may be classified as residential if they do not clearly possess the characteristics of boardinghouses, bunkhouses, or small cabins.
Residential Building Platform: A platform, confirmed by artifacts, to have supported an unspecified residential building.
Residential Building Remnant: The structural remnants of a residential building.
Road: Residential complexes usually required roads to accommodate traffic. Roads are at least 8 feet wide.
Root Cellar: Root cellars often manifest as collapsed dugouts located near residential buildings. They were independent structures used for food storage, and were usually made of rocks, logs, or lumber.
Stable: Mining companies often erected stables to house draft animals used for wagon drayage. Stables feature wide doorways, mangers, and stalls, and consisted of lumber or logs
Stable Remnant: A collapsed stable.

Figure F 8.2. When intact, this structure in Boulder County was a typical log cabin, but it has decayed into what is currently termed a *cabin remnant*. These types of cabins were a universal form of housing at mines and in towns. Source: Carol Beam.

Figure F 8.3. Privy pits usually manifest as vegetated depressions near commercial and residential buildings. They hold the potential to contain meaningful buried deposits. Source: Carol Beam.

Figure F 8.4. Nearly all mining companies provided boardinghouses for their crews when distant from the nearest town. The boardinghouse at the Blue Bird Mine northwest of Nederland is a typical example. Boardinghouses were important social centers for miners. Source: Carol Beam.

Townsite and Unincorporated Settlement Features

Townsites and unincorporated settlements usually included some of the same features described above with Workers' Housing.

Assay Shop: An assay shop was a facility where trained metallurgists tested ore samples for their mineral content. Assay shops usually featured stout workbenches, coal bins, a small furnace, and possibly a tall brick chimney.

Assay Shop Platform: A platform where an assay shop stood. Assay shop platforms may be identified by artifacts such as crucibles, cupels, fire clay fragments, laboratory ware, ore specimens, and bricks.
Commercial Building: Commercial buildings housed businesses and ranged in construction from small log buildings in nascent settlements to formal brick buildings. Most commercial buildings featured an open floor, a back room, and a storage area.
Commercial Building Platform or Foundation: A platform on which a commercial building stood. Commercial building platforms may be identified by a substantial platform or foundation and associated privy pit with little evidence of actual residence, such as food-related items.
Ditch: Some towns often featured ditches that delivered fresh water for consumption and other uses.
Hotel: A hotel was a temporary housing business and often featured a common room, an office, private quarters, and rented rooms. Small hotels may have consisted of logs and featured only several rooms while businesses in major towns may have been substantial and complimented by a dining and drinking establishment.
Hotel Platform or Foundation: A platform where a hotel stood. Hotel platforms tend to be large and may feature a cellar pit. Artifact assemblages usually include small personal items, food-related artifacts, furniture parts, and lamp parts and fragments. Hotel platforms may be difficult to distinguish from other residential structure platforms, and may be identified through archival research. Large and numerous privy pits are often associated, and the quantity of ornate artifacts may be high.
Livery: A livery was an establishment where draft animals were temporarily boarded. Liveries may be defined by large stable remnants or platforms associated with broad corrals. Earth packed by animal traffic, manure deposits, collapsed fences, and artifacts such as tack straps and hardware can define a livery complex.
Mercantile: A mercantile was a retail establishment that ranged in construction from small log buildings in nascent settlements to formal brick buildings. Most mercantiles featured a sales floor, a back room, and a storage area.
Mercantile Platform or Foundation: A platform on which a mercantile stood. Mercantiles were primarily retail establishments often located in a moderate to large building. Based on this, mercantiles may be identified by a substantial platform or foundation and associated privy pit with little evidence of actual residence, such as food-related items.
Restaurant: A restaurant was a dining business that ranged in construction from small log buildings in nascent settlements to formal

brick buildings. Most restaurants featured a dining room, a kitchen, a storage area, and a root cellar. Work areas also usually existed behind the restaurant building.

Restaurant Platform or Foundation: A platform or foundation where a restaurant stood. Restaurant platforms are almost always denoted by large quantities of food cans, fragmented tableware and bottles, butchered bones, and kitchen implements.

Saloon: A saloon was a business that served primarily alcoholic beverages and possibly light dining fare. Most saloons ranged in construction from small log buildings in nascent settlements to formal brick buildings. They usually featured a bar room, a storage area, and a root cellar.

Saloon Platform or Foundation: A platform where a saloon stood. High proportions of fragmented bottles relative to other types of artifacts often denote a saloon platform.

F 8.2: Mining Settlement and Residence Significance

Because of its key role in Boulder County's overall mining industry, the Property Type of Settlement and Residence holds great significance. On a broad and fundamental level, settlements and residences were the very places of inhabitation for prospectors, workers, miners, and many other participants of the county's mining industry. The residences provided shelter and granted the inhabitants an environment where they could attend to the basic necessities of life. Both individual residences and settlements served as bases for cultural practices, leisure, socializing, communication, transactions between individuals, education, and numerous other activities. In sum, settlements and residences were the support system for the people that constituted the county's mining industry. By providing for such needs, settlements and individual residences were a direct support system that allowed Euro-Americans to bring mining and permanent inhabitation throughout the county. In addition to a broad significance, the individual Property Subtypes are associated with narrower arenas of significance, which are outlined below.

Prospectors' Camps: These temporary encampments served as bases of operations for prospectors engaged in activities key to the discovery of the county's economic mineral deposits. Camps allowed prospectors to search for ore, characterize a region's geology, and conduct general exploration. When inhabited by groups of prospectors, camps served as frontier meeting and communication centers where individuals exchanged information and news. Camps also served as primitive social centers for a segment of the mining industry that often went without human contact for long periods of time.

Only one Period of Significance applies to prospectors' camps on a county-wide level, and that Period ranges from 1859, when prospectors began their search for gold, until 1865, when the county's mining industry collapsed. Afterward, prospectors' camps should be considered within the Periods of Significance for the county's various mining districts.

Workers' Housing: The arenas of significance for workers' housing fall into several categories. The first is engineering and architecture, which primarily includes boardinghouses built by well-capitalized, progressive mining companies and excludes simple and basic forms of housing. A few well-capitalized companies, especially in remote locations, erected handsomely appointed accommodations for their workers for several reasons. The most common was to attract quality, skilled workers and entice them to live under a company atmosphere. Less common reasons were to provide comfortable housing out of humanitarian concerns and to make a statement to the mining world of a company's productivity and progressiveness.

In terms of architecture, well-capitalized companies working in remote locations had to combine conventional building practices with structural engineering to meet the rigorous conditions of mountain winters. They erected boardinghouses capable of withstanding extreme cold, hurricane-force winds, and even avalanches.

The simpler, mundane boardinghouse and bunkhouses are associated with some architectural significance. When made of logs or stone masonry, they reflect the adaptation of local building materials to the residential needs of workers. In a few cases, mining companies combined local materials and lumber to build accommodations with elements of architectural style, such as accents that contribute to a Classical Revival impression.

Economics serves as another arena of significance for workers' housing, and they can be divided into interactions within residences and outside. Residences, especially boardinghouses and bunkhouses, were microcosms of important economic activities. They were the sites of personal financial transactions such as the exchange of time and labor for pay, and the exchange of pay for room, board, and goods.

Cumulatively, residences were an important economic foundation for regional, statewide, and national economic systems. The hundreds of workers employed by the county's mining companies consumed food and other domestic goods purchased from a variety of sources. Preserved food was shipped from packing companies in the Midwest and on the West Coast, while fresh foods came from the county's farms and ranches. By consuming preserved and fresh foods, mining company employees not only supported a complex national food transportation network, but also helped the development of farming and ranching in the county. Merchants in the major towns handled most of the food and goods, and the acquisition of such therefore contributed to local economies.

Another important arena of significance attributable to workers' housing involves social themes. Communal residences were centers of communication between individuals, company officials, and the outside world. They were also the place of cultural practices, traditions, and diffusion, be the cultures American or from other countries and ethnicities. Last, residences were places where workers could attend to the necessities of life outside of the workplace. On a broad scale, the sum of workers' housing sheltered much of the mining industry's workforce and saw it fed. Workers' housing also was a direct manifestation of and instrument for permanent settlement of the mountainous portion of the county.

Isolated Residences: By definition, isolated residences cannot be directly attributed to an industry or other pattern of subsistence. For this reason, arenas of significance remain unknown until detailed studies or archaeological investigations of a given site provide clarifying information.

Townsites and Unincorporated Settlements: Because these forms of settlement were complex and were tied to numerous themes and systems, they are associated with several important arenas of significance. The first is engineering and architecture. Building construction in the county's townsites and unincorporated settlements contributed to the adaptation of both utilitarian vernacular and formal architecture to the materials and construction practices of the greater Rocky Mountains. Townsites also were the prime vehicle for the application of defined architectural styles to the types of commercial and residential buildings erected in the county's mining towns. It should be noted that when architectural styles changed, they continued to make a fresh presence in the mining towns.

On a broad scale, towns, and to a lesser degree unincorporated settlements, were nodes and centers of infrastructure important to the county's mining industry. In this role, they were vehicles that brought infrastructure and primitive urban planning to the mountainous portion of the county.

The theme of economics serves as another arena of significance for the county's townsites and unincorporated settlements. These two forms of settlement were centers of commerce, banking, business, and trade. They also were transportation nodes and transfer points for the movement of goods and people. The supplies, equipment, and services required by mining companies and industry participants often flowed into settlements prior to their distribution to consumers, and ore and mill products flowed out. The transportation occurred on several levels that depended on a region's remoteness and development, and ranged from rail service to pack trains.

Established townsites and unincorporated settlements served as anchors and conduits for capital and investment. The presence of established settlements, especially towns, lent legitimacy to a local mining industry, which fostered confidence among potential investors. Further, these investors were more likely to personally examine a mining district if it featured an established settlement. In general, settlements were the points through which capital flowed from investors to associated mines and mills.

On a broad scale, settlements were part of and contributed to complex regional, statewide, and national economic and financial systems. For example, the inhabitants of the county's settlements consumed food and other domestic and commercial goods purchased from a variety of sources. Preserved food was shipped from packing companies in the Midwest and on the West Coast while fresh foods came from the county's farms and ranches. Domestic and commercial produces were acquired from manufacturers in the East, Midwest, and the West Coast. By consuming preserved and fresh foods, settlement residents not only supported a complex national food transportation network, but also helped the development of farming and ranching in the county. The consumption of domestic and commercial goods had a similar impact.

Townsites and unincorporated settlements were associated with social themes of significance. Settlements were important communication centers for the residents and businesses within a region, as well as with the outside world. They also were centers for both passive and active cultural practices and traditions. For passive practices, inhabitants followed their cultural patterns, traditions, and ways almost unconsciously in daily life. For active practices, inhabitants purposefully sought out cultural traditions such as performances, lectures, salons, organizations, and community events. Through these practices, settlement residents imprinted their culture on a surrounding region.

In addition, the interaction of the mining industry with the surrounding wilderness landscapes fostered a culture of its own. This movement, which we can refer to as Rocky Mountain mining culture, became pronounced in Boulder County's mining settlements early in Colorado's history. The county's mobile workforce carried this mining culture into other portions of Colorado as they moved from place to place, helping spread the phenomenon.

The county's townsites and unincorporated settlements attracted a variety of individuals who did not work directly in mines or mills but were important to the development of the social fabric. This included women, families, day laborers, and businessmen, and all played various roles. Their arrival fostered a demand for cultural and social institutions that were both embraced and distained. Institutions that communities openly accepted included, for example, schools, churches, civic associations, unions, and meeting halls. Institutions that communities openly condemned but tacitly supported anyway included prostitution, dens of substance abuse, a drug trade, and saloons.

The theme of politics is another arena of significance that settlements share. On one level, settlements were active centers of the law enforcement and judicial systems that maintained order. On another level, settlements and especially the organized towns gave rise to administrative and regulatory bodies that oversaw local government activities, ordinances, claim registration and regulation, and records keeping. Settlements also served as polling stations, and, occasionally, as sources of candidates for local and county-wide political offices.

F 8.3: Mining Settlement and Residence Registration Requirements

Prospectors' Camps: Because prospectors' camps were occupied briefly and were ephemeral, relatively few retain integrity and many cannot be clearly identified today. Given this, we can consider prospectors' camps with integrity to be uncommon resources in Boulder County. Resources that can be confirmed as prospectors' camps are important and may be eligible provided they possess physical integrity relative to a mining district's mineral discovery Period of Significance. Because prospectors' camps possessed few structures, most of which were usually removed when the site was abandoned, the integrity will probably be archaeological. For archaeological remains to constitute integrity, the material evidence should permit the virtual reconstruction of the camp.

A few of the seven aspects of historical integrity defined by the NRHP are likely to be relevant for prospectors' camps. The most applicable will probably be Setting, Feeling, and Association. The Setting around the camp must not have changed to a great degree from its Period of Significance, except for the removal of structures and equipment. Usually, this requires a preserved natural landscape and environment. In terms of Feeling, the site should convey the sense or perception of prospecting and residence from a historical perspective and from today's standpoint. For Association, the site's sum of features and artifacts should permit the researcher to reconstruct the prospect camp and aspects of the prospectors' lifestyles.

In addition to possessing integrity, prospectors' camps must meet at least one of the Criteria defined by the NRHP. Resources eligible under Criterion A must be associated with at least one arena of significance noted above, as well as events, trends, and themes important to the specific mining district. Because it is extremely difficult to directly attribute a given camp to an important person, few camps will be eligible under Criterion B. Prospectors' camps hold the highest likelihood of being eligible under Criterion C because they represent the typical residences associated with mineral examinations and discoveries, the beginnings of mineral booms, and the general exploration of the county. Clearly definable resources with integrity are uncommon and offer important characteristics and attributes. Prospectors' camps many also be eligible under Criterion C if the resource possesses intact architectural features and facilities necessary for prospecting, such as cabins and field forges. These were important aspects of prospecting and few survive in the county today. Prospectors' camps will typically not be eligible under Criterion D because most information can be collected by detailed recordation of surface features. Because occupation was brief, buried archaeological deposits are unlikely.

Workers' Housing: The Property Subtype of workers' housing forms a spectrum ranging from small, simple, and unimportant houses to large, complex, and significant complexes. In Boulder County, the small and simple houses were common at one time and tended not to be involved with major engineering or architectural contributions on an individual basis, although they could have been important to a specific region. Large complexes were uncommon and often participated in the development of residential engineering and architecture in the county, and they tend to be associated with multiple themes of importance.

Eligible resources must possess physical integrity relative to a specific Period of Significance in their host mining districts. Because most buildings either collapsed or were dismantled, the integrity of workers' housing will probably be archaeological. For archaeological remains to constitute integrity, the material evidence should permit the virtual reconstruction of the locations and arrangements of buildings, and reflect aspects of the residents and their lifestyles. Due to their commonality and relative unimportance, many small complexes will be ineligible unless they possess standing structures.

Most of the seven aspects of historical integrity defined by the NRHP apply to workers' housing resources. Some complexes may possess standing structures, which must retain the aspect of Location to contribute to a resource's integrity. To retain Location, the structure must be in its original place of construction. For a resource to retain the aspect of Design, the material remains, including archaeological features, must convey the organization and planning applied to workers' housing. Resources may feature standing buildings that were reoccupied periodically. Residents may have altered a building and constructed additions, and in such cases, the building can retain the aspect of Design if the material remains reflect the changes over time. To retain the aspect of Setting, the area around the resource, and the resource itself, must not have changed a great degree from its Period of Significance, excepting the removal of structures. If the resource is isolated, then the natural landscape should be preserved. If the resource lies in a mining landscape, then the surrounding mines and industrial features should retain at least archaeological integrity. If the resource is part of a built environment, then the surrounding structures should retain integrity relative to one of the mining district's Periods of Significance. In terms of Feeling, the resource should convey the sense or perception of residence from the Period of Significance. For Association, the resource's sum of features and artifacts should permit the researcher to reconstruct the residential complex.

In addition to possessing integrity, workers' housing resources must meet at least one of the Criteria defined by the NRHP. Resources eligible under Criterion A must be associated with at least one area of significance noted above, as well as events, trends, and themes important to a specific mining district.

Resources may be eligible under Criterion B provided that they retain integrity from an important person's period of occupation or participation. Some buildings and complexes can be traced to important individuals, and in these cases, they can be eligible under Criterion B. It should be noted, however, that the mere ownership of a property or very brief occupation by an important person is too indirect an association for Criterion B. The individual of note must have either been present on-site for a significant amount of time or played a fundamental role in the site's physical development.

Most small residential complexes will probably not be eligible under Criterion C because they are common, usually lack integrity, and offer few important characteristics and attributes. However, if standing structures are present, then a resource may be eligible under Criterion C. In general, intact structures with integrity to a single Period of Significance are uncommon and important representations of architecture and residence associated with the county's mining industry. Large complexes can be eligible under Criterion C if the resource possesses intact archaeological, architectural or engineering features and artifacts that clearly convey the organization and infrastructure of the housing and aspects of the residents and their lifestyles.

Many workers' housing complexes can be expected to offer a high potential for eligibility under Criterion D because they may contribute meaningful information. An analysis of the complex and any architectural features may enlighten the existing understanding of workers' housing and the residential environment associated with the county's mining industry. Workers' housing complexes often possess building platforms, privy pits, and refuse dumps that feature buried archaeological deposits. Testing and excavation may reveal information regarding the lifestyles, social structures, and demography of workers, as well as the presence of families and women. Such studies are important because these subjects were not heavily documented in the past.

Isolated Residences: Isolated residences are common and since they cannot be tied to a specific industry or means of subsistence, they lack significance. However, buried archaeological deposits may clarify which industry the residents were associated with. If this seems likely, the site may be eligible under Criterion D.

Townsites and Unincorporated Settlements: These Property Subtypes form a spectrum ranging from small and simple to large, complex, and significant. While most of the county's settlements were not involved with major engineering or architectural contributions on an individual basis, they were certainly important to a specific mining district. Large towns were uncommon in the mountainous portion of the county and a few such as Caribou participated in the development of mining frontier engineering and architecture, and these tend to be associated with multiple themes of importance.

Eligible townsites and settlements must possess physical integrity relative to their host mining district's Periods of Significance. Because most buildings in the townsites and settlements either collapsed or were demolished, the dominant integrity will probably be archaeological. For archaeological remains to contribute to integrity, the material evidence should permit the virtual reconstruction of the locations and arrangements of buildings and infrastructure, and reflect aspects of the residents and their lifestyles.

Most of the seven aspects of historical integrity defined by the NRHP apply to settlements. Some may possess standing structures, which must retain the aspect of Location to contribute to a resource's integrity. To retain Location, the structure must be in its original place of construction. For a resource to retain the aspect of Design, the material remains, including archaeological features, must convey organization and planning applied to a settlement. Resources may feature standing buildings that were reoccupied on a serial basis. Residents may have altered a given building and constructed additions, and in such cases, the building can retain the aspect of Design if the material remains reflect the changes over time. To retain the aspect of Setting, the area around the resource, and the resource itself, must not have changed a great degree from its Period of Significance, excepting the removal of structures. If the resource is isolated, then the natural landscape should be preserved. If the resource lies in a mining landscape, then the surrounding mines and industrial features should retain at least archaeological integrity. In terms of Feeling, the resource should convey the sense or perception of settlement from the Period of Significance. For Association, the resource's sum of features and artifacts should permit the researcher to reconstruct the settlement.

In addition to possessing integrity, townsites and settlements must meet at least one of the Criteria defined by the NRHP. Resources eligible under Criterion A should be associated with at least one area of significance noted above, as well as the events, trends, and themes important to the host mining district.

Resources may be eligible under Criterion B provided that they retain integrity from an important person's period of occupation or participation. Some buildings and complexes can be traced to important individuals and in these cases they may be eligible under Criterion B. It should be noted, however, that the general inhabitation of a settlement by an important person is too indirect an association for Criterion B. The specific place of occupation by the individual of note must be identified, or they must have played a fundamental role in the settlement's physical development.

Settlements can be eligible under Criterion C if the resource possesses intact archaeological, architectural or engineering features and artifacts that clearly convey key aspects. Examples of key aspects include the settlement's organization and infrastructure; the makeup and arrangement of residences and businesses; the distribution of socioeconomic status, gender, ethnicity, and modes of employment; and characterizations of lifestyle such as diet, health, substance abuse, and consumerism. Of note, many of these aspects can be charted through a careful study of artifacts and architectural characteristics. For Criterion C, the resource should clearly represent a specific type of town or unincorporated settlement associated with mining.

The presence of standing structures can complicate a resource's eligibility under Criterion C. Structures that retain integrity relative to a Period of Significance may be contributing elements of a town or unincorporated settlement because they can be uncommon and important representations of engineering, architecture, business, and residence associated with the county's mining industry. The county's currently inhabited mining towns, however, such as Nederland, Ward, and Jamestown, possess numerous buildings that were constructed outside of the relevant Periods of Significance. If the number of such buildings exceeds those within the Period or disrupts the settlement's historic fabric, as an entity, the settlement may no longer possess integrity. Because most of the currently occupied towns are complex resources, survey and recordation may be warranted to assess integrity relative to the host mining district's Periods of Significance. Architectural surveys are well equipped to assess the integrity of the built environment, but they are inadequate to address the assemblage of archaeological features, which may extend considerable distances beyond existing clusters of historic buildings. Even though some towns may lack architectural integrity due to high percentages of recent buildings, they can still retain archaeological integrity and hence be eligible.

Settlements offer a high potential to be eligible under Criterion D because many are likely to contribute meaningful information. An analysis of architectural features may enlighten the existing understanding of commercial architecture, housing, and the residential environment associated with the county's mining industry. Broad scale studies of settlements often reveal aspects of community development, distribution of gender, modes of employment, socioeconomic status, and businesses. Settlements often possess building platforms, privy pits, and refuse dumps that feature buried archaeological deposits. Testing and excavation may reveal information regarding types of businesses, the lifestyles, social structures, and demography of residents, as well as the presence of families and women. Such studies are important because these subjects were not heavily documented in the past.

SECTION G: GEOGRAPHICAL DATA

The geographical area covered by the MPDF consists of the western, mountainous half of Boulder County. The area extends west from the base of the foothills to the Continental Divide.

SECTION H: IDENTIFICATION AND EVALUATION METHODS

Two general research tracks proved to be the most effective for providing accurate context information and the discussions of Property Types for the Placer and Hardrock Mining Multiple Property Documentation Form. In terms of the context information, the collections offered by six important research facilities in the Denver area were intensively examined for archival materials. The institutions in order of relevance are: Boulder Public Library Carnegie Branch, Colorado State Archives, University of Colorado at Boulder library system, Denver Public Library Western History Collection, Colorado School of Mines, and the Colorado Historical Society. Of these, the Carnegie Library, The Colorado State Archives, and Denver Public Library possess the richest collections by far.

As noted in Section E, some uncertainty surrounds the exact boundaries of Boulder County's mining districts and only a handful of archival materials provided clues in this matter. Percy Fritz's *The Mining Districts of Boulder County* was the clearest and most accurate for defining the boundaries and dates of establishment. The changes and expansions than many of the districts experienced over time had to be secreted out of mine inspectors' reports and manuscript collections.

The key events, trends, and themes of the various districts were synthesized from a wide variety of materials. The most important were historic publications, historic newspapers, popular literature, mine inspectors' reports, mine engineers' reports, manuscript collections, and other archival materials.

Two approaches were useful for identifying the Periods of Significance for the individual mining districts. One was consulting the materials identified above, and the other was a statistical analysis of population and the numbers of active prospects, mines, and mills between 1859 and 1980. These resources were tabulated for their frequency in five year increments, and mines were divided among small, medium, and large scale operations. Colorado Mining Directories, historic newspapers, and other archival materials were used to estimate the numbers of resources that were active between 1859 and 1915, and mostly Colorado Mine Inspectors' Reports were used for the period spanning 1915 to 1980. Susanne Schulz's Colorado census compilation entitled *A Century of the Colorado Census* provided population figures.

The above described method of statistical analysis has inherent weaknesses, but it is well equipped to identify Periods of Significance by mining district. For example, sudden rises in both population and the numbers of prospects in a mining district can be interpreted as a period of discovery, mineral exploration, and boom. Gradual population growth combined with an increase in small- and medium-sized mines often reflects the early phase of a productive mining industry, and a slight contraction in population coupled with a decrease in small mines and an increase in large operations suggests the maturation of mining. In terms of weaknesses, the statistical analysis relies on the accuracy of the archival resources. Some of the five year increments were poorly covered, and some important mines were not mentioned or reported, even though they were active at times. In addition, it seems likely that many prospects were not reported because of their unimportance at the time.

Ordinarily, production figures are important indicators of the phases that a mining industry experienced. Archival sources such as Charles Henderson's *Mining in Colorado* and the *Minerals Yearbook* divide production among specific metals which, in Boulder County, were primarily gold, silver, lead, copper, and tungsten. But because these archival sources cite the figures on a county-wide level, they were of limited application to Boulder County's individual districts. The figures for silver and tungsten, however, were of some use since they were produced primarily in Caribou and in the Tungsten district.

Few if any broad-scale Multiple Property Documentation Forms or other resource contexts have been produced for mining industries anywhere in the western United States at the time of this writing.[1] As a result, no models or examples were available for the Placer and Hardrock Mining Multiple Property Document Form, leaving the author to draw two on resources for the definition of Property Types, their associated features, and their registration requirements. The first resource was personal experience identifying, recording, and evaluating hundreds of mining resources over the course of more than eight years. During this time, the author also produced several archaeological mining contexts and wrote the Property Type section for the statewide Multiple Property Document Form *The Mining Industry in Colorado*. This document is available in draft form and has been approved by the Office of Archaeology and Historic Preservation. The author's treatise on mining technology *Riches to Rust*, currently in print, was also important.

The cultural resource surveys mentioned in the introduction of Section E, and the author's personal informal field investigations in Boulder County, constituted the second resource used to identify Property Types and tailor their registration requirements. The author personally conducted the Historic Boulder survey in 2002, which was an attempt to quantify the county's potentially significant mining resources.

[1] According to a search of State Historic Preservation Offices and State Historical Societies.

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