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.

PAGE NUMBERS SUBJECT TO CHANGE

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.

_X_ New Submission ___ Amended Submission

SECTION A: NAME OF MULTIPLE PROPERTY LISTING

Historic Mining Resources of San Juan County, Colorado

SECTION B: ASSOCIATED HISTORIC CONTEXTS

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

The Gold Rush, 1860-1861
Return to the San Juans, 1870-1874
Settlement and Establishment of Industry, 1875-1881
The Early 1880s Boom, 1882-1885
The Value of Silver is Restored, 1890-1893
The Silver Crash, 1894-1897
The Great Mining Revival, 1898-1910
World War I Revival, 1915-1921
Great Depression Era Revival, 1933-1939
Post World War II Recovery, 1946-1954

SECTION C: FORM PREPARED BY

name/title Eric Twitty, historian, M.A.
organization Mountain States Historical (303) 499-4334 date September 27, 2010
street & number 1011 Glenwood Drive telephone (303) 499-4334
city or town Lafayette state CO zip code 80026

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

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

National Register of Historic Places
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_X_ New Submission ___ Amended Submission

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

Section E 1: History of Mining in San Juan County

INTRODUCTION

In terms of mining history, San Juan County is among the most important regions in the Rocky Mountain states. The county hosted a local mining industry that was significant for its longevity, productivity, role in key industry events, and association with important people. For example, in 1860, the Animas River drainage was the scene of the first popular gold rush in southwestern Colorado. This initial event led to the exploration and popularization of the San Juan Mountains. During the late 1870s, hardrock mining took hold and became important enough to convince the Denver & Rio Grande Railroad to grade a narrow-gauge line to the San Juans and then up to Silverton. The railroad is still in service today as one of Colorado's premiere tourist attractions, designated a National Historic Landmark in July 1961. Following the Silver Crash of 1893, the owners of the two largest mines in the county instituted the practice of producing and milling low-grade ore in unprecedented volumes to offset the meager returns per ton of material. When these two individuals demonstrated that the strategy was effective, the rest of Colorado's hardrock mining industry followed and pulled the state out of the mid-1890s depression.

An outstanding assemblage of historic resources represents the county's fascinating and important hardrock mining industry. Following abandonment, many of the prospects, mines, and mills succumbed to the pressures of mineral exploration, scavenging, recreational use, and especially natural decay, leaving a number of resources in various states of preservation. While some of the important mines and towns are well-known, forgotten resources are being rediscovered through historic preservation efforts, environmental cleanup, and greater attention to local and Federal public lands.

To foster the understanding and preservation of important sites, the Bureau of Land Management (BLM) commissioned a Multiple Property Documentation Form focused on the county's rich mining heritage. Little other context work has been completed as of 2009 regarding the county's mining history. Several popular publications and a series of resource inventory reports constitute the only broad-scale body of historical analysis. Between the late 1990s and early 2000s, the BLM funded a sweeping inventory of the county's principal mine and settlement sites. The BLM divided the county into study units, identified the principal sites within each unit, and contracted with archaeological consultants to inventory the selected resources. The consultants then produced reports of findings.[1]

While these projects established an important baseline, they were not designed to provide specific guidance regarding the identification, interpretation, and evaluation of the county's

[1] Steve Baker, *Cement Creek West Study Unit-AML Historic Site Survey* (Montrose, CO: Centuries Research, 1998); Ross S. Curtis, *Recording of Historic Mining Properties in the Galena Mountain Study Unit, San Juan County, Colorado* (Durango, CO: Durango Archaeological Consultants, 2001); Eric Twitty, *Mining Cement Creek: A Selective Inventory of Historic Mine Sites on the East Side of the Cement Creek Drainage, San Juan County, Colorado* (Boulder: Mountain States Historical, 2000); Eric Twitty, *The Silverton Mining District k: A Selective Inventory of Principal Historic Sites, San Juan County, Colorado* (Boulder: Mountain States Historical, 2002).

mining resources. The 2010 *Historic Mining Resources of San Juan County, Colorado Multiple Property Documentation Form* commissioned by the BLM 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 today.

The *Historic Mining Resources of San Juan County, Colorado* is a subcontext of the larger statewide Multiple Property Documentation Form *The Mining Industry in Colorado*.[2] Jay Fell and Eric Twitty wrote the document in 2005, and the Colorado Historical Society published a revision in 2008. *The Mining Industry in Colorado* provides a broad overview of mining throughout Colorado between 1858 and 2001, general descriptions of its common resource types, and their general registration requirements. A subcontext with greater detail and specificity to San Juan County is necessary to better support regional nominations. The county's history is complex, and the resources varied in type specialized to the region's environment.

Section E.1 of the subcontext describes San Juan County's geography, mining districts, and history in greater detail than the statewide context, and in chronological order. The statewide context, in contrast, follows a geographic approach. The subsection on history is new material and covers the events, trends, people, organizations, and Periods of Significance specific to the county. The subsection is crucial for placing present historic resources in time and place, and identifying relevant Areas of Significance for nomination. Section E.2 reviews the technology, methods, and equipment commonly employed for prospecting, mining, and milling in the county. This information is important to promote a better understanding of the county's mining history and to help interpret mining resources in the field. Section E.2 directly reproduces a parallel section in the statewide context, with author permission, and adapted to the county-specific industry. Material not directly relevant to San Juan County, such as coal mining, has been omitted.

Section F of the subcontext describes the property types common to the mining industry in San Juan County as well as their registration requirements. The section was also directly repeated from the statewide context for consistency, and because terminology and many resource types are universal throughout the greater Rocky Mountains. Section F was, however, adapted to San Juan County where needed. Some resource types are described in more detail while those not found in the county, such as dredge placers, were omitted. Editorial improvements were made as well, and embedded illustrations removed to comply with revision to National Park Service policy.

THE PHYSICAL ENVIRONMENT OF SAN JUAN COUNTY

San Juan County lies in southwestern Colorado, and it encompasses approximately 753 square miles within the central San Juan Mountains. Cycles of geological uplift, subsidence, and glaciation contributed to particularly difficult terrain dominated by high alpine peaks and deep

[2]Jay Fell and Eric Twitty, *The Mining Industry in Colorado Multiple Property Documentation Form* (Denver: On file with the Colorado State Historic Preservation Office, Colorado Historical Society, 2008).

valleys. The peaks range in elevation from around 11,000 to 14,000 feet, and separate several distinct drainages.

The Animas River carved the county's principal valley from between towering landforms. Following a cultural geographic pattern common to the greater Rocky Mountains, nearly all the county's principal towns grew in the valley. The river begins at the confluence of three alpine creeks in the county's northern extent. The appropriately named town of Animas Forks lay at the confluence, and from here, the river trends southerly for around three miles to the townsite of Eureka. The valley widens, curves southwest around two miles to Howardsville, and continues three more miles to the town of Silverton, the county seat. From there, the valley constricts again and resumes a southward course out of the mountains toward Durango.

Numerous streams descend into the Animas River valley from both sides, draining basins between the principal peaks. On the north side, the principal streams are, west to east, Mineral Creek, Cement Creek, Eureka Gulch, California Gulch, and the North Fork of the Animas.

Mineral Creek ascends northwest from Silverton for several miles and then branches at a point historically known as Burro Bridge. The South Fork continues west into a cluster of peaks and basins forming a divide with the Telluride area in the western San Juans. Ice Lake Basin, near the headwaters, was noteworthy because it was center to the Ice Lake Mining District and a cluster of mines developed during the 1880s. The basin is above treeline, features an alpine environment, and, historically, was remote and difficult to access, which confounded mining.

The main fork of Mineral Creek ascends due north from Burro Bridge for around four miles and ends at Red Mountain Pass. Here, the tributary Mill Creek extends west into a group of peaks. The historic settlement of Chattanooga grew at the confluence, and it was center to a small collection of mines. When the Red Mountain Mining District boomed on the north side of the pass (Ouray County) during the mid-1880s, Mineral Creek became a principal route and Chattanooga served as a gateway.

Cement Creek, another principal drainage, ascends north from Silverton and is flanked on both sides by high peaks. The valley trends north for around six miles, curves northeast, and ends at the townsite of Gladstone, which was established at a confluence. Near Gladstone, Prospect Gulch ascends steeply northwest into the Red Mountain peaks, which rise to elevations of more than 12,000 feet. At Gladstone, the South Fork of Cement Creek branches south, the main fork ascends north, and both end in alpine basins. While Cement Creek was heavily prospected during the late 1870s, twenty years passed before the drainage saw mining of significance. Most of the substantial operations were relatively close to Gladstone, and a few were in Prospect Gulch. The Gold King, one of the county's most productive mines, was on the east edge of Gladstone.

Eureka Gulch enters the Animas valley at the townsite of Eureka, and it passes northwest between peaks to Lake Emma and Sunnyside Basin. The gulch saw some of the county's earliest activity, and Sunnyside Basin hosted the Sunnyside Mine, which was one of the most important mines both in the county and state.

California Gulch and the North Fork of the Animas are the last two principal drainages on the north side of the Animas River. They and Cinnamon Creek join at the townsite of Animas Forks, and this confluence serves as the Animas River's headwaters. California Gulch ascends gently west, the North Fork ascends north, and Cinnamon Creek extends east. High peaks rising to elevations of 12,500 to 13,200 feet surround the confluence, and the confluence itself is a lofty 11,000 feet.

The south side of the Animas River valley features almost as many tributary drainages as the north side. From west to east, the tributaries include Arrastra Gulch, Cunningham Gulch, Maggie Gulch, Minnie Gulch, and Burns Gulch. Arrastra Gulch, scene of the first hardrock mine in the San Juans, is relatively short and ascends steeply south to an abrupt headwall bracketed by high peaks. Beyond lies Silver Lake Basin, which hosted several of the county's most advanced mines.

Cunningham Gulch is one of the deepest of the tributaries and featured several of the earliest and longest-lived mines. The drainage extends southeast from Howardsville for one mile and curves southwest. At the curve, Stony Gulch veers southeast, and while it is a minor tributary to Cunningham, the gulch is noteworthy because it was historically one of the main entry points into the region. Cunningham Gulch continues south for around two miles and branches into several alpine creeks. King Solomon Mountain and North Star Peak form the gulch's west side, and Green Mountain serves as the east side.

Maggie and Minnie gulches open into the Animas valley relatively close together. Over the course of two miles, Maggie Gulch curves from southeast to south and ends in a glaciated basin. Minnie Gulch is almost as long and follows a similar course. Burns Gulch, which featured several productive mines, lies between Eureka and Animas Forks and follows a short and southeastern ascent into numerous peaks.

The far northern reach of the county, mostly above treeline, is the only portion that drains northwest away from the Animas River. Mineral Creek carries snowmelt from the area north of Animas Forks westerly into Ouray County and the Uncompahgre River. Poughkeepsie Gulch, north of Cement Creek, flows from alpine basins into Mineral Creek. Both drainages were, for a brief time early in the county's history, important centers of prospecting.

The climate in the San Juan Mountains presented the mining industry with conditions that some observed were second in difficulty only to Alaska. The editors of the *Silverton Standard* summed the general weather pattern in a simple sentence: "Snow-banks whiten these upper elevations from January to August, and from August to January. The clouds weep about all the year round."[3] What the editors forgot to mention were the high winds.

The summers were the most important season for activity, and while they tended to be hospitable, they were remarkably short and cool. Summer begins in June when temperatures in the 60s and 70s, Fahrenheit, melt the thick snowpack from lower elevations and improve transportation. June is usually clear and bright, but by July, a regional phenomenon known as the monsoon shrouds the mountains in clammy and rainy weather until September, when reliable warmth and sun return. With occasional snows, the middle of summer in the San Juans could be mistaken for mild winter in more temperate climates. The fall begins in October, and while it tends to be dry, the weather has an element of unpredictability. At the least, the temperatures during both day and night are cooler, and cold snaps, snow, and prolonged warm weather are all possible through November. Winter sets in during November and lasts through April. Powerful

[3] *Silverton Standard* (7/27/95): 1.

Pacific storms blowing in from the west deposit up to several feet of snow at a time and send temperatures plummeting well below zero degrees. Cold air masses that follow the storms force the temperatures down as low as -40 degrees, although readings in the 30s and 40s are more typical. Because the cold air tends to sink, the mountain canyons, where most of the settlements were located, channeled streams of frigid air, while the areas on the slopes where the mines lay tended to be much warmer. Despite such conditions, mining thrived in the San Juans by the 1880s and all-year residence became common. Nevertheless, both the geographic and climatic factors contribute to a distinct sense of physical isolation.

SAN JUAN COUNTY'S MINING DISTRICTS

In general, prospectors across the West organized mining districts as a primitive form of frontier government to regulate claim activity and some behaviors of miners. The boundaries of a mining district were usually drawn around concentrations of mineral claims. When prospecting and mining spilled outside of an established district, the boundaries were usually amended to incorporate the additional activity. An elected board set regulations that defined the types of claims, claim sizes, requirements to maintain title, rights for infrastructure and engineering projects, and discovery rights for placer and hardrock deposits. The board also kept records, defined laws that governed behavior and enforced law and order. With the rise of effective county governments throughout Colorado, the majority of these responsibilities fell to a clerk and recorder, while the sheriff administered law enforcement. Mining districts, however, continued to be recognized.

Roughly between 1870 and 1880, prospectors in San Juan County established seven formal mining districts: Animas, Bear Creek, Eureka, Ice Lake, Mineral Creek, Mineral Point, and Poughkeepsie. The press, industry experts, and local interests often attributed new centers of activity to the nearest district and substituted popular names for original designations. As a result, some of the county's districts are known by several names, and their exact boundaries remain nebulous.

Las Animas Mining District

The Las Animas Mining District enjoys the status of first district in the county and probably the greater San Juan Mountains. Prospectors organized the entity, often known simply as the Animas district, on June 15, 1871, to govern claim activity throughout the Animas River drainage.[4] The original district proved unwieldy in size, and when prospectors arrived in significant numbers in 1873, they began carving other districts out of the Las Animas. The Eureka district was the first and took in the territory north of the Animas River and east of Cunningham Gulch. Mineral Creek was the second and assumed the Mineral Creek drainage and mountains west of the Animas River. This left the large cluster of towering peaks southwest of Silverton as the Las Animas district, and they included Kendall Mountain, Kendall Peak,

[4] Allen Nossaman, *Many More Mountains: Volume 1: Silverton's Routes* (Denver: Sundance Publications, 1989) 103.

Hazelton Mountain, Round Mountain, King Solomon Mountain, and North Star Peak. Silver Lake Basin lay near the center. In terms of final boundaries, the Animas River defined the district's west and north edges, Cunningham Gulch was the east side, and Whitehead Peak marked the south line. Silverton anchored the district's northwest corner and Howardsville the northeast corner.

Eureka Mining District

Ruben J. McNutt and George W. Howard, two of the county's pioneers, were the driving force behind the Eureka Mining District. They formalized the district in 1873 and, while the original boundaries are unclear, they designated the region north of the Animas River, east of Cunningham Gulch, and west of the Continental Divide. The boundaries became defined in 1874 or 1875 when prospectors created the Mineral Creek district to the west, and the Mineral Point district to the north. Ultimately, the Eureka district assumed a complex shape. Silverton lay at the southwest corner, and from here, the west boundary passed northwest through the series of peaks that culminated as the Red Mountains. In particular, the west boundary passed through, south to north, Anvil Mountain, Ohio Peak, McMillan Peak, and Red Mountain No.3.

The district's north boundary was inconsistent. It started at Red Mountain No.3, followed the ridge east to Red Mountain No.1, and wrapped around the head of Cement Creek to Hurricane Peak. The north boundary then followed the ridge northeast to Tuttle Mountain, east to Houghton Mountain, and crossed over the North Fork of the Animas to Cinnamon Pass. In essence, the entire north boundary followed the separation between south-flowing and north-flowing drainages.

The east boundary followed a similar principal. That boundary was drawn along the Continental Divide from Cinnamon Pass south to Stony Pass. The Divide also served as the separation between San Juan and Hinsdale counties.

The south boundary was almost as complex as the north. Specifically, the boundary extended from Stony Pass west to Cunningham Gulch and then followed the gulch northward to Howardsville. Thus, the mountains on the west side of the gulch remained within the Animas district while those on the east side belonged to the Eureka district. The south boundary then followed the Animas River west to Silverton.

Cement Creek Subdistrict

It remains uncertain whether the Cement Creek Mining District was formally organized, but archival sources, including mining journals and mine inspectors', reports allude to the existence of a district by that name. The Cement Creek district was limited to the Cement Creek drainage and can be considered a subdistrict within the Eureka.

Mineral Creek Mining District

When prospectors fanned out into the western portion of the county in 1874 and 1875, they found enough mineral deposits to justify a mining district. The prospectors organized the Mineral Creek Mining District, and because the discoveries were widely scattered among the peaks and drainages, the district boundaries remained poorly defined. In general, we can assume that the district included the Mineral Creek drainage west of the Animas and Eureka districts. Most of the activity in the district occurred along the forks of Mineral Creek.

Ice Lake Mining District

During the late 1870s, prospectors found a concentration of mineralized veins in Ice Lake Basin, near the head of the South Fork of Mineral Creek, at the county's west edge. Because the collection was a distinct entity, they organized the Ice Lake Mining District, which was limited to the basin and head of the creek. Ground largely devoid of mineralization between Ice Lake Basin and the mines on Mineral Creek helped the district maintain recognition as distinct.

Mineral Point Mining District

The county's northern extent featured a second Mineral Creek, and it was center to another early district. When Albert W. Burrows and Charles H. McIntyre prospected the area and staked a number of claims in 1873, they almost certainly organized a district at the same time. The original name probably contained the term Mineral but excluded Point because the name Mineral Point did not come into being until 1875 when the Postal Service recognized the settlement of Mineral City as Mineral Point. Afterward, the mining industry adopted the name Mineral Point, and the district was one of the most remote, highest, and difficult to work in.

The district straddled southeast Ouray and northeast San Juan County and encompassed the Mineral Creek drainage. The northeast edge followed the Continental Divide between Wood and Engineer mountains, and extended west from Engineer Mountain across several unnamed peaks. The west edge went almost due south to Tuttle Mountain and respected the divide between the Mineral Creek and Poughkeepsie drainages. The district's south boundary was the same as the Eureka district's north boundary. In particular, the south edge connected the crests of Tuttle and Houghton mountains, and leapt over the North Fork of the Animas River to Cinnamon Pass. The east edge then followed the Continental Divide from the pass north to Wood Mountain, closing the loop.

Poughkeepsie Mining District

The Poughkeepsie Mining District encompassed the Poughkeepsie Gulch area, which was also the headwaters of the Uncompahgre River, in the county's northern portion. From another perspective, the district occupied a pocket of territory west of the Mineral Point and north of the Eureka districts. McNutt and Howard may have formulated a version of the district as early as 1873, when they staked the Poughkeepsie and other claims. The original boundaries are uncertain, but the district became well-defined by 1875. The Poughkeepsie district's east boundary was the same as the Mineral Point district's west edge. In particular, the boundary formed a line from Tuttle Mountain north over Mineral Creek to the crest of an unnamed peak. Originally, the west boundary may have extended as far as Ironton Park and Red Mountain Creek, but this was pushed eastward with the creation of the Red Mountain Mining District in the early 1880s. As a result, the Poughkeepsie district's western edge followed the crest of Brown Mountain, which was also the boundary between San Juan and Ouray counties. The district's southern edge respected the divide between the Cement Creek and Poughkeepsie drainages and extended from the south end of Brown Mountain through Poughkeepsie Pass to Hurricane Peak.

Bear Creek Mining District

The Bear Creek Mining District was one of the last designated in San Juan County. Prospectors discovered gold on Bear Creek in 1893, prompting a small rush the following year. The district centered on Bear Creek, which flows northeast into the headwaters of the Rio Grande River. Deep in the mountains southeast of Cunningham Gulch, the district was so remote that mining companies found Creede in Mineral County to be easier to reach and relied on it as the nearest point of commerce instead of Silverton. The district extended west over the Continental Divide and included the headwaters of Elk Creek.

THE HISTORY OF MINING IN SAN JUAN COUNTY

Each subheading in Section E itemized below refers to a discrete Period of Significance in San Juan County mining history as defined by historical events, trends, and patterns:

The Gold Rush, 1860-1861
Return to the San Juans, 1870-1874
Settlement and Establishment of Industry, 1875-1881
The Early 1880s Boom, 1882-1885
The Value of Silver is Restored, 1890-1893
The Silver Crash, 1894-1897
The Great Mining Revival, 1898-1910
World War I Revival, 1915-1921
Great Depression Era Revival, 1933-1939
Post World War II Recovery, 1946-1954

The Gold Rush, 1860 – 1861

Mining in San Juan County began not in the San Juan Mountains, but far to the northeast in California Gulch near present-day Leadville. A prospector named Charles Baker postulated that the gulch lay within a huge mineral belt extending from Boulder County southwest to points deep in the mountains. Baker came to Colorado with the Pikes Peak Gold Rush in 1859 or 1860, examined placer mining centers on the Front Range and in Park County, and finding the most profitable ground already claimed, joined the excitement in California Gulch. Arriving late, he found the same conditions there and, in need of income, joined a crew of miners working for S.B. Kellogg & Company. In his travels, Baker observed that from Boulder County to California Gulch, the placer fields conformed to a northeast-southwest pattern, which supported the mineral belt idea.

Baker discussed the concept with Kellogg and convinced him that more gold probably lay to the southwest. Kellogg agreed to fund an expedition, which Baker led into uncharted territory during the summer of 1860. Leaving the Arkansas River valley, the Baker party crossed over the Continental Divide and descended west along the Gunnison River panning for gold. Repeated failures to find even traces put the mineral belt hypothesis in doubt, although had the party gone south along Cochetopa Creek or north in the Elk Mountains, they would have been successful. Baker instead continued southwesterly toward the San Juan Mountains and followed the Lake Fork of the Gunnison River. When the party arrived at Lake San Cristobal, Baker found gold, but the small deposits were unprofitable and some members turned back. The gold, however, was enough to tantalize Baker and six or seven others into further exploration, and they crossed west over Cinnamon Pass into the Animas River valley. Thus Baker and partners became the first Euro-Americans clearly known to penetrate the deep San Juan Mountains.[5]

When the party reached the Animas River, it followed the constricted, rocky gorge until the valley broadened into an area where tributary drainages converged from nearly all directions. Here, the members pitched camp and prepared for a systematic search for gold. The party allotted specific tributary drainages to its members, who would later compare findings in camp. W.H. Cunningham assumed the first deep gulch near camp that extended south, a prospector named Mason took the only gulch to the west, Baker wandered the Animas valley, and others fanned out to the north.

In the latter portion of summer, Baker and partners grew excited when they discovered what they thought were bonanza placers at the mouths of Cunningham and Mason gulches (later renamed Arrastra Gulch), and near the later townsite of Eureka, presumably named after this initial placer strike. During August, men converged on the discoveries and pursued deeper deposits. Had they taken the time, however, to track the horizontal extent of the gold-bearing gravel, the prospectors may have proceeded less enthusiastically.

Regardless, they processed the shallow gravel with pans and sluices through September, realizing that the season's end drew near. In need of supplies, and seeking to popularize the find, Baker traveled out from the San Juans. In October, he followed the Animas River south to the New Mexican trading outpost of Abiquiu. After relaying his story, Baker turned east and trekked to settlements on the Rio Grande River, where he not only acquired goods, but found a ready audience. After heavily promoting the placer discoveries, Baker assembled a party of around 150 prospectors and other individuals willing to try their luck in what he referred to as Baker's Park.[6]

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[5] Nossaman, 1989: 36-37.
[6] Nossaman, 1989: 39.

By mid-October, the original party welcomed Baker and his 150-member entourage. Baker apparently neglected to inform the new prospectors that their window for exploring the high country was short and that they would have to descend before deep snows stranded them. This became painfully obvious as the temperatures fell and the weather turned increasingly unpredictable. Still, the participants of the small rush had just enough time to examine the placer fields, stake claims, and break ground. In response to new competition and out of certainty that the following year would see a major rush, the Baker party claimed their camp and surrounding land as Baker's Park. When winter set in, the entire assemblage of prospectors decided the season was over and descended south out of the mountains.[7]

When they approached the lower elevations, the prospectors broke into several groups. Wanting more than just the Animas River gold, Baker and several others wrapped west around the San Juans to the Dolores River for additional prospecting. Some of the 150 returned to the San Luis Valley and Abiquiu, while Baker's original party and others established a small settlement on the Animas River. The group named their collection of dank and crude cabins Animas City and felt some security in its strategic location (another town by the same name was founded during the mid-1870s down river). The immediate area offered water, shelter, timber for cabins, and game, and the settlement was as close as possible to the gold discoveries. Reasons for insecurity also abounded, however. Because Animas City was completely isolated, residents had to be completely self-sufficient. Of greater import, the settlement was within territory traditionally used by the Ute Indians, and the presence of the prospectors fueled tribal fears of encroachment. Ultimately, these fears would prove well-founded.[8]

As various parties left the San Juans in late fall, they conveyed information that contributed substance to the rumors initially spread by Baker. The reports of gold in the mysterious San Juans spread like wildfire. The Pikes Peak Gold Rush was souring, mountain discoveries were at their zenith, older gold fields were claimed and moreover showed signs of exhaustion, while optimistic wealth seekers continued to arrive. Colorado was ready for another significant gold discovery.

As individuals repeated Baker's stories, the richness and extent of the gold deposits were wildly elaborated. Even the voices of rational and experienced prospectors who personally journeyed to Baker's Park were unable to counter the exaggerations. The highly seasoned Richard Sopris and partners left Animas City by December and returned to the Front Range to report that Baker's discoveries were a bust. Another prospector went so far as to write a series of letters to *Rocky Mountain News* in January 1861 arguing against Baker's finds. The dissent did little to dissuade the unsuccessful, optimistic, and adventurous from journeying to the San Juans as early as October 1860.[9]

S.B. Kellogg was among those that mobilized almost immediately. He felt that Baker's discovery would incite a significant rush and wanted to be among the first to stake profitable ground. He quickly returned East for his family, brought them to Colorado, and organized a party

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7 Ibid.
8 Ibid.
9 Nossaman, 1989: 40, 51.

of 150 to 200 individuals. Some of Colorado's most notable pioneers were among the group, and their interest fostered a sense of confidence that Baker's Park would be the next bonanza. Abe Lee, the discoverer of California Gulch, Henry Allen, a founder of Auraria, and Thomas Pollock, one of Denver's first settlers and business operators, all joined Kellogg. In an attempt to establish a foothold in advance of the big rush, Kellogg's party hastily left in the uncertain weather of December with relatively few provisions.

Meanwhile, the idle residents at Animas City grew impatient as they waited for the weather to change. Eager to be first at the diggings, Baker and partners built sleds, hauled supplies 30 miles up to the park, erected cabins, and readied for the season. Much to their surprise, Kellogg's massive party arrived at Animas City in early April along with other, smaller groups of prospectors. Kellogg then joined Baker on what they hoped would be the last trudge up to the placer fields. Despite snow, they tramped to the discovery site and began panning gravel in the icy water.[10]

After Baker had been absent for some days, some Animas City residents assumed that conditions had dramatically improved. A large contingent ascended into the park, and they were undoubtedly disappointed when they saw a thick snowpack covering much of the ground not exposed to direct sun. Further, the weather turned and snow began falling. And yet, the prospectors respected the frontier etiquette of permitting the discoverer, Baker in this case, to stake his claims first before defining their own. As the conditions worsened, the prospectors grew panicky at the thought of being snowbound and implored Baker and partners to take action. Aware of the potential uprising, Baker, his partners and members of Kellogg's party reluctantly staked claims, despite the snow, over the areas that Baker remembered being the best. The group staked 20 claims ascending Cunningham Gulch from its confluence with the Animas River, a like set of claims in Mason Gulch, and another 20 on the Animas at what the group named Eureka. In the context of haste and uncertainty, the Baker party staked the first claims recorded in the San Juan Mountains. As soon as this was finished, the extraneous prospectors then staked their locations adjoining the Baker and Kellogg assemblages, and all retreated back down to Animas City and safety.[11]

Finally, in May, scouts reported that the passes were negotiable, and within several days, Animas City emptied. When the swarm of prospectors arrived in Baker's Park, some paused to build cabins around Baker's supposed townsite while others continued on to the diggings. There, eager prospectors looked over the groups of claims staked in April, added their own, and built cabins and crude shelters nearby. Through May and into June, more prospectors continued to arrive, constituting the first mineral rush to the San Juan Mountains. Silverton historian Allen Nossaman claims that more than 1,000 individuals were interested in Baker's Park in 1861 but not all came. In total, the rush probably drew between 500 and 700 prospectors who invested considerable emotional capital and time in the difficult journey.[12]

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[10] Ibid:53.
[11] Nossaman, 1989: 56.
[12] Ibid:60.

Within several weeks, the Animas River ran muddy as those prospectors fortunate enough to possess claims began to process gravel for gold. As a brilliant June progressed, however, doubt about the richness of Baker's Park slowly grew. The meager returns from backbreaking labor demonstrated that the gravel deposits in the lower reaches of Cunningham and Mason gulches and at Eureka were the only ones that contained appreciable amounts of gold and that all the rest offered nothing. Further, the profitable deposits had been claimed by the Baker party and the other prospectors who braved the April snows, leaving little for hundreds of others. Some despaired, many grew angry, and the disenfranchised prospectors looked for someone to blame for their failure. They seized upon Baker, who countered that he had been accurate and that exaggerations of his factual reports were at fault. Regardless, some prospectors attempted to foment rebellion and sought punishment of and even threatened to hang Baker. Most, however, conceded defeat and left the San Juans in June and early July, popularizing the event as the San Juan Humbug.[13]

After most of the rush participants departed, Baker, Kellogg, and party members continued to recover gold but realized that they were not going to be wealthy. The party quickly exhausted its claims in Mason and Cunningham gulches then contracted around Eureka, and after a number of weeks, quit and packed their tools. With little to show after a year of hardship, Baker and partners left the San Juans and brought to an end a gold rush in a land that would later yield millions of dollars in silver.

When Baker arrived at Fort Garland, he found that the Civil War had begun, and feeling the call of duty, hastened to his native state of Virginia to enlist in the Confederacy. After the war's end, Baker returned to Colorado to resume prospecting and was drawn to the upper Arkansas River valley in 1867 by gold discoveries at Granite. Probably still interested in his gold belt hypothesis, he and a small party began exploring the Western Slope and followed the Colorado River into Utah. There, Baker, who managed to survive the deadly Civil War, was killed in tribal conflict with the Ute.[14]

Return to the San Juans, 1870 – 1874

The failure of the San Juan Humbug etched an indelible prejudice against the mountains during the 1860s and 1870s, even though the region was in reality a mineralogical treasure trove. Experienced prospectors, however, remained cognizant of this potential. Unknown to each other, two parties made plans during the late 1860s to search the San Juans not for additional placer deposits, but for hardrock silver and gold ore.

One party consisted of Adnah French, John C. Dunn, Rodney McKinnon, and Solomon Shoup, who prospected together in west-central Arizona. Born in Brandon, Vermont, French

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[13] Robert L. Brown, *An Empire of Silver* (Denver: Sundance Publications, 1984) 19; Nossaman, 1989: 64; J.G. Pangborn, *The New Rocky Mountain Tourist Arkansas Valley and San Juan Guide* (Chicago: Knight & Leonard, 1878) 41; Robert E. Sloan, and Carl A. Skowronski, *The Rainbow Route: An Illustrated History of the Silverton Railroad, the Silverton Northern Railroad, and the Silverton, Gladstone, & Northerly Railroad* (Denver: Sundance Ltd, 1975) 14.

[14] Brown, 1984: 19; Nossaman, 1989: 74; Pangborn, 1878: 41; Sloan and Skowronski, 1975: 14; Muriel Sibel Wolle, *Stampede to Timberline: The Ghost Towns and Mining Camps of Colorado* (University of Ohio Press, 1991 [1949]; Swallow Press) 340.

joined the famed Lawrence Party in 1858, one of the three original groups to find placer gold in Colorado and launch the Pikes Peak Gold Rush. As such, French was one of the founders of St. Charles City at the Cherry Creek diggings, and went on to help found Denver. Two years later, French hoped to repeat his good fortune and joined the Baker Party, where he became intimately familiar with Baker's Park. Dunn was born in New Brunswick in 1838, moved to Maine, and then to Lawrence, Kansas at the age of sixteen. Seeking adventure, he traveled over the Santa Fe Trail to wild New Mexico in 1862 and worked at the Apache-Navajo Indian Agency. Dunn also served as an agent between 1864 and 1866. During his time in New Mexico, Dunn heard of the failed rush to Baker's Park and suspected that the gold came from a parent source.[15]

Corydon E. Cooley, Henry W. Dodd, and Dempsey Reese constituted the second party, also in Arizona. Like French, Reese had direct experience as a prospector. Born in Henry County, Indiana, in 1835 Reese joined the Pikes Peak rush in 1860. Finding no gold, he worked for outfitters and helped Charles Baker begin his journey into the San Juans. When the Pikes Peak rush went bust, Reese left Colorado and joined a party to prospect in Oregon. Wealthy in experience but not gold, he returned to the East via Idaho, British Columbia, and Montana. Restless, Reese came west on another whirlwind prospecting tour of Utah; California; Nevada; and Sonora, Mexico, winding up in Arizona in 1868.[16]

Whether the two groups met or simultaneously came up with a common idea is unknown, but both parties idealized the potential for hardrock ore in the San Juans and joined forces. In 1869, the merged party began its journey across the Southwest and quickly confronted problems. Water was difficult to find, and Apache raids and threats struck fear into most of the party, who had increased beyond the original eight. Within a short time, all but the original eight turned back. With Dunn's experience as an Indian agent, the party successfully negotiated passage across the desert and finally reached abandoned Animas City by October. An early snowstorm blocked their ascent into Baker's Park, but the group was unwilling to hunker down in the abandoned collection of cabins, some of which the Utes had destroyed, and went southwest to the safety of Fort Lowell in New Mexico.[17]

Once there, the party decided to split and winter in various points in the region. A few stayed at Santa Fe, several went on to Tierra Amarilla, and Reese and others took up residence at San Juan Pueblo. There, Reese met Miles T. Johnson, an old Pikes Peak friend. During the winter, Cooley arrived at San Juan Pueblo with several of the prospectors who turned back, and all waited for the spring thaw.[18]

When April 1870 arrived, the party amassed at Tierra Amarilla and left for the San Juans. They reoccupied the intact cabins at Animas City and waited for the snowpack on the passes to thaw. During the idle time, Dunn and some of the other members grew impatient, and they left for a venture around the west base of the San Juans to the Dolores River drainage, which was

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[15] Roger Henn, *Lies, Legends & Lore of the San Juans* (Montrose: Western Reflections, 1999) 14; Nossaman, 1989: 43, 81.
[16] Nossaman, 1989: 82.
[17] Brown, 1984: 21; Nossaman, 1989: 81-82; Pangborn, 1878: 42; Sloan and Skowronski, 1975: 15.
[18] Brown, 1984: 20; Nossaman, 1989: 84.

free of snow. French, Reese, Johnson, and a few others, however, were still fixated on Baker's Park and awaited passage.[19]

Later in the month, French was able to wait no longer and broke tracks over the passes and into Baker's Park. These adventurous prospectors were the first Euro-Americans in the area since the rush of nine years before and must have thought that the realization of riches was only a matter of time. They had the river valley to themselves, and furthermore sought hardrock ore, which the Baker party had not considered. French and partners at once returned to the scene of the original gold discoveries in Cunningham and Mason gulches and probably occupied one of the original cabins built in 1861. Possibly working as a group, the prospectors tried the stream gravels again for gold but eagerly began examining the sides of the gulches for the parent veins.

While French, Reese, and Johnson would have considered silver ore, they were interested primarily in gold. In 1870, gold was valued at $20.70 per ounce and could be easily separated in the field with fine crushing and amalgamation with mercury. Silver, by contrast, was valued at $1.33 per ounce and usually required in-depth processing including roasting, leaching, and smelting. In addition, the exact process was dictated by the proportion of silver and other metals, which could only be determined through assay.

With this in mind, the trio began their search for ore in Cunningham Gulch, followed the drainage to its end, and veered southwest up a tributary they named Mountaineer Creek. Near an unusual geological formation on the north side, one of the prospectors found a vein that carried metals. Close examination suggested that the metal was silver, and the party claimed the formation as the Mountaineer (later part of the Highland Mary Mine). French, Reese, and Johnson thus found the first hardrock lode and staked the earliest hardrock claim in the Animas drainage. On the way down and north out of the gulch, the party examined the steep walls and found another vein of similar character on the east side and staked it as the Manderfield, the second lode and claim (later the Green Mountain Mine).[20]

Afterward, French, Reese, and Johnson focused on Mason Gulch, which had featured the richest placer deposits in the past. At first, the prospectors examined mineralized veins in the gulch's outcrops and cliffs, and one of them ascended a ridge on the west side and encountered a third silver vein. The group staked the region's third discovery as the Mammoth (later part of the Aspen Mine) and then resumed the search for gold.[21]

Rather than try to find the source of the placer gold by happenstance, the party resorted to a systematic strategy practiced by experienced hardrock prospectors. In particular, they sampled the gravel in the gulch for traces of placer gold, not to recover the material, but instead to find the point where the gold particles were being introduced into the drainage. Through digging and panning, they slowly progressed upward until the gold disappeared. This marked the point where the gold was eroding into the stream from its parent source, and the prospectors turned to soil samples taken from the gulch sides. Recovering gold well above the stream channel, the prospectors neared the source and began closely examining the gulch sides for any sign of a

[19] Nossaman, 1989: 86; Sloan and Skowronski, 1975: 15.
[20] Nossaman, 1989: 89.
[21] Ibid: 89.

mineral formation, vein, or fault. Possibly after encountering fragmented vein material lying on the ground, the party found that the gold came from a minor drainage on the gulch's east side, and after inspecting the bedrock outcrops, one of the prospectors finally found gold ore. Excited and optimistic, the party staked the find as the Little Giant but was reluctant to declare absolute success until the vein's content had been proven. The claim was the fourth in the region and the only gold vein yet found.[22]

By drilling and blasting, the prospectors drove a discovery cut into the vein and found, that the ore continued deep into the rock. The size of the discovery workings remains unknown, but it seems highly likely that the prospectors collected sacks of ore for assay. During the last month of summer 1870, French, Reese, and Johnson reluctantly packed their camp. Even though they were undoubtedly excited, the three prospectors understood that hard work was ahead if they were to make the claims legal and profit from their finds.

French, Reese, and Johnson wintered in Santa Fe, where they met the Dunn party. Dunn reported gold and silver discoveries near what became Rico. Based on French's recounts, Dunn planned his own visit to Baker's Park in 1871. While in Santa Fe, French also encountered William J. Mulholland, one of the 1869 Arizona prospectors who turned back in fear of Apache attacks. Mulholland was born in Ireland in 1837 and immigrated to Canada in 1847 to seek a better life. He went south in 1859, working as a carpenter before reaching Colorado in 1865, where he tried his luck at Buckskin Joe in Park County. When the boom there collapsed, he engaged in construction in Huerfano County before joining the rush to Elizabethtown, New Mexico. In 1869, Mulholland went to Arizona to prospect, where he encountered French and Reese. After abandoning French's expedition, Mulholland finally reached Santa Fe, where he accepted a position as carpenter for the government and worked with Thomas Blair.[23]

Blair was a western roustabout and skilled carpenter. He was born in Pond Mills, Ontario, probably during the 1830s and may have served as a mercenary in the Civil War. Restless after the war ended, Blair sought adventure in the West, working as a carpenter and prospecting along the way. In 1870, he found employment at Santa Fe as a government carpenter and worked with Mulholland.[24]

After meeting Mulholland and Blair, French realized that the two carpenters possessed the skills needed to develop the Little Giant. In particular, they had tools, knowledge of mechanics, the ability to build from scratch, and most importantly, adventurous spirits. The only resources that lacked were adequate capital for supplies, specific mining equipment, and materials. To interest the carpenters and several investors, French, Reese, and Johnson divided the Little Giant into six shares and offered one each to themselves, Blair, Mulholland, and merchant James H. Cook for $500 and a grubstake. French realized that $500 was not enough

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[22] Nossaman, 1989: 89; Frederick Leslie Ransome, *USGS Bulletin No. 182: A Report on the Economic Geology of the Silverton Quadrangle, Colorado* (Washington, D.C.: U.S. Geological Survey, Government Printing Office, 1901) 19; *"The San Juan Mines"* EMJ (2/11/73); Sloan and Skowronski, 1975: 15.
[23] Nossaman, 1989: 93.
[24] Ibid: 94.

and approached William A. Pile, New Mexico governor, and Joshua S. Fuller, Santa Fe merchant, to offer them a deed to half of the Little Giant for a greater sum.[25]

In May 1871 French, Reese, Johnson, Mulholland, Blair, and Cook left Santa Fe to develop the Little Giant. They departed in secrecy and followed the Rio Grande River to its westerly headwaters. Certain that the party had not been followed, the six wealth-seekers pitched camp on the grassy floor of Cunningham Gulch, relocated the Mountaineer claim, and conducted additional prospecting. Afterward, the party made the short climb into Mason Gulch and immediately went to work.[26]

While French, Reese, and Cook began blasting ore from the vein, Blair and Mulholland most likely erected several cabins. Because the ore could not be economically shipped to one of the handful of mills in New Mexico or Colorado's Front Range, the party came prepared to build their own facility, based on the traditional Spanish arrastra. This simple apparatus consisted of a circular stone floor hemmed in by low sidewalls with a capstan at center and a beam that rotated around the capstan. A draft animal walked a track around the arrastra and pulled the beam, which dragged stones around the floor. As the stones ground the ore, an attendant added water and mercury, which amalgamated with the gold as it was freed.

The arrastra that Mulholland and Blair built, however, was more sophisticated to treat a larger tonnage of ore in less time. The Little Giant facility featured four drag beams linked to a side-shot waterwheel with a leather belt. The arrastra floor was relatively large at 15 feet in diameter, the sidewalls consisted of vertical planks, and the waterwheel was 18 feet in diameter. To take advantage of waterpower, Mulholland and Blair sited the arrastra on the floor of what came to be known as Arrastra Gulch. A dam and flume provided the water, which flowed through a ditch.[27]

When the apparatus was finished, the party gathered for the trial run and eagerly awaited the results. After the ore had been ground, they drained out standing water, shoveled off the sandy tailings, and grew excited over the dark gray amalgam lining the stone floor. They scraped the material into a leather bag, squeezed out the liquid mercury, and heated the pasty mass in a retort to drive off and condense the remaining mercury for reuse. When the retort's cover was cautiously removed, all marveled at the golden results of their year-long planning. They produced the first pure gold, or any metal for that matter, in the San Juans.

Isolation was ordinarily perceived as an impediment to mining, and yet, the French party treasured the fact that they had the Animas River drainage and its potential riches to themselves. Thus, they were pained when they saw another party of prospectors arrive in May, followed by two more in June. George Howard led the first party, and he too had direct experience with the San Juan Humbug. Howard spent the winter of 1871 in Elizabethtown, New Mexico, where he learned of the gold discoveries at what became Summitville. He assembled a party at Loma, on the Rio Grande River, and traveled into the mountains where they were turned back by snow. When the party reappeared in Loma, Howard learned of the French party's quiet escape and set

[25] Ibid: 94.
[26] Nossaman, 1989: 95, 97.
[27] Ibid: 102-3.

out after them only several days behind. Imitating French, the Howard party arrived in Cunningham Gulch, pitched camp, and prospected the area. Howard ascended the east flank of King Solomon Mountain, found a silver vein, and staked it as the Weminuche claim. Afterward, Howard joined the French group in Arrastra Gulch and staked several more claims.[28]

John Dunn brought the second party into Baker's Park. Disenchanted with the Dolores drainage and remembering French's excitement over Baker's Park, Dunn formed his group and came to the Animas drainage. The party consisted of George U. Ingersoll, David P. Quinn, Andrew Richardson, and Edwin Wilkinson. Ingersoll was born in Maine during 1847 and began life on the frontier as a reporter in the railroad town of Cheyenne in 1867. The following year, Ingersoll prospected south through Colorado and into New Mexico, and turned back north to Gilpin County, where he worked as a miner until 1871. There, he honed his knowledge of prospecting and mining gold. Rumors of strikes around the San Juans, particularly Summitville, drew him back south to Del Norte, where he joined Dunn's party.[29]

Like the two parties before him, Dunn and compatriots gravitated to the head of Cunningham Gulch, where they may have encountered French's Mountaineer claim. Nearby, they found another silver vein and claimed it as the Highland Mary. In Arrastra Gulch, the prospectors found a gold vein, named it the Sampson (which should not be confused with the Sampson Mine on Cement Creek), and began development. In imitation of the Little Giant operation, Dunn and partners built their own arrastra, probably relying on traditional animal power. Unlike the Little Giant arrastra, however, Dunn's facility was unsuccessful and became the first in a long series of mill failures that plagued the region for three decades.[30]

Ruben J. McNutt, Jim Pringle, George Rolbin, and Jack Munroe constituted the third prospecting party to arrive in the summer of 1871. McNutt had as much experience with the western frontier as anyone in Baker's Park. He was born on a farm in Albany, New York, in 1841, went west to California on the tail end of the Gold Rush in 1859 to find the placer fields mostly exhausted. To earn income, he worked as a miner at Placerville before joining the Fifth California Infantry in 1861 to participate in its Civil War march to New Mexico. After the war ended, McNutt remained on the plains as a scout amidst perennial conflict between settler and tribal interests before returning to New York. Unhappy, McNutt came to Colorado in 1870 and ended up at Loma, New Mexico, where he learned of the strikes in the San Juans.[31]

Pringle was another seasoned frontier prospector. He was born in Roxburghshire, Scotland, in 1838 and immigrated to the United States as a young man. Pringle spent a year in New York, followed by a brief sojourn in western Canada, and tried his luck in the California gold fields. When he arrived in 1857, Pringle found that organized companies dominated the available placer deposits, and, in need of income, shoveled gravel for one of those companies until he saved enough money to move on. Hoping to strike it rich at distant, inland placer strikes, he joined the rushes to Boise Basin and Montana in 1865. Still unsuccessful, he went to White

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28 Ibid: 98.
29 Henn, 1999: 14; Nossaman, 1993: 39, 100, 121.
30 Henn, 1999: 13-14; Nossaman, 1989: 100-101.
31 Nossaman, 1989: 102; *Portrait and Biographical Record of the State of Colorado* (Chicago: Chapman Publishing Co., 1899): 1026.

Pine, Nevada, during its 1869 silver rush then prospected his way south through Utah to Arizona. When Pringle assessed his situation, he realized that Colorado was the only place of mineralogical significance he had yet to visit, so he traversed the dangerous southwest to the San Luis Valley in 1871. Impressed with the region's potential, he made a semipermanent home in Cañon City and spent the warm months prospecting. On his way to Cañon City, however, Pringle joined McNutt and partners.[32]

During June, the three parties of prospectors acknowledged that there was enough activity, to justify the organization of a mining district. Because the French party was the first in Baker's Park, the rest of the prospectors gave them seniority in terms of administration and appointed Miles T. Johnson as recorder. On June 15, 1871, they congregated around Johnson's tent and created the Las Animas Mining District around the main portion of the Animas River drainage. Initially, the district included the peaks and tributaries flanking the Animas River from the Continental Divide on the east, over to the west end of Baker's Park. As noted above, this original geographic entity was divided into smaller mining districts during the following ten years. Ultimately, the cluster of peaks and basins bounded on the east by Cunningham Gulch, on the north by the Animas River, and on the south by Whitehead Peak constituted the district's core.[33]

With a mining district formally designated, an estimated forty to fifty prospectors kept Johnson busy recording claims. Thomas Blair was among the prospectors who submitted information and, curious about the Mammoth Lode, he ascended Arrastra Gulch's west rim and found a more robust, parallel formation. Blair claimed the vein as the Aspen, which sparked only minor interest at the time because gold commanded the attention. This would change. The Aspen, like the other veins recorded by Johnson, featured silver and industrial metals, and none offered gold like the Little Giant. However, that mine was the only truly productive operation in the San Juans during 1871.

When the working season came to a close, the prospectors made preparations to leave. They had demonstrated that the mountains abounded with mineral veins, and in an attempt to regulate claim activity, created the first mining district. The prospectors also established a camp in Arrastra Gulch, which would serve as a base of operations for years to come. Of greatest significance, the first profitable mine and mill were brought into production, proving that mining could be successful.[34]

1872 was also significant for mining in the San Juan Mountains due to three factors. First, prospectors realized that Baker's Park was vast and untapped, and therefore offered high potential. Thus, when the French, Dunn, and McNutt parties returned in the late spring, other groups followed and increased the total number of individuals up to around 150. Second, these new prospectors were interested in silver as well as gold. The net result was that the p prospectors spread out, found silver veins of considerable richness, and began actual development of them. Third, the overall increase in activity, proof of ore, and success of the

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32 *History of the Arkansas Valley* (Chicago: O.L. Baskin, 1881) 755; *Portrait and Biographical Record*, 1899: 1102.
33 Nossaman, 1989: 103.
34 Nossaman, 1989: 104. Dollar conversions are derived from consumer price indexes on eh.net.

Little Giant Mine began to draw the interest of alert investors. Because the San Juans were remote, though, another rush was long in coming.

During 1872, Arrastra Gulch, Cunningham Gulch, and the Animas River valley continued to host most of the activity. The French party enlarged the camp in Arrastra Gulch, other individuals built cabins in nearby drainages, and George Howard pioneered the mouth of Cunningham Gulch. With silver now of interest, individuals began developing the Mountain Boy, Green Mountain, and other veins on the east side of Cunningham Gulch. With the Sampson gold mine not producing, the Dunn party joined the search for silver, targeting veins near Howard's discovery on King Solomon Mountain. Dunn ascended Cunningham Gulch's precipitous west wall into a glaciated hanging valley. The basin was crowded on all sides by North Star Peak, another peak to the south, and a connecting arête, or knife-edged ridge, between. In what became known as Dives Basin, Dunn, Ingersoll, Richardson, Quinn, and several others established a camp and fanned out across the ragged bedrock walls. Within days, the party located the Shenandoah vein, traced it northwest across the valley, and staked the extension with a series of claims that included the Dives and Shenandoah No.3. Satisfied, Dunn and partners returned to Arrastra Gulch. In imitation, Miles Johnson made the ascent and staked his namesake claim on the peak, and Henry B. Adsit, John Goodwin, and members of the Dunn party located additional properties.[35]

Prospecting partners Theophile Benjovsky and Martin Van Buren Wason were among the new arrivals in 1872, and they joined the small rush up to North Star Peak. Benjovski was born in Poland in 1854. Possibly in response to the Moose silver discovery of 1871 and Fairplay's reputation for placer gold, he decided to try prospecting the Mosquito Mountains. Discouraged, Benjovski tried his fortune at Summitville. During 1871, Benjovsky staked and sold a few claims there and formed a partnership with Wason.[36]

Wason could match almost anyone in terms of mining and prospecting experience. Born in New Hampshire or Vermont in 1823, he became a sailor, traveling to Japan, China, and India. He weathered Cape Horn several times and joined the California Gold Rush, during which he learned the basics of prospecting, placer mining, and the dark side of the mining frontier. Wason also spent much time in Central and South America where he served as a captain on a pearl boat, ranched in Argentina, and mined gold in Central and South America. He returned to California in 1870, acquired a small herd of horses, and drove them east into Colorado. Impressed by the Rio Grande River valley and its proximity to markets, he established a ranch. When gold was discovered at Summitville, Wason joined the small rush in 1871 where he met Benjovsky. The partners staked several unsuccessful claims, but with whetted appetites, continued on the following year to North Star Peak.[37]

In Dives Basin, the partners enjoyed a streak of good fortune. They identified one of the best silver veins, claimed it as the North Star, then followed it northwest with the North Star

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[35] Nossaman, 1989: 124, 220.

[36] Allen Nossaman, *Many More Mountains: Volume 2: Ruts into Silverton* (Denver: Sundance Publications, 1993) 145-6.

[37] Nolie Mumey, *Creede: The History of a Colorado Silver Mining Town* (Denver: Artcraft Press, 1949) 81-2; Nossaman, 1989: 122; Nossaman, 1993: 99.

Extension claim. They also identified a spur south of the Shenandoah vein and staked the Spotted Pup claim. In so doing, Wason and Benjovsky had unwittingly laid claim to the best veins in Dives Basin.

Inevitably, reports of silver, word of the North Star excitement, and the success of the Little Giant Mine reached eastern investors who specialized in remote and unproven mining ventures. Emery Hamilton reasoned that, because the San Juans had just been opened, he could have his choice of prospects, but only if he personally spent time on the scene. Thus, in 1871, he left New York for Loma, New Mexico, a major departure point for prospectors. Because the Little Giant Mine was already a seemingly rich producer, it clearly offered great potential. When the French party came to town for supplies, Hamilton offered them immediate payment of $1,000 to each party member, the equivalent of $15,000 today, and another $4,500 to each by September 1, 1872.[38]

Hamilton's desire for a quick return, however, clouded his judgment, and he made a major financial error that proved costly. Instead of paying the outstanding debts to the French party, Hamilton used his capital to purchase a stamp mill. The plan was to replace the arrastra with the mechanized mill, process higher volumes of ore, and recover more gold in less time. Shipping the pieces from the East over the Santa Fe Trail and into the Rio Grande valley was relatively easy, but Hamilton was unable to secure a freighter willing to complete the last difficult leg to Arrastra Gulch. An entire working season passed, when Hamilton finally interested Martin Van Buren Wason in the project. While in Santa Fe, Wason learned of the mill, and since he was going back to his ranch on the upper Rio Grande, made a costly proposition to Hamilton to haul the pieces onward. Hamilton agreed, Wason purchased ten heavy wagons, and with Hamilton, freighted the first substantial cargo into the Animas drainage. Unfortunately for Hamilton, the trip consumed two months, placing him in the mining district at the end of September, too late for construction.[39]

Subsequently, Hamilton neglected to make the September payment to the French party, and they rightfully repossessed the Little Giant with other buyers waiting in the wings. In Hamilton's absence, French sold the mine to Samuel S. Wallihan, Sterling P. Rounds, and George W. Bishop of Wisconsin, and Dan Castillo of New Mexico. The four investors then organized the Little Giant Gold & Silver Mining Company, also known as the Chicago Company.[40]

Horrified, Hamilton attempted to pry his way into the new organization. When company officials arrived in Loma with supplies, he met with them and used the disassembled mill as a bargaining tool. Hamilton offered to trade the equipment for company stock and asserted that he would also pay Cook's share of the mine, which had not been transferred. After clashing with

[38] Nossaman, 1989: 109; Sloan and Skowronski, 1975: 15.
[39] Nossaman, 1989: 122; Nossaman, 1993: 99; Sloan and Skowronski, 1975: 15.
[40] Nossaman, 1989: 126; Ransome, 1901: 167; *"The San Juan Mines"* *EMJ* (2/11/73).

Wallihan, the rest of the owners consented and Hamilton was once again a force behind the Little Giant. Flush from the sale of the mine, the French party returned to the Las Animas district.[41]

The new owners of the Little Giant invested considerable capital to make their mine as well-equipped as any other of similar size in Colorado. The company appointed Mulholland as superintendent. In July 1873 he had a crew assemble the mill machinery on the valley floor. A Dodge crusher pulverized crude ore into small cobbles, a battery of stamps reduced the material to sand and gravel, and a ball mill pulverized the lot into slurry. With increased surface area, the particles flowed over amalgamating tables coated with mercury to leach out the gold. As was the case with the earlier arrastra, workers recovered the amalgam and drove off the mercury in a retort. The mine and mill were separated by around 500 vertical feet, which presented the logistical problem of transporting the ore efficiently. Ordinarily, burros would have packed the material down in canvas sacks, but the company instead built a single-rope reversible tramway. A bucket on a pulley rode a fixed-track cable spanning between the mine and station, where a worker winched the bucket up and lowered it down via a brake. Compared with the tramways built three decades later, the Little Giant system was simple and limited, but it was the earliest in western Colorado.[42]

Despite progress at the Little Giant, localized excitement over silver discoveries, and some claim development, there was little actual production in the San Juans. The vast distance to nodes of commerce and communication and the lack of treatment facilities rendered all but the richest ore uneconomical to produce. In addition, politics between the U.S. government and the Ute Indians, who depended on the natural resources of the region, exacerbated the isolation and threatened the fledgling mining industry.

Simply put, the prospectors were squeezed between the Utes, who did not want them in the San Juans, and the U.S. government, which recently outlawed activity there. During the 1860s, the Utes learned to mistrust newcomers due to interactions of intolerance and violence, and several times attempted to regain portions of their traditional territory. Aware that settlement and mining were inevitable in the territory, the government and the Utes agreed to the Hunt Treaty in 1868. Accordingly, the Utes would relinquish the central portion of the territory and remove to the west and southwest; in exchange, the government outlawed permanent settlement there. However, officials perceived the Utes as a single entity when, in fact, they belonged to at least seven bands. Secondly, for the sake of political convenience, the government recognized Ouray as spokesman for all Utes, when he actually held limited power. Lastly, the government ignored the fact that the lust for gold and silver overpowered respect for the law.[43]

As a result, settlement in the San Juans followed the problematic pattern wherein non-native settlers usurped native American lands. Prospectors infiltrated the mountains, the Utes responded, settlers felt threatened, and tensions rose. In hopes of preventing violence, the government passed an order during the spring of 1873 outlawing prospecting in the San Juans. Because unenforceable and against popular sentiment, the government attempted again to treat

[41] Nossaman, 1989: 127.
[42] Nossaman, 1989: 134; Nossaman, 1998: 311; Ransome, 1901: 19; *Rocky Mountain News* (7/20/73):4; Sloan and Skowronski, 1975: 15.
[43] Brown, 1984: 23; Nossaman, 1989: 79; E.F. Tucker, *Otto Mears and the San Juans* (Montrose: Western Reflections, 2003): 51.

with the Utes. With Otto Mears as mediator, the government met with Ouray and devised the Brunot Treaty in 1873. Mears and Ouray both understood that settlers would inevitably come, and that the Utes must leverage some agreement at least favorable to tribal interests. The Utes ultimately ceded the San Juans in exchange for annual interest on a $500,000 trust and a promise that the lands surrounding the peaks would remain theirs.[44]

The treaty revolutionized mining in the San Juans because they were now unquestioningly open. With the prospect of violence mitigated, prospectors were free to wander the San Juans, and businessmen and merchants felt that permanent lines of trade could be established with the growing, if still seasonal, population. Political stability instilled confidence among investors. Under these circumstances, the central San Juans saw more prospecting and, finally, ore production in addition to the Little Giant. Extreme isolation and difficult conditions were now the principal impediments to the blossoming of a mining industry.

In 1873, Arrastra and Cunningham gulches were still the hub of activity, largely because they had been proven to offer ore. What the Little Giant Mine featured in actual production, adjacent properties had in promotion. The Little Giant Extension, just developed but as yet unproven, was one example, for which capitalists offered an astounding $450,000 (around $7 million today). Prospectors continued to make rich discoveries in the gulches. When Thomas Blair developed silver ore at his Aspen Lode, prospectors hastened up to the ridge west of Arrastra Gulch and searched for similar veins. Robert McGregor found a parallel chute in what was becoming a complex series of narrow ore bodies and named the claim after himself. Several days later, Thomas P. Higgins and Z.H. Lawman, both of whom arrived in 1873, staked the nearby Susquehanna and began a tunnel downslope and east.[45]

As most of the prospectors who arrived in 1873 congregated around Arrastra and Cunningham gulches, some pioneer individuals turned their attention to other drainages where competition was lesser. Reuben J. McNutt and George Howard trekked into the high peaks on the north side of the Animas River, which were relatively unexplored. During the summer, they made several discoveries, which confirmed their suspicions that the peaks on the north side of the river held as much promise as those on the south side. At what became Lake Emma, at the head of Eureka Gulch, they found a particularly rich gold and silver vein and claimed it as the Sunnyside. The partners then crossed north over barren ridges and found another silver formation they named the Poughkeepsie. Aware that other prospectors would begin searching the area, McNutt and Howard organized the Eureka Mining District so their claims would be officially recognized. At the time, the Eureka district took in nearly the entire region on the north side of the Animas.[46]

Even though the northern peaks were largely unexplored in 1873, McNutt and Howard were not completely alone. Albert Burrows and Charles H. McIntyre established a camp in open

[44] Brown, 1984: 23; Nossaman, 1989: 144-145; Tucker, 2003: 51, 55.
[45] Nossaman, 1989: 179; *"The San Juan Mines"* EMJ 10/28/73.
[46] Nossaman, 1989: 139; Nossaman, 1993: 206; *"The San Juan Mines"* EMJ 12/2/73; Laurel Michele Wickersheim and Rawlene LeBaron, Mine Owners and Mines of the Colorado Gold Rush (Westminster, MD: Heritage Books, 2005) : 418, 429.

country at the headwaters of the Animas River. En route to the San Juans in 1872 or 1873, Burrow met McIntyre, who came from the Dakotas. With a party in tow, the partners followed Baker's old route up the Lake Fork of the Gunnison River and began their search in what became known as Burrows Park. The party then crossed west over the Continental Divide and were immediately impressed by the plentitude of mineralized veins at the headwaters of the Animas. Wasting no time, the party claimed a number of veins, including the Big Giant, Bill Young, Bonanza, Boston, Burrows, and Red Cloud. Exactly where the camp was located is uncertain, but it lay proximal to the Mineral Creek in the county's northeast reaches.[47]

While Burrows, McIntyre, McNutt, and other prospectors wandered the peaks, entrepreneurs familiar with the needs of mining prepared to profit from the region. Henry F. Tower and Wesley A. Stevens understood that every mining industry required lumber, so they established the first sawmill in the Animas drainage at Mineral Creek ascending north from Silverton. Their lumber was consumed almost as quickly as they could mill it.[48]

Reese, Blair, and William Kearnes claimed large tracts of land for ranching or platting a townsite. Adnah French was conspicuously absent from the group's plans. A true prospector, French realized a dream with the discovery of the Little Giant. Flush from its sale, French spent his money on luxurious living and died of alcohol poisoning during the summer. Reese filed an eighty acre homestead claim on the broad, open floor of Baker's Park, where a settlement was most likely to grow. Blair and Kearnes filed adjoining 160 acre homestead claims.[49]

Just as the Animas River drainage gained momentum in its transition from prospecting to mining, snow brought the working season of 1873 to an end. The year saw key elements for future growth. Mears and the U.S. government successfully negotiated the San Juans away from the Utes and formally opened the mountains for development. The resultant security encouraged a wave of prospecting, bold investment in minor claim development, and machinery for ore and lumber. By setting up their sawmill, Tower and Stevens began providing one of the most important commodities needed for the growth of industry. In addition, these lumbermen, and Martin Van Buren Wason, hauled in the first machinery and, in so doing, set a precedent. Mining would come to depend on machinery. The last significant factor was the actual production of silver ore from the Aspen and other claims, and gold bullion from the Little Giant. When these materials arrived in Del Norte and other commercial centers, they contributed to an ever growing interest in the San Juans.

In the spring of 1874, entrepreneurs put in place the final pieces necessary for a mining industry to blossom. Approaching the season with foresight, Donald Brown, aware of a nascent townsite in Baker's Park, recognized that the region's population was too small to support two competing locations. In an attempt to get ahead of Reese, Brown risked winter storms to cross over the range from Del Norte and locate the townsite claim of Bullion City at the mouth of Cunningham Gulch. Brown, Horton D. Chase, Theodore F. Braun, and others formed a townsite

[47] Brown, 1984: 96; Henn, 1999: 45; Nossaman, 1993: 176.
[48] Nossaman, 1989: 147.
[49] Nossaman, 1989:127, 152; Nossaman, 1993: 11.

company and filed the necessary papers. The location was well-chosen, because it offered water, open land, building materials, and lay at one of the most important crossroads in the entire drainage. The trail up Cunningham Gulch and over Stony Pass was the principal artery to points east, and another trail that ascended the Animas River to Cinnamon Pass was the second gateway. A third trail descended southwest into Baker's Park. Given such a strategic location, Bullion City was poised to receive most of the traffic flowing into the deep San Juans.[50]

Meanwhile, after planning a townsite with Blair and Kearnes, Reese spent the winter in Chicago and Cedar Rapids, promoting the mineral wealth of the San Juans and soliciting investment. Reese found a ready audience in George Greene, one of the founders of Cedar Rapids, a justice on the Iowa Supreme Court, and president of the Union Bank of Cedar Rapids. Reese boosted the handful of nascent mines and dozen proven ore bodies under development. Greene, who previously published a mining periodical, was experienced enough to see through fraudulent promotion. He nevertheless gathered from Reese that even though the region was not yet thoroughly explored, it was already an outstanding opportunity. Further, Greene understood that real profit could be made by treating the ore that others produced instead of investing in specific mines, and so he committed to financing a smelter. Reese returned to Colorado victorious with a key element for the mining district and a major anchor business for his townsite.[51]

When the working season of 1874 opened, Cunningham and Arrastra gulches remained the centers of activity. Some of the known veins now yielded ore, others were being developed, and prospectors found yet more. In Cunningham Gulch, Reese, Blair, and Mulholland prospected the high, barren, east side and found a startlingly rich silver vein that they staked as the Green Mountain. Over the course of several months, they drove a tunnel and produced enough ore to render the operation one of the region's most important. Dunn, Quinn, and Richardson returned to their Highland Mary claim on the west side of the gulch's head to conduct development work. King Solomon Mountain, between Cunningham and Arrastra gulches, also drew interest. W.S. Stratton was among those at work on the Cunningham side, where he staked the Silver Cross and Black Crook claims. Later in the 1890s, Stratton discovered the Independence Lode near Cripple Creek, and realized millions of dollars.[52]

In Arrastra Gulch, Blair, Ingersoll, and Higgins were at work on the Aspen ore system, and the Little Giant continued production. With the obvious veins now claimed, the prospectors who arrived in 1874 invested in searching inaccessible areas. Gregory and Brower picked their way along the gulch's shear, west wall, where, nearly opposite the Little Giant Mine, they found a clearly exposed vein. One of them claimed it as the Gray Eagle. But because the vein cropped out high on the cliff face, the prospectors had to scale the wall to determine the vein's orientation, measure the claim boundaries, and place corner monuments, all on uncertain footing. Gregory and Brower began production and shipped 1,200 pounds of high-grade ore to New York

[50] Nossaman, 1989:162.
[51] Nossaman, 1989:184, 207; Nossaman, 1993:20, 161.
[52] Nossaman, 1989:106, 169, 178, 261.

for processing. Meanwhile, the Black Hawk smelter in Gilpin County could have treated the material at a much lesser cost.[53]

In addition to hosting the region's first ore production, Arrastra Gulch also was the scene of the region's first serious conflict. After Emery Hamilton used his mill to win a prominent position in the Little Giant, Samuel Wallihan continued to protest Hamilton's involvement but found it difficult to dislodge the wily investor because the mill was now an important part of the operation. To maintain control, Wallihan and Bishop hired Gassy Thompson and crew to work through the winter, hold the property, and turn it over when Wallihan and Bishop arrived in the spring. When Hamilton learned that Wallihan and Bishop were to take physical possession of the property, he resorted to trickery. In Del Norte, Hamilton paid for four gunmen to seize and occupy the mine in advance of Wallihan and Bishop. They hastily made their way into Arrastra Gulch, met Thompson and claimed ownership without raising his suspicions. Leaving the gunmen at the mine, Hamilton accompanied Thompson to Del Norte to meet Wallihan and Bishop. Hamilton then filed claim amendments on the argument that the property had to be relocated when the Brunot Treaty conveyed the San Juans over to the Territorial government in 1873.[54]

Wallihan and Bishop arrived in Del Norte in June to meet Thompson and take possession of the mine, when Thompson innocently informed them of Hamilton's actions. The trio quickly figured out Hamilton's deceit and rushed to the Las Animas district to reclaim their operation, leaving Hamilton behind in Del Norte. Hamilton hit the trail to beat them to the Little Giant. Hamilton overtook the party and tried sneaking around but was noticed. Thompson responded by pursuing Hamilton, and they raced until Hamilton's horse proved to be have better endurance. Hamilton barricaded himself in the tunnel and ordered his gunmen to form a shield. Thompson in turn appealed to Miles Johnson, who called the miners' court into special session because claim jumping was a grave offense in any mining district. William Kearnes and Alexander Wilson armed themselves for battle and crept into the mine and confronted Hamilton. More armed miners arrived and the party threatened Hamilton with public hanging. Ultimately, they banished him from the region without reimbursement. Hamilton later continued to attempt to wrest control of the Little Giant through a series of lawsuits in distant courts.[55]

Meanwhile, the Little Giant failed by the end of 1874. During the summer, miners encountered an end to one portion of the gold-bearing vein after another, and the company operated the mill fitfully until the payrock was gone. Wallihan let a contract to have miners drive exploratory workings in search of an extension of the vein, but when profits evaporated and legal fees mounted, Wallihan suspended operations. Wallihan closed the mill and Arrastra Gulch quieted.[56]

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[53] Nossaman, 1989: 178.
[54] Nossaman, 1989: 173-5.
[55] Ibid: 173-175.
[56] Nossaman, 1989: 175-6, 214; Ransome, 1901: 19; *Rocky Mountain News* (8/26/74): 4; Sloan and Skowronski, 1975: 15.

In 1874, outside of the Animas River drainage, the geographically expansive Eureka district boasted the most activity. The district featured the subsequently named mountains including, north to south, California, Treasure, Hanson, and Eureka, the peaks of which were the focus of considerable prospecting. The mountains were neatly framed by a circular arrangement of drainages, such as California around the north half, Eureka at the southwest edge, and the Animas River on the east side. Placer Gulch, which offered limited amounts of placer gold, descended northeast through the peaks.

The Sunnyside Vein, discovered the previous year by McNutt and Howard, drew the most interest, and prospectors traced it from what was later named Lake Emma, at the head of Eureka Gulch, at least one mile northeast into Placer Gulch. In advance of the other prospectors, McNutt and Howard had all of 1873 to examine the bold formation and claim what they thought was the best section, which crossed Hanson Peak and over to Placer Gulch. McNutt paid Howard for his share of the Sunnyside property and began shallow development in 1874. On the other side of Hanson Peak, prospectors staked additional segments of the vein, such as the Sunnyside Extension. Elsewhere, prospectors began work opening the Crispin, Niagara, Silver Wing, and Tom Moore.[57]

Because Eureka and California gulches were the two gateways into the cluster of peaks, prospectors established camps at the mouths of both drainages. McNutt's log cabin, built in 1873, became a magnet for prospectors at Eureka Gulch. Local speculators predicted that because of the strategic location, the camp would probably evolve into a formal settlement. They quickly organized the Eureka Townsite Company and platted a townsite of the same name. The founders lacked in promotion, however, and did little to secure businesses and residents. They, like the rest of the camp's residents, were busy prospecting.[58]

Albert Burrows was largely responsible for the Eureka district's second camp at the mouth of California Gulch. After the working season of 1873, Burrows remained fixated on the veins at the watershed between the Animas River, which flowed south, and Mineral Creek, which trickled northwest. In 1874, he led a party that included Henry E. Wood and E. Bradford Greenleaf back into the area, and pitched camp a short distance south. As with McNutt's cabin at Eureka Gulch, prospectors began to congregate around the camp, enlarging the settlement. The name of Animas Forks derived because the river began at the confluence of the three drainages there.[59] Burrows apparently maintained a second camp at the watershed, northwest of Houghton Mountain. The reason for the dual residence was that he, Charles McIntyre, and partners also developed the Red Cloud and other claims. Their camp was on the edge of a marshy meadow at treeline, and it was most likely Burrows' party that named the camp after the explorer.

With the Las Animas district busy and competition increasing in the Eureka district, frontiersmen went farther afield to unexplored territory in the northwestern river drainage. At least one group picked their way up Cement Creek, found many exposed mineral formations, and

[57] John Marshall and Zeke Zanoni, ***Mining the Hard Rock in the Silverton San Juans*** (Silverton: Simpler Way Book Co., 1996) 119; Wolle, 1995: 405.
[58] Brown, 1984: 87; Nossaman, 1993: 203.
[59] Nossaman, 1993: 184.

established a camp. Within several months around twenty individuals joined them, and the camp grew into a noteworthy collection of crude cabins and wall tents. Several prospectors developed the Porcupine and Gopher claims and actually began producing ore. Farther west, more wealth-seekers examined Mineral Creek, and on Sultan Mountain someone discovered the Hercules, which held great promise.[60]

Even though a number of veins throughout the river drainage were in development during 1874, the work qualified more as prospecting than mining. The operations were shallow, simple, and yielded only small tonnages of ore due to a lack of capital and efficient transportation. Despite the slow start to mining, Reese and the Greenes were confident enough to continue with their smelter idea. During the spring, Greene organized Greene & Company, gathered the components for a smelter and sawmill, and hired John J. Epley and Thomas E. Bowman to accompany them to Reese's new townsite. Epley was an expert with heavy machinery and Bowman was a formally educated metallurgist and assayer.[61]

Greene's son Edward arrived in advance of Epley and made preparations to break ground for the smelter where Cement Creek emptied into the Animas River. Part of the preparations involved establishing a supply business for the smelter and crew, which Edward did as Greene, Eberhart & Company. Seeing an opportunity to profit from retail to local individuals as well as from smelting, the Greenes opened a public mercantile, which was gladly welcomed as the first in lower Baker's Park.

Other entrepreneurs simultaneously saw the opportunity presented by the growing mining industry in the Animas River drainage. Two other parties constructed smelters during the summer of 1874 to compete with the Greenes. Christian Schoellkopf, Ashley Cooper, and Henry Remington constructed the Little Pioneer Furnace and the Little Dutch Smelter on flat ground just west of Arrastra Gulch's mouth. The facility was primitive and relied on an arrastra made of brick to crush silver ore, and a furnace to roast then melt the material. Schoellkopf, an ethnic German, likely based the furnace on designs he worked on in Swansea, Wales, smelting capital of the world. The choice of an arrastra for crushing was unusual since the Little Giant mill exemplified superior machinery requiring less manual labor. It therefore seems likely that a lack of capital was the reason for Schoellkopf's choice of a labor-intensive arrastra. Calder, Rouse & Company built the second facility, the Rough & Ready Smelter, on Cement Creek near the Greene operation.[62]

When the three smelters of various sizes were finished, the river drainage finally saw the last crucial component needed to bring the nascent mining industry to fruition. The Greene Smelter was perceived as the best facility and used ore from the Gray Eagle Mine for its trial run. After the furnace had been heated and charged with ore, a crowd gathered to see the silver matte, an unrefined blend of silver and industrial metals, pour out of the ports. They were not

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[60] Nossaman, 1993: 169; Wickersheim and LeBarron, 2005: 397.

[61] Brown, 1984: 29; *"Mining News"* *EMJ* (8/14/80): 111; Nossaman, 1993: 15; Nossaman, 1989: 210; Sloan & Skowronski, 1975: 19, 46; Duane A. Smith, *Song of the Hammer and Drill: The Colorado San Juans, 1860-1914* (Golden, CO: Colorado School of Mines, 1982) 26.

[62] Nossaman, 1989: 211, 213.

disappointed, initially. But when Brown, Epley, and Edward Greene compared the results with the amount of metals that the ore was supposed to contain, they were embarrassed to find that the smelter recovered only a fraction. Schoellkopf and the Rough & Ready Smelter had similar disappointing experiences. Word quickly circulated that the smelters were failures. Disappointment pervaded, the backers of the smelters lost precious capital, and confidence in the region faltered. Greene & Company, however, refused to concede defeat and applied their capital and metallurgical expertise to identify a process that would work. One important factor was ultimately that the region's ore was more complex and resistant to treatment than first suspected.

Meanwhile, Reese continued to formalize and promote his townsite. Reese, Blair, and Kearnes interested William Mulholland, Francis M. Snowden, Nathaniel E. Slaymaker, and William Munroe in the venture, and organized the Silverton Townsite Company. Reese acted as president and Munroe, a surveyor, arranged the lots and streets on paper. Slaymaker, a lawyer who came to prospect, reverted to his former profession and administered the legal aspects. On slightly different dates, Blair, Snowden, and Slaymaker built the first three cabins in Silverton to anchor development. Greene & Company erected buildings, followed by prospectors who constructed a few more cabins. By summer, Silverton featured at least twelve residences and the Greene mercantile, while the smelter stood on the north fringe.[63]

While Silverton grew slowly and its role as a milling center was tentative due to the smelter failures, Bullion City saw nothing less than a boom. Donald Brown was correct in his faith that the mouth of Cunningham Gulch was an excellent location, and Bullion City quickly became the region's principal hub. During the spring, speculators and businessmen rushed to the townsite and claimed the best lots, while prospectors took up residence on the outskirts. The north side of Cunningham Creek offered the best land, and a small business district materialized there. John C. Sullivan and James N. Galloway opened the first blacksmith shop, Thomas Trippe established a surveying office, William Nichols formed an assaying business, and F.B. Hackett organized a law practice. All these men were experienced and provided the services necessary for the successful evolution of a mining industry. Trippe was born in Brooklyn in 1848, earned a degree in engineering and surveying, worked as a surveyor for a railroad, and came to Colorado in 1872. Nichols was an early arrival in Colorado, ran an assaying business in Clear Creek County, and closed shop to come to the Las Animas district. Due to his skill, he was later appointed Territorial Assayer for the San Juan region.[64]

Other entrepreneurs established businesses catering to the prospectors and miners. John and Amanda Cotton, the first woman to permanently reside in the river drainage, opened a mercantile-cum-restaurant. George Howard first sold liquor, followed by the formal saloons of George L. Wright and John Burrow. During the summer, additional businesses including another mercantile, boot maker, and bakery opened. Located at the crossroads of important transportation arteries, Bullion City attracted a livery and the first cattle herd as stock for a butcher.[65]

[63] Nossaman, 1989: 187.
[64] Nossaman, 1989: 160, 170-2; Nossaman, 1993: 214-5.
[65] Henn, 1999: 146; Nossaman, 1989: 171, 177, 185; Nossaman, 1993: 279; Sloan and Skowronski, 1975: 19; Wolle, 1991: 401.

As the business district began to take form, residents built cabins on surrounding lots and in a cluster near George Howard's establishment on the south side of Cunningham Creek. Based on this association, residents named their suburb Howards. During 1874, residents petitioned for a post office, which the Postal Service granted as Howardsville. The post office, the first in the drainage, furthered Howardsville's role as a commercial center.[66] To complete Howardsville's supremacy over Silverton, after the Brunot Treaty was signed, the Territorial Government realized that the considerable new tract of land would be prospected and homesteaded in time. Forecasting the demand for government administration, the Territorial Legislature divided the southwest quarter of Colorado into La Plata, Rio Grande, and Hinsdale counties in 1874. La Plata County encompassed the Animas River drainage with Hinsdale as its eastern neighbor. When the legislature surveyed for the best seat, they identified the largest, most promising town, Howardsville. George Howard offered his small cabin for the administrative building, and a second log cabin was rented as the court house. Howardsville's status as county seat was not to last, however, Reese and partners petitioned the Territorial Legislature and managed to have the seat transferred. The victory was important to Silverton, but the failed milling center still paled in comparison to Howardsville.[67]

Settlement and Establishment of Industry, 1875 – 1881

At the beginning of 1875, the San Juan Mountains possessed the ingredients necessary for a tangible rush, despite the smelter failures. Prospectors had proven rich silver ore and regularly made new strikes, the limitless mountains offered plenty of unexplored territory, the Animas River drainage featured several towns, and residents could live on site year round. The only key element missing was outside investment, and developments elsewhere in Colorado siphoned off the attention of capitalists willing to risk money in the frontier. In 1873, Richard C. Irwin, William J. Robinson, and James Pringle proved rich silver in the Wet Mountain Valley, southwest of Canon City. Their discovery incited the Rosita rush of 1874, one of Colorado's most important silver excitements of the mid-1870s. Concurrently, miners at Gold Hill in Boulder County realized that a dark material previously discarded as waste rock was actually telluride gold. Boulder thus saw its most intense period of prospecting since the initial gold rush of 1859. The development of the Moose, Dolly Varden, and other silver mines in the Mosquito Mountains stimulated a wave of prospecting and mining west of Fairplay. Montezuma in Summit County experienced a similar trend. Mining in Nevada also drew considerable share of investor attention. Remote, new, and unproven, the Las Animas district could not compete with these rushes. As a result, the mining industry grew slowly during the mid-1870s and may have even become static were it not for several important advancements in 1875.[68]

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[66] William H. Bauer, James L. Ozment, and John H. Willard, *Colorado Post Offices: 1859-1989* (Golden: The Colorado Railroad Museum, 1990) 74; Henn, 1999: 70; Nossaman, 1989: 184; Sloan and Skowronski, 1975: 19.

[67] Henn, 1999: 145; Nossaman, 1989: 158, 172; Nossaman, 1993: 214, 279; *Rocky Mountain News* (2/19/74): 4; Sloan and Skowronski, 1975: 17, 19; Wilbur Fisk Stone, *History of Colorado* Vol. 1 (Chicago: S.J. Clarke Publishing Co., 1918) 198.

[68] Weston, W. *"The San Juan Mines"* *Engineering & Mining Journal* (3/2/78):150-151.

The Greenes were behind the first fundamental development, which began when John A. Porter arrived at Silverton in 1875. Porter was born into privilege in Berlin, Connecticut, in 1850. Intent on a career in mining, Porter attended the Columbia School of Mines before studying metallurgy at the Royal Academy of Mines in Germany. Porter returned to the United States in 1872 and went to Eureka, Nevada, where he gained practical frontier experience as an assayer for the Richmond Consolidated Mining & Smelting Company. After several years, Porter moved on to Cherry Creek, Nevada, and served as assayer and assistant metallurgist, before establishing a consultancy. At the behest of investors, Porter traveled southeast through the Great Basin into the San Juans to report on the region's potential. Porter approached the San Juans from the south and ascended along the Florida River, through sedimentary geology rich with coal beds. As a mining expert and metallurgist, Porter took an interest in the coal, a resource always in demand, and noted the location for future reference.[69]

Edward Greene and John L. Pennington, business manager for Greene & Company, saw in Porter the expert who could solve the smelter's problems. Within a short time, Greene & Company secured Porter as chief metallurgist. Porter may have also sensed that Silverton was the gateway to a lucrative trove for capitalists.[70] Porter refitted the smelter. Repeating the sequence of events that preceded the 1874 failure, the furnace was blown in, charged with ore, and company officials impatiently waited to see what came out of the spouts. Not only was the material liquid metal, but also in the proportions necessary for the smelter to be an economic success. Due to Porter's acumen, the Greene Smelter was now open for business, which electrified the Animas drainage. The Rough & Ready Smelter showed promise anew as well. The owners came to an agreement, rallied, and fired up the facility. After the furnace generated a ton of matte, however, they resumed fighting and suspended operations, leaving Greene & Company with a monopoly. Even though the Greene Smelter was the only regional ore treatment facility, the company wisely secured contracts with mines for ore and even went so far as to lease the Aspen from Blair and partners, who were glad for the effortless income from royalty payments.[71]

The Greenes could not have expected their monopoly to last long. While Porter worked, the Crooke brothers engaged in similar activities in the Summitville Mining District, located southeast over the range. The Crookes were highly experienced, and Jonathan in particular was a New York City smelting and mining financier with a twenty-five-year year record. Instead of entering direct competition with the Greenes, the Crookes hastily built a smelter in the Lake City area to capture trade there. The mines of the Lake Fork drainage, however, were part of what the Crookes hoped would be a larger empire to include the Animas River drainage.[72]

Before the Crookes even completed their smelter, they aggressively solicited contracts for ore throughout the San Juans, initiating a trade war with the Greenes. To ensure reliable sources of ore, both companies either leased or purchased mines outright during 1876. The Greenes

[69] Henn, 1999: 134; Nossaman, 1989: 270; *"Prominent Men in the Mining Industry"* *EMJ* (9/26/91): 213; Sloan & Skowronski, 1975: 46; Duane Smith, *Rocky Mountain Boom Town: A History of Durango, Colorado* (Niwot, CO: University Press of Colorado, 1992 [1980]) 9.
[70] Nossaman, 1989: 268; Sloan and Skowronski, 1975: 46.
[71] *"Mining Notes from Colorado, Missouri, Montana, Nevada, and Northern Carolina"* *EMJ* (7/29/76): 77; Nossaman, 1989: 267-8, 271; Nossaman, 1993: 153; Sloan and Skowronski, 1975: 19.
[72] Nossaman, 1993: 144; Smith, 2002: 5.

claimed Hazelton Mountain as their territory, leased the Aspen Mine, and invested $11,000 in properties elsewhere in the Animas drainage. In their home territory of Hinsdale County, the Crookes purchased the Ute and Ulay mines, and in the Animas drainage bought the Royal Tiger claim and an interest in the North Star Mine.[73]

The demand for ore and the superior returns provided by the two smelters finally fostered a long-awaited wave of intense mining, property transactions, claim development, and additional prospecting. Because the Las Animas district hosted more prospecting to date and featured the highest number of mines, however simple, it naturally led the way in ore production. Greene & Company did well with the Aspen, and independent parties drove tunnels from several directions to develop different sections of this ore system. Several prospectors pushed the Legal Tender Tunnel from a point downslope and north, and, striking the vein in 1876, found Greene & Company petitioning them for a lease. Higgins and Ingersoll continued to advance their Susquehanna Tunnel from Arrastra Gulch. In 1877, after penetrating 515 feet of rock, miners struck the ore formation, which featured a bonanza of silver; they named the vein the Victor. Higgins and Ingersoll renamed the operation the Ingersoll Tunnel and enjoyed significant profits. Nearby, James L. Briggs attempted to imitate the success with his Briggs Tunnel, which progressed slowly. The Gray Eagle, around the corner in Arrastra Gulch, produced and shipped to the Greene Smelter.[74]

Prospectors in the Animas district tried to profit from the smelting war by hitting the trail in search of new ore formations. A fortunate few found silver veins in areas that had been examined at least once already. In 1875 Howardsville assayer William Nichols prospected the north face of King Solomon Mountain a short distance above town, found a small system of veins, and claimed the apex as the Little Nation.[75]

Most prospectors, however, sought new ground in the district's remote reaches, where few others had yet been. Théophile Ressouches and Alfred Py chose Little Giant Basin, which was a glaciated, hanging valley on the east side of Arrastra Gulch. Ressouches and brother Louis were born in France and came to Denver in 1866. Laurent found employment as a premier gardener, but Théophile and Louis left for the San Juans when they were able and of age. The brothers arrived in the Animas drainage with little money and worked as miners until they saved enough to prospect. Théophile met Py, and the partners ascended into Little Giant Basin and made camp on the valley floor. In 1875, they examined King Solomon Mountain on the valley's east side, found a vein with a rich showing of silver, and claimed it as the Jura. But before the partners could develop the formation at depth, dwindling finances forced them back to work. The following year, they returned with Louis, staked the adjoining King Solomon, repeated the pattern in 1877 with the Mountain Queen (not to be confused with the Mountain Queen in California Gulch). When other prospectors learned of the discovery, they joined the Ressouches brothers, picked over the opposite side of the valley, and found a vein so large they named it the Big Giant.

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[73] Henn, 1999: 6; Nossaman, 1989: 313; Pangborn, 1878: 52.
[74] *"Mining News"* *EMJ* (5/12/77): 319; Nossaman, 1989: 313, 271; Nossaman, 1993: 118.
[75] Nossaman, 1993: 215.

At the same time that Ressouches and Py examined King Solomon Mountain, several independent prospectors made the dangerous ascent into the upper reaches of Arrastra Basin, a short distance south. During the first several years in the Animas district, prospectors on the floor of Arrastra Gulch undoubtedly gazed up and south at the imposing headwall and wondered what lay beyond. The wall was locked in ice and snow for all but several months of the year, which discouraged ascent. John Reed was the first prospector documented to satisfy his curiosity, and in 1876, he scouted a route up the headwall.

What he found was another hanging valley carved by glaciers from between Kendall Peak and Round Mountain to the west, and North Star and other peaks to the east. Their flanks, with 1,000 feet of relief, were as sheer and rugged as those in Dives Basin, which was the next valley to the east, and the peaks presented a lacework of veins and dykes that would have excited any prospector. At the valley's center lay a pristine glacial lake, and its outflow cascaded northward until it roared over the headwall into Arrastra Gulch. Examining the flank of Round Mountain on the valley's west side, Reed quickly found more than one vein that carried silver and industrial metals. He claimed two on Round Mountain as the Whale and the Round Mountain, and located the Silver Lake near the lake. Around the same time, another prospector working at the valley's head identified a huge fault and traced it southeast, where it featured a vein he claimed as the Buckeye. During the summer, both men excavated shallow workings to prove ore and retain title to the claims, then left for the season. When the prospectors returned the following year, Silver Lake Basin, as the valley came to be known, saw its first production, which was shipped by burro to the Greene Smelter. To the Greenes, the volume of ore was insignificant because the arduous and dangerous approach discouraged Reed and the other prospectors from packing much out and importing anything but the most essential materials, which limited production.[76]

In the Eureka district, the success of the Greene and Crooke smelters stimulated a wave of activity in 1875 and 1876. A greater number of wealth-seekers than ever climbed through the peaks and valleys in the district's center. Eureka and California gulches, and the peaks between, were thoroughly examined and most of the principal veins claimed. Prospectors also began to seriously explore the district's southern portion, including Minnie and Maggie gulches, soon realizing that the area was not as mineralized as the north side of the Animas River.

Even though rich ore had been proven in veins scattered throughout the district, there was little production because lack of capital retarded development. This began to change when handfuls of adventurous investors took an interest in the most promising properties, and tepidly fronted limited funds. Milton M. Engleman was one such individual, coming to the Animas River drainage in 1876 on the assumption that the region was on the brink of a boom. Engleman was born in 1842 in Carrolton, Illinois, and became involved in a men's clothing business in his hometown. Within a short time, Engleman was a partner, and through the business met Emma Thompson, who operated a millinery shop. Engleman and Emma married but enjoyed their life in Carrolton for only a short time before a change in the business partnership forced Milton to

[76] Nossaman, 1993: 35, 118; Ransome, 1901: 149.

examine other regions, and he targeted Colorado as a potentially lucrative market. An exploratory trip in 1872 confirmed his hopes, and Engleman established a clothing outlet in Canon City. When Engleman arrived in the Animas River drainage, he settled in Eureka and sent for Emma, and they brought with them dearly needed capital.[77]

The Englemans bought a share in the Eureka Townsite Company to open a mercantile and also acquired mining property. In particular, Engleman bought a half interest in the Sunnyside from Ruben McNutt, and Emma purchased interests in George Washington and Poughkeepsie No.2. Afterward, they had little left over for development of the claims, but managed to hire several miners who began sending down ore from shallow workings. Thus the Sunnyside assumed the role of one of the Eureka district's first productive operations, although the mine remained small for years.[78]

The Silver Wing was another important property, and it was among the earliest in the Eureka district to attract an organized company. In 1874, prospectors found the vein near the mouth of Burns Gulch on the east side of the Animas River valley, between Eureka and Animas Forks. Investors learned of the find, organized the Silver Wing Mining & Reduction Company, and purchased the group of claims. Nathan S. Culver, a physician in Colorado Springs, was a company principal, and used his success as a gateway for other mining investments. Matt France, the other principal, owned a ranch in Colorado Springs and came equipped with considerable experience from developing several mines in Clear Creek County. Because of his experience, the company appointed France as on-site manager, and under his guidance, a small crew of miners conducted development and began production.[79]

Probably because of the potential offered by as yet undeveloped claims, John Epley broke away from Greene & Company with the intent of building his own smelter in the Eureka district. The timing was questionable because few mines in the district produced enough ore to sustain such a costly enterprise, but Epley and Newton A. Foss interested H.C. Brown in the idea, and they allocated the necessary capital. In 1876, Brown, Epley & Company began construction in the Animas valley south of Animas Forks and made considerable progress before winter stopped work. Epley suddenly sold to his partners and moved to Ouray. Foss and Brown reorganized as the San Juan Smelting & Refining Company and resumed construction. When the facility neared completion, an avalanche destroyed it, and the company dissolved, leaving the local market for a smelter untested.[80]

Epley was not alone in assuming that the Eureka district was ready for an ore treatment facility, although productive mines were few in number. In 1875, Charles McIntyre organized the Dakota & San Juan Mining Company to develop the Red Cloud and other claims at Mineral Point and build a mill to treat the ore. The mill was not intended to produce gold bullion like the Little Giant nor silver matte as with the Greene Smelter. Instead, McIntyre planned a concentration facility to separate as much waste from the metalliferous material as possible.

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[77] Nossaman, 1993: 205.
[78] Nossaman, 1993: 206; *"Mining News"* MSP (3/3/88): 141.
[79] *Colorado Mining Director, 1883* (Denver: The Colorado Mining Directory Co., 1883) 674; Nossaman, 1993: 250; Wickersheim and LeBarron, 2005: 425.
[80] Nossaman, 1993: 39, 193.

Following conventional concentration processes, machinery was supposed to crush the ore into sand and slurry, special appliances would achieve the separation, and the concentrates were to be shipped to a smelter for final processing. In so doing, McIntyre hoped to save the costs of transporting waste-laden ore and some of the fees that smelters levied for full treatment. McIntyre also planned to accept custom orders in addition to material from the Red Cloud to pay for construction, but the prospects at Mineral Point were not ready to support a mill. Thus McIntyre eyed Animas Forks as a better location. He projected that the mill would require a year to complete, and by the time it was ready, the district would be far enough along to keep the facility busy. In 1876, he interested E. Bradford Greenleaf in the project, secured investors, and began what was known as the Greenleaf or Dakota & San Juan Mill. Although the facility was small, it lent legitimacy to the small camp of Animas Forks.[81]

It was outside capital from Edward Innis that made the Highland Mary Mine, at the head of Cunningham Gulch, the most advanced operation in the Animas River drainage, if not the entire San Juans. Innis poured money into the property for reasons that defied logic and economics. Edward and brother George inherited a fortune and profitable businesses in New York: a wood dye plant, investment banks, the Pennsylvania & Erie Railroad, and the Poughkeepsie Bridge over the Hudson River.[82] Edward kept an advisor on retainer who guided him in business matters. Interested in the potential offered by mining, Innis consulted his advisor, who suggested that he examine the Las Animas district. What Innis kept to himself was that the advisor was actually a psychic medium. Rather than follow the criteria of most capitalists, legend has it that she chose the Las Animas district by placing her finger on a map and declaring that there lay a lake of gold awaiting discovery![83]

Confident in the seeress' advice, Innis journeyed to the Animas River drainage and surveyed the mines in production. It perhaps seemed reasonable to assume that a lake of gold in a region rich with silver veins would logically be the only gold mine. The psychic claimed that the lake of gold lay underneath a mountain in the area, but could not be specific about which one. Seeking further clarification, Innis examined several operations and consulted with Emery Hamilton, but did not divulge his source of advice. Hamilton informed Innis of extremely rich ore specimens collected from the Highland Mary claim, which Christian Schoellkopf had bonded for purchase. Innis quickly purchased not only the Highland Mary, but adjoining claims to the west for the exorbitant sum of $30,000.[84]

Innis then consulted with H.D. Whittemore to drive a tunnel into the lake of gold. Whittemore was an agent of the Ingersoll Rock Drill Company in New York City conversant with the new technologies of compressed air and rockdrills, although he was by no means an

[81] Nossaman, 1993: 176.
[82] Henn, 1999: 13; Nossaman, 1989: 259.
[83] *Denver Times* (7/10/01): 5; Nossaman, 1989: 261; *Rocky Mountain News* (9/14/58): 65.
[84] Henn, 1999: 15-6; Nossaman, 1989: 178, 261-2.

experienced mining engineer. Whittemore naturally made rock drills a centerpiece of the operation, which pleased the company he represented.[85]

So sure was Innis that he would realize his Holy Grail within a short time, he financed the construction of a small smelter at Howardsville in 1875. With the support of Hamilton, Innis attempted to pillage the idle Little Giant Mill not to save capital, but because he did not want to wait for machinery that otherwise had to be shipped from the East. Goaded, Innis sued Wallihan for possession and lost, forcing Innis to have mill machinery sent anyway. Completion of the smelter undoubtedly excited Howardsville residents, who looked forward to challenging Silverton as an ore treatment center.[86]

In 1876, Whittemore arrived at the Highland Mary with the rock drills and immediately put them to work driving the Innis Tunnel. Whittemore returned to New York, leaving a significant and lasting impact on the western mining industry. His introduction of rock drills to the mine in 1876 was one of the earliest commercial applications in the Rocky Mountain west. Not until the 1890s did the mining industry truly embrace rock drills, and ten years passed again before they were commonplace.[87]

A year after Innis began developing the Highland Mary, the lake of gold still eluded him, although he remained confident in the psychic's advice. Because progress was slow, Innis decided to approach from two directions, so he purchased the Little Giant Mine in hopes that it would lead to the gold. He consulted the psychic regarding the direction that the Innis Tunnel should take, but she often gave inconsistent directions. As a result, miners drove the tunnel until it was serpentine. When the miners penetrated perfectly fine, profitable veins of silver ore, they were astounded when Innis commanded them to ignore the veins and drill and blast onward to some unknown destination.[88]

The Highland Mary complex became a community hub by 1878, in part because Innis was generous at his residence known as the Whitehouse, which cost around $10,000 to build, or $175,000 today. The cost was for construction alone, as the land on which the log building stood was public. Innis took in the occasional guest, offered a few meals to prospectors and other mine owners, provided a polling place for elections, and obtained a post office under the name Highland Mary. Innis ordered a stamp mill with a battery of twenty-five stamps and hired Lewis Schantl, expert metallurgist, to replace Mosely. Schantl was to oversee construction of the mill, but quit within the year.[89]

As mining and prospecting gained momentum during the mid-1870s, many single men collected in the growing settlements. Silverton experienced the greatest change and mushroomed to 210 buildings by 1876. One new building housed the San Juan County courthouse when the Territorial Legislature carved out of La Plata County to administer the concentration of activity

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85 Henn, 1999: 16; Nossaman, 1989: 262, 319; Nossaman, 1993: 120.
86 Nossaman, 1989: 264, 266.
87 Nossaman, 1989: 319; Nossaman, 1993: 120.
88 Nossaman, 1993: 120; Nossaman, 1998: 104.
89 Bauer, et al., 1990: 72; *"Colorado Mines"* EMJ (10/19/78):278; Nossaman, 1993: 136, 252.

in the Animas River drainage. Designation as county seat ensured that Silverton would remain the dominant town. James Briggs took a break from his Briggs Tunnel on Hazelton Mountain and opened the first hotel in 1875. Four saloons opened. The community also erected a combination school, courtroom, and meeting hall.[90]

Howardsville continued to rival Silverton as the region's commercial and social hub. In 1876, Charles and John Pearson established a slaughterhouse and a stockyard to supply butcher shops and mines with meat. John, James, and Joseph Gunsolus ran pack trains to the surrounding mines. Charles Fischer and Henry P. Gill built western Colorado's first brewery, the Rocky Mountain Brewery (Gill & Fischer). In 1877, Edward W. Johnstone and Andrew Bigger both opened saloons. Johnstone was a family man and Bigger was a bully who shot a man in Del Norte and fled to Howardsville. He went to prison for subsequent murders after he left. Prostitutes set up several tents on the edge of town. The enterprise was unsuccessful, however, and the ladies failed to return the following year.[91] Individuals who did not gravitate to Silverton or Howardsville established residences in one of the six other settlements. On Hazelton Mountain, local prospectors and miners referred to their informal collection of cabins around the Aspen vein as Quartzville. A similar demographic maintained the small camp at the head of Cement Creek, the name of which remains unknown.

While Burrows Camp on Mineral Creek was also a primitive settlement, members of the original Burrows party actively guided its development into something more. In 1875, they named the collection of tents and cabins Mineral City and applied for a post office, but another town with the same title already existed. Thus, the community chose Mineral Point after a prominent quartz outcrop, which the Postal Service recognized. Ironically, Mineral Point featured offices for several mining companies before a single retail or service business opened. In 1875, McIntyre's Dakota & San Juan Mining Company established headquarters, and J.S. Buell and brother organized the Buffalo & San Juan Mining Company. The following year, entrepreneurs brought in a few businesses. Henry Ketchum and John Dowling ran a miners' supply store, Ehrenfried Steinbach an assay shop, and Albert Dyes a mine brokerage business. To accommodate travelers, B.F. Weeks and H.B. Perry served meals, and Perry's restaurant doubled as the Forest House, the first hotel at Mineral Point. The population, including all the prospectors scattered in the area, numbered around 75.[92]

Animas Forks, which began in a manner similar to Mineral Point, rapidly progressed due to a more diverse group of interests. Because the settlement was a gateway into the mineralized portion of the Eureka district, it naturally hosted prospectors. Miners lived in town as well, and worked on one of several properties in development within walking distance. Entrepreneurs chose Animas Forks because they were interested in the potential offered by the upper Animas River drainage but felt that Mineral Point was too small, remote, and harsh in climate. Animas Forks, located at treeline, was not much better. Even though the settlement was little more than a prospectors' camp in 1875, community activists confident in the future secured a post office.

[90] Nossaman, 1989: 238, 283; Nossaman, 1993: 12.
[91] Nossaman, 1989: 252; Nossaman, 1993: 215, 218, 219; *Rocky Mountain News*, (10/17/77): 2.
[92] Bauer, et al, 1990: 98; Nossaman, 1993: 176, 178, 179.

William Randall and Martin Codding built the first mercantile. Unlike Mineral Point, Animas Forks enjoyed a boom the following year. For those who called Animas Forks home, Henry Warren, William and Frank Stein, and Edward Suydam opened three more stores, and regional meat dealer Henry Helmboldt and another individual established two butcher shops. Lewis and Clara Mercer and Esther Ekkard ran boardinghouses for workers. The Mercers opened the Mercer House hotel and livery and Frank McGivern served meals in the Flagstaff House restaurant and bakery. In contrast to the stereotypes of western mining camps, Animas Forks featured only one saloon, which Albert and Anna Brendel tended. Specialized businesses also served the nascent mining industry. An assay shop and blacksmith provided services needed by prospectors, and several freight packers established headquarters. Charles McIntyre began building the Greenleaf Mill to receive ore from local mines.[93]

Curiously, Eureka lagged far behind Animas Forks in development, although it shared a similar function and geographic relationship with the mining district. In 1875, the townsite company secured a post office and cleared trees and stumps from the platted streets but neglected to follow with promotion. As a result, few businesses and residents chose Eureka. Founder Fred Blaisdell opened a tiny store, and in 1876, Henry O. Montague established a second, while Suydam moved his mercantile down from Animas Forks. Eureka had lodging, but no saloons or restaurants. It seems likely that Milton Engleman chose to settle in Eureka prior to his involvement with the Sunnyside because the vacuum in business afforded opportunity.[94]

The other settlement that drew some of the prospectors and miners was Niegoldstown, located in the Las Animas district where Stony Gulch opened into Cunningham Gulch. Reinhard Niegold, the eldest of four German brothers, came to the Las Animas district in 1872 to prospect, and brother Gustave, joined him within a year or two. Despite the tardy arrival, Gustave found a vein rich with silver and industrial metals south of Stony Gulch in 1874, and the brothers claimed it as the Philadelphia and Little Fanny. Two more brothers joined the Niegolds in 1876 and they began production according to the simple, labor-intensive methods commonly employed in the mining district. The brothers had select ore samples assayed in Howardsville, probably by William Nichols, and the reports indicated that the payrock featured as much as $1,100 in silver per ton. With visions of wealth, the Niegolds hired a crew to increase the output.[95]

Like Charles McIntyre, the Niegolds decided to build a concentration mill at the mouth of Stony Gulch instead of sending waste-laden crude ore directly to a smelter. In 1877 or early 1878, the brothers started the mill, and it worked at first. But as the ore increased in complexity with depth, the mill lost too much of the metal content and forced the Niegolds to ship the payrock to a smelter anyway. The bunkhouses for the miners and mill workers became the seed for a small settlement that the brothers modestly named Niegoldstown. Taking advantage of opportunity, the brothers decided to formalize the settlement and requested a post office, which the Postal Service granted in 1878. They also built a sawmill for their operation and sold the

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[93] Nossaman, 1993: 186-9.
[94] Bauer, et al, 1990: 52; Nossaman, 1993: 203-205.
[95] Henn, 1999: 68; Nossaman, 1993: 40, 224.

surplus lumber, which was always in demand. The Niegolds' employees and a few prospectors and miners who moved into the settlement fostered enough demand to support a mercantile, saloon, and hotel, which may have been operated by the Niegolds. The town, however, remained small and primitive and never grew beyond a cluster of log buildings, even though it lay directly on the heavily traveled Stony Pass route.[96]

By 1877, both the promotion and proof of ore in the Animas River drainage created a sensation that spread through Colorado and onward to the greater mining industry. The region possessed a small smelting industry, despite initial failures, as well as a permanent population, formal settlements, and businesses. A leading mining journal noted:

> In the spring of 1872, when the San Juan excitement first began, few people regarded it in light of anything but a common mining stampede, which would shortly die out or prove to be only an ordinary furor over a fairly good mineral district. Instead of this, however, the five years that have passed since then have, in their results, not only upheld all but the most exaggerated of the assertions first made in regard to the wealth of the district, but have brought to light many new resources which are at present being developed with an energy equal to that found in any part of the West. In a word, San Juan is an undoubted success. Its mines are not myths, nor its rich ore products solely of the imagination.[97]

While the statement may have been slightly ahead of the actual situation in the San Juans, the Animas River drainage seemed to be headed for greatness. The cornerstone, of course, was mining, which continued to gain momentum. The Crookes and Greenes battled for sources of ore, and the Greenes retained their exclusive rights to Quartzville, Arrastra Gulch, and Silver Lake Basin. The Greenes had so many contracts and independent deliveries that metallurgist John Porter decided to add a second furnace to the smelter. North Star Mountain remained the domain of the Crookes, and they tightened their grasp on the productive operations there. In addition, the Crookes had a relatively easy time establishing a presence at Animas Forks and Mineral Point because of the easy route northeast over Engineer Pass and down Henson Creek to Lake City.

The Crookes' presence was as symbolic as practical because most of the operations around the Animas River headwaters were still being developed and only a few had just begun to produce ore in meaningful tonnages. Some of those that did generate ore were financed by outside investors, which was a noteworthy trend. Cleveland capitalists Alfred A. Hard and Harry L. Bull backed the Mastodon Mining & Reduction Company, which brought the Mastodon Mine into production. The Mastodon was on the Sunnyside Vein. Local prospectors developed the Mountain Queen, at the head of California Gulch, into one of the Eureka district's most important producers for the year. Small amounts of ore trickled from other mines such as the Columbia and Vermillion.[98]

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[96] Bauer, et al., 1990: 105; Nossaman, 1993: 85.
[97] *"The San Juan Mines"* *EMJ* (5/5/77): 291.
[98] *Colorado Mining Directory*, 1883: 650; Nossaman, 1993: 173; Ransome, 1901: 21.

Some of the mines saw more activity on paper than in the ground. C.H. Graham organized the Graham Silver Mining Company to speculate with claims in the area, and when he lost interest in 1877, Graham left. His partners William and Alexander G. Bowman bought in and reorganized as the Sioux City & San Juan Mining Company. Jonathan S. Buell established the Buffalo & San Juan Mining Company with a like intent and reformed it as the Colorado Mining & Land Company. Charles McIntyre ran short of funds for his mill in 1877; he subsequently found investors and included them as the Animas Forks Mining Company. None of these entities produced much in 1877.[99]

The Red Cloud, the only truly promising property at Mineral Point, was shallow but served as an anchor for one of the most important operations in the upper reaches of the Animas. It appears that in his effort to allocate capital, McIntyre sold the claim to Franklin Josiah Pratt, who represented a group of wealthy investors in Massachusetts. Instead of developing the vein from the top down through a shaft, Pratt promoted the idea of undercutting the formation at depth with a long haulage tunnel. Even though the Red Cloud was near Mineral Point, Pratt proposed driving the tunnel northward from California Gulch because this offered the lowest point of entry. The tunnel would have to penetrate around one mile of rock to reach the vein, and Pratt probably forecasted that the tunnel was likely to intersect other ore formations over this distance. If these veins were not claimed, then Pratt and partners could obtain rights, and if they were, then the owners could work them from bottom up through the tunnel and pay a royalty. Such a scheme made the tunnel attractive in theory, and the investors provided Pratt with the funds to start. Pratt then commissioned what was known as both the Bonanza and the Mineral Point tunnel in 1877, and the following year, organized the Mineral Point Tunnel Company. Animas Forks benefited as the nearest commercial and communication center, and Mineral Point, where the target vein was located, received some publicity as well.[100]

Previously quiet portions of the county finally began to see significant claim development and some production in 1877 and 1878. This deeply interested the Greenes because these areas lay to the west of the Eureka district and within their territory. One of the most remote was Poughkeepsie Gulch, which was a drainage to the north of Cement Creek. There, prospectors made a number of discoveries in 1875 and 1876, designated the Poughkeepsie Mining District, and developed their claims. Ruben McNutt and George Howard, who already extracted payrock from their Poughkeepsie Mine, were probably principals in the district's creation. By 1877, partnerships had the Alaska, Bonanza, Columbia, Forest, and Red Roger mines in limited production. Packtrains carried the ore in sacks south over Poughkeepsie Pass and down Cement Creek to the Greene Smelter. Sale of the Old Lout Mine for $10,000, even though it was shallow, caused a stir and stimulated a small rush to the district.[101]

The center of new activity that was nearest the Greenes lay on Sultan Mountain, which loomed west of Silverton. In 1876, several prospectors found a lengthy vein they named the Empire, and within a short time, other prospectors identified several parallel formations

[99] Nossaman, 1993: 191-2; Wickersheim and LeBarron, 2005: 371, 382, 426.
[100] Nossaman, 1993: 121; Wickersheim and LeBarron, 2005: 376.
[101] Ransome, 1901: 192; *Silverton Standard* (10/20/17): 1; Wickersheim and LeBarron, 2005: 370, 376, 418.

including the Hercules, Little Dora, and North Star. Simultaneously, parties began driving tunnels to develop the veins, and all but one of the operations were small. Knight, Slocum & Company began work on the Hercules, and John Williams started his tunnel toward the North Star. The most significant endeavor was the Diamond Tunnel, which the Silver Producing Mining Company pushed to undercut the Hercules and other veins. Ironically, all but the well-funded Diamond Tunnel began minor production by 1878.[102]

In 1877 and 1878, the Crookes and Greenes no longer competed only with each other for the ore produced by San Juan County's young mining industry. Each faced potential rivals in their home territories, and some of the threats were serious while others were not. In Hinsdale County, three new plants posed the possibility of diverting some of the ore that the Crookes relied on. The Ocean Wave Smelting & Mining Company built a smelter in Lake City, George Lee started the Lee Smelter at Capitol City, and both of these made the Crookes uneasy because they were relatively efficient. The Van Giesen Lixiviation Works at Lake City, however, was not much of a threat because during its brief life, the mill proved to be a failure.[103]

In San Juan County, five organizations built facilities that made the Greenes wary. In 1876, James H. Winspear began promoting a smelter he proposed for Eureka, formed the Eureka Reduction Works the following year, and convinced investors in Ohio to provide him with money. He saw the smelter completed by 1878, sought contracts for ore, and apparently purchased an interest in the North Star Mine on North Star Peak for its payrock. When Winspear started the plant, however, it proved to be a complete failure due to mismanagement, debt, and inappropriate processes. The Greenes were relieved, and Winspear quietly escaped his creditors and left for Rosita.[104]

W.G. Melville paralleled Winspear in terms of both timeframe and outcome, but his method for recovering silver differed. In 1876, he organized Melville & Summerfield and built a lixiviation mill at Silverton. Developed in Europe, lixiviation was specific to silver and used chemicals and water as a solvent to leach the metal out of roasted payrock. While lixiviation had been proven to work with simple silver ores, it was no match for the complex material in the Animas drainage, and the mill's immediate failure in 1877 sent Melville back to the drawing board. He tried again in 1878 with the same result and, like William H. Van Gieson at Lake City, suspended operations.[105]

Thomas P. Medly, Lorenzo Dow, and J.H. Earnest Waters planned another lixiviation mill in Cement Creek that would intercept the ore that passed from mines in that canyon and the Poughkeepsie district to the Greene Smelter. Melville had not yet demonstrated that lixiviation was inappropriate for San Juan silver, and also failed to run adequate tests to prove that the process would work. This seems curious because two of the three principals had considerable experience in the mining industry.

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[102] Nossaman, 1993: 147-8; Ransome, 1901: 251; *Silverton Standard* (3/12/10): 1; Wickersheim and LeBarron, 2005: 397, 425.

[103] *"Mining News" EMJ* (7/14/77): 30; Pangborn, 1878: 52; Lee Scamehorn, *Albert Eugene Reynolds: Colorado's Mining King* (Norman, OK: University of Oklahoma Press, 1995)178; *Silver World* (10/5/78).

[104] Nossaman, 1993: 23, 210, 252; Pangborn, 1878: 54; Ransome, 1901: 21.

[105] *"Mining News" EMJ* (7/14/77): 30, Nossaman, 1989: 316; Nossaman, 1993: 39, 116; Pangborn, 1878: 52.

Waters was born in Parsonstown, Ireland, in 1851, son of prominent physician John Waters. Interested in mining and not medicine, he received a formal education at the Royal School of Mines in London and the School of Mines at Freiberg, Germany. In 1872, Waters became an apprentice in the machine shops of John & Henry Gwynne in London for practical experience with machinery. Ready for the field, Waters traveled far and wide. Under the employment of a London investment syndicate, he traveled to Gilpin County in 1873 and examined mines there, then went to Japan where the imperial government hired him to serve as State Mining Engineer and build the Japanese Imperial Mint. In 1875, Waters resumed his practice as a consulting engineer and examined mines in the Lake Superior area and Mexico, then came to Colorado and joined the Leadville rush in 1877. He spent the next four years primarily in Leadville and the San Juans, where he made his mark.[106]

Dow, much older than Waters, was born in Maine in 1824, received a formal education at Wesleyan University, and moved to Topeka, where he was elected mayor in 1859 and then to the state supreme court. Dow traveled widely, and on a visit to Europe during the early 1860s, became fascinated with mining and engineering. He became an expert with explosives, brought one of the first diamond drills for mining from Europe to the United States, and became involved with several mining companies.[107]

The San Juan Lixiviation Company, which the trio established in 1877 with British backing, was Dow's latest venture. The group sited the new mill at the confluence of the South Fork and main fork of Cement Creek, and named the associated settlement Gladstone, after the British prime minister who held office at that time. The company began operations in 1878 and, along with Melville at Silverton, immediately ran into trouble. To obtain capital for the improvements deemed necessary, Dow and Waters reorganized the firm as the San Juan Reduction Company and managed to win 200 pounds of silver from Poughkeepsie district ore. That small amount was the crowning achievement, and the company spiraled into bankruptcy in 1879.[108]

Charles McIntyre's Greenleaf Mill was not much of a threat to the Greene Smelter either. David Nevin, brother of the inventor of the Nevin jig, a concentration apparatus, designed the mill and saw it completed in 1877. To his embarrassment, the jigs, which used water currents to separate heavy metalliferous particles from light waste, proved to be only moderately successful on the complex ore of the upper Animas. Thus, the mill operated intermittently, may have been refitted, but drew away no business from the Greenes.[109]

Edmund T. Sweet and Oliver Matthews opened the only facility that presented the Greenes with competition. Even then, the threat was limited because the new plant filled a specific niche. Specifically, Sweet and Matthews erected an ore sampler in 1878, which catered to small mines with sporadic production. A sampler was a combination assay house, smelter, and ore buyer, and it specialized in providing assays, testing batches of complex ore to identify the

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[106] Nossaman, 1993: 170; *"Obituary"* *EMJ* (5/13/93): 444; *"Prominent Men in the Mining Industry"* *EMJ* (8/22/91): 213; Clark C. Spence, C. *Mining Engineers and the American West* (Moscow, ID: University of Idaho Press, 1993) 8.
[107] Nossaman, 1993: 170.
[108] *"Colorado Mines: San Juan Region"* *EMJ* (10/19/78); Nossaman, 1993: 170; Ransome, 1901: 21; Smith, 1982: 27.
[109] Nossaman, 1993: 187.

best treatment methods, and buying small lots of ore from outfits that needed immediate income. At the sampler, the purchased ore was segregated into piles by composition and when enough of a single type had accumulated, the batch was smelted in a custom run. Ordinarily, samplers posed no immediate threat to smelters such as Greene & Company although the smelters, set up for large volumes of specific ore types, were unwilling to make process adjustments just for the small, specialty batches. Sweet and Matthews, however, did have some impact on the Greenes, who wanted every pound or ore that they could secure. Instead of building a facility anew, which would have been costly, Sweet and Matthews refitted the idle Rough & Ready Smelter. Because the Animas drainage possessed an array of small mines with complex ore, the Sweet Sampler enjoyed success from the start.[110]

To simultaneously nurture and profit from the growth of mining, local investors and community activists backed the development of a primitive infrastructure in the county. Because the industry depended on the movement of supplies, ore, and people, improvements to the transportation system were among the most important.

Prior to the smelting war, the Animas River drainage lacked formal roads, and horses, mules, and burros were the principal movers of materials and people. Given the reliance on draft animals, it comes as no surprise that the original transportation system in the Animas River drainage consisted of a network of pack trails. As alluded to in the pages above, several well-beaten artery trails entered Baker's Park from the east over Stony, Cunningham, and Cinnamon passes, and from the south over Molas Pass. From the commercial and transportation hubs in the county, more packtrails extended up all the major valleys and gulches to the centers of mining. The trails naturally followed the paths of least resistance and fewest obstacles and usually wound along the flattest ground. Feeder trails branched off the main routes and zigzagged up to nearly every mine and prospect of note, and because these were the responsibility of the users, they tended to be well-constructed. By winter, these trails became impassable, however, and all but the most daring and resourceful on snowshoes attempted to follow only the principal routes out of the region. For a mining district with aspirations of notoriety and fulltime ore production, this simply would not do.

Otto Mears, pathfinder of the San Juans, understood this problem and foresaw great profit in toll roads. During the 1870s, he hired crews to grade a network of roads from the San Luis and Arkansas River valleys west toward the San Juans and the Gunnison area. The fathers of Lake City, including the Crookes, realized that roads were necessary for their well-being and graded several trunk lines in the eastern San Juans. The principal interests in the Animas River drainage, however, were slightly less developed.

Most of the goods consumed in the drainage came from shipping points in eastern Colorado and so it would seem logical to improve the Stony and Cinnamon pass trails first and establish links with the Lake City and Otto Mears' road networks. Instead, Dempsey Reese and lumberman Henry F. Tower commissioned the first toll road, which took a route south and down the Animas River canyon to Hermosa and Animas City in 1876. Reese and Tower's direct

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110 Nossaman, 1993:153.

experience with the region's weather superseded geographic distances. They understood that wagon roads over Stony and Cinnamon passes would become blocked by snow while the Animas River valley route, although much longer, was serviceable most of the year. Further, a road graded by the Park View & Fort Garland Freight Company already linked Conejos, in the San Luis Valley, with Animas City and provided the essential connection with eastern Colorado. Reese and Tower saw their road carrying traffic by 1877 and began to recover the construction costs by charging a lofty $6 for teams and $6 round trip for stages, which equates with about $100 today.[111]

An embarrassment to the Greenes and other Animas River drainage interests, Lake City investors apparently completed a road to Animas Forks before they did. The Lake City interests widened the trail over Cinnamon Pass, obviously to encourage residents to conduct business in Lake City. In 1875, the Animas Forks Toll Road Company began a road from Silverton up to Animas Forks, but the project took two years because it was under-funded. The road was poorly engineered and a bog in places, but it granted the desired shortcut over the range to Otto Mears' eastern network. San Juan County now had two routes that could accommodate wagons, which lowered the cost of both mining and living. Because wagons carried freight in some volume, they were able to haul larger loads into the county at lower rates than the pack animals.[112]

Several areas of mining in the county were important enough to justify the construction of rough but negotiable spur roads. In 1876, the Innis brothers assumed that a toll road would be graded over Stony Pass and funded the first segment from Howardsville to Stony Gulch. Probably at the behest of the Greenes and Blair's party, the county graded a road up Hazelton Mountain to the Aspen vein system in 1877, which increased the volume of ore packed to the Greene Smelter. In 1879, local investors funded a toll road up Cement Creek, over Poughkeepsie Pass, and into the Poughkeepsie district, whose miners were glad to now ship ore by wagon to the Greene Smelter.[113]

Communication with the outside world was necessary for the success of mining in San Juan County, and it saw great improvement during the mid-1870s. The mail, newspapers, and word-of-mouth were the principal sources of information. In the early 1870s, someone from the Animas River drainage had to fetch the mail from Del Norte, where the nearest post office lay. By 1875, post offices at Animas Forks, Eureka, Highland Mary, Howardsville, Mineral Point, and Silverton served the county, and a carrier delivered the mail at regular intervals. Newspapers were an indispensable institution, and county residents had a choice of several, which they read, reread, and passed on to others. The *Rocky Mountain News*, published in Denver, usually covered important national and territorial stories as well as cultural topics, but because it arrived by post, the news was usually outdated. In 1875, John R. Curry established the *La Plata Miner* in Silverton, which became the *Silverton Miner* in 1879. Curry's paper, the first in the Animas River drainage, covered local news, extracted stories from Denver and eastern publications, and served as a promotional voice for the region.

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[111] Nossaman, 1993: 87; Nossaman, 1993: 294; Pamgborn, 1878: 50
[112] Nossaman, 1993: 95, 113; Sloan & Skowronski, 1975: 21.
[113] Nossaman, 1993: 98, 113; Ransome, 1901: 21; *"San Juan Silver Mines"* EMJ (12/20/79): 452; Sloan & Skowronski, 1975: 21.

To keep pace with new construction, several firms erected additional sawmills at the timber stands. In 1876, Greene & Company merged its logging operation with Tower & Stevens on Mineral Creek (north of Silverton), and Melville & Summerfield set up another sawmill in the same area. After the company finished its lixiviation mill, it began selling the lumber in Silverton. H.F. Schenk brought a third sawmill into the Cement Creek drainage, previously untimbered. The San Juan Reduction Company erected a fourth sawmill at Gladstone in 1878.

In 1878 and 1879, several trends and forces set in motion events that permanently changed the social, industrial, and economic landscapes of San Juan County. One of the trends had to do with the value of silver. In 1878, the Federal government passed the Bland-Allison Act, which was, in essence, a massive subsidy for the silver mining industry. Initially, the government declared that the federal treasury would recognize a gold standard to the exclusion of silver. Concerned over the impact to silver mining, western senators and representatives drafted the Bland-Allison Act, which reinstituted the partial monetization of silver and required the government to buy the metal at an average of $1.20 per ounce, or around $21 today. Previously, silver fetched $1.15 per ounce, and the increase in value, coupled with the stability imparted by the Act, instilled considerable confidence among investors, mine owners, and ore buyers. This should have generated considerable interest in the Animas River drainage, where rich silver ore had been proven at a number of mines in need of development.[114]

A conspiracy of factors, however, prevented interest from taking hold. First, Colorado hosted two of the most significant booms in the West in 1878 and 1879, which captured the attention of investors. The first was Leadville and the second was Silver Cliff, ironically in the same area as Rosita, whose boom distracted investors from the Animas drainage in 1874. Second, the wave of mill and smelter failures in the San Juans and San Juan County specifically, clouded the region's reputation among individuals knowledgeable about sound mining investment. The ore could be profitably treated, as the Greenes, the Crookes, and Sweet's Sampler demonstrated, but investors instead focused on the failures. Third, the Meeker Massacre resulted in considerable caution. The Brunot Treaty granted various bands of Ute Indians title to the lands surrounding the San Juans, and following the established pattern, settlers encroached on the territory anyway, and the Utes were moved several times. The Southern Utes quietly settled on a reservation in southwestern Colorado. Nathaniel Meeker, in charge of the White River agency in northwestern Colorado, tried to force the Northern Utes into an agricultural lifestyle. As tensions between the Northern Utes and Meeker escalated, Meeker sent a communication to the army, which headed for the White River area against warnings by the Utes. The Meeker Massacre ensued. Subsequent virulent hysteria developed, although the settlers themselves had ultimately been the perpetrators. With the resultant Ute removal of 1881, however, the tribe was left with only two reservations in the state.

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[114] Joseph King, *A Mine to Make A Mine: Financing the Colorado Mining Industry, 1859-1902* (Texas A&M University Press. 1977): 92; *Report of the Director of the Mint* (Washington, D.C., Government Printing Office, 1894) 20; Glenn O. Saxon, *Colorado and Its Mining Industry (1859-1959)* (New Haven: Yale University, 1959) 7, 8, 14, 16; Smith, 1982:92; Smith, 1994: 148.

For San Juan County, these factors proved to be very troublesome. Why, investors reasoned, should they risk capital on an underdeveloped and remote region where the climate was uncertain and problematic, when Leadville, Silver Cliff, and other booms held great potential? As a result, the mining industry in the drainage remained static and many of the small operations even ceased as their high-grade ore gave out. Production figures for the county reflect the downward trend. In 1876, the county's mines produced $56,000 in silver, $5,000 in gold, and $15,000 in lead. By 1879, the value dropped to $35,000 worth of silver, $6,000 in gold, and $20,000 in lead.[115]

Competition between the smelters and mills, built on the expectation of an increase in ore production, intensified and the vulnerable ones closed. In a move that stunned the Animas River drainage, the Greenes decided to suspend their operations at Silverton in 1879. Financial troubles, emotional exhaustion, and the distance of the Greenes from Silverton were partially responsible, but competition and ore that grew increasingly complex and difficult to treat were the major underlying reasons. The physical frailty of George Greene, the engine behind the business, certainly contributed as well.

Caught by surprise, the county's miners tried to assess how the smelter's closure would impact them. Other mills and smelters existed at Lake City and Ouray, but the costs of shipping ore over the mountains consumed most of the profits. Sweet's Sampler and the San Juan Reducing Company lixiviation works at Gladstone were able to process some of the ore, but the mining companies relegated themselves to producing only the highest grades of ore. As the county subsided into a depression, many wage laborers left, but visionary mine owners and business interests held fast because an end to their problems was already in sight.

William J. Palmer, William A. Bell, and other principals with the Denver & Rio Grande Railroad clearly saw the inevitable growth of southwestern Colorado and the potential offered by mining in the mountains. They began grading a line in 1876, spent three years traversing south around the San Juans, and established the town of Durango as a terminal. The track required several years to finish, but assurance of service in the near future increased optimism and confidence in San Juan County. The close proximity of the railroad would bring immeasurable benefit because trains could carry greater volumes of freight at much lower rates than wagons. Not only would this reduce the cost of living in the county, but also ore could be shipped to the large smelters in Black Hawk, Golden, Denver, Pueblo, and Leadville. Further, these facilities were prepared to profitably treat the district's complex ore.

While the residents of San Juan County were certainly excited about the Durango railhead, few thought that the Denver & Rio Grande would bear the exorbitant costs of grading a spur up the Animas River to Silverton. Palmer and associates, however, quietly made arrangements for exactly that. They envisioned Durango as the hub of an empire that would capture the two surest and most profitable aspects of mining, transportation and smelting. As track gangs pushed toward Durango in 1880, Palmer contacted John Porter, who had returned to

[115] Henderson, Charles W. *USGS Professional Paper 138: Mining in Colorado: A History of Discovery, Development, and Production* Washington, D.C., 1926, U.S. Geological Survey, Government Printing Office:216.

Eureka, Nevada, in 1877 and explained his strategy. He planned to build a massive smelter in Durango, capable of treating the most resilient ores the San Juans had to offer and at rates that would undercut the facilities in the mountains. A railroad to Silverton would carry ore down and send supplies and coal up, and similar lines to other portions of the San Juans were to be considered. In so doing, the Denver & Rio Grande would dominate the freight and smelting business with the investors as beneficiaries. Palmer offered Porter the position of chief metallurgist and manager of the smelter, which Porter accepted.

As a first step, Palmer, Bell, and associates organized the New York & San Juan Mining & Smelting Company in 1880 and, through Porter, secured the Greene Smelter. Porter then hired Thomas Bowen and John Pennington as metallurgists, and began securing contracts for ore at highly competitive rates. Porter had the Greene equipment freighted down to a site on the lower Animas at Durango, then unloaded. At the same time, the company came to an agreement with Edmund Sweet where Sweet would serve as ore buyer if he agreed not to expand his sampler into a smelter. To ensure a constant supply of ore, the company surveyed the best mines in the Animas River drainage and came to the conclusion that the Aspen, Ingersoll, Legal Tender, and the other mines on Hazelton Mountain offered the greatest potential. In 1880, the company approached Blair, Ingersoll, Higgins, and the other claim owners with an offer of $60,000, or $1,073,483 today, for their interests.[116]

News of the project traveled fast in the San Juans, and the inhabitants of San Juan County learned not only that they were to have direct rail service, which was a benchmark for any mining region, but also a new smelter. The greater mining industry had finally accepted San Juan County as legitimate, which stimulated attention. Prospectors returned, investors examined proven properties, optimistic individuals cautiously invested in new properties, however, and existing companies and successful mines saw greater development. Curiously, the county's production figures continued to fall instead of rise. In 1880, the existing companies generated only $13,000 worth of silver, $6,000 in gold, and $21,000 of lead. The reason for the trend was that, instead of shipping ore to the distant smelters at high costs, the mine owners engaged in some production, much underground development, and patiently waited for Palmer and Porter to finish the railroad and smelter. By 1882, the owners deposited around 1,200 tons of payrock at the future railroad depot in Silverton and stockpiled more at their mines.[117] The dismal production figures belied an overall increase in activity among the county's mines, although the industry remained depressed. Mine owners in particular benefited from the wave of confidence and either invested capital developing their properties or sold to one of a number of new companies.

In the Las Animas district, most of the owners were unwilling to sell because they knew their mines were valuable and would only become more so. Instead, owners self-funded development and improvement. The Aspen complex remained one of the district's most important mines, and the New York & San Juan company consolidated the 4,000 feet of

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[116] *"Mining News"* *EMJ* (3/27/80): 222; Nossaman, 1993: 295-296; Nossaman, 1998: 39, 58; Smith, 1992:18.
[117] Henderson, 1926:216; Nossaman, 1998: 180.

disparate workings into a single operation. Foreman C.M. Osman kept a crew of thirty-five miners based in Quartzville busy driving development workings and stockpiling ore in anticipation of the railroad's arrival.[118]

North Star Peak and Dives Basin remained the Las Animas district's other key center of ore production. During the summer, Martin Van Buren Wason, Theophile Benjovsky, George Ingersoll, and others maintained production from the Shenandoah and Dives mines, as well as several surface operations. In complete control of the North Star, the Crooke brothers became unsatisfied with the seasonality of operations and decided to consult with a professional mining engineer in 1880. At this time, Ebenezer Olcott arrived in Lake City at the Crookes' doorstep.

Olcott came from a wealthy New York family, and from an early age was interested in mining and had the opportunity to enter the industry from the top. Olcott studied engineering and metallurgy at Columbia School of Mines in New York, graduated in 1874, and took a job as a chemist for the Ore Knob Copper Company in North Carolina. In 1875, he accepted a position as superintendent of the Pennsylvania Lead Company, and then jumped at an offer the following year to work as an engineer for the Orinoco Exploring & Mining Company in Venezuela. In 1879, Olcott returned to the United States, established a consulting practice, and easily secured several important clients due to his experience. D. Willis James of Phelps, Dodge & Company was one of Olcott's best clients, and Olcott quickly packed his bags when Willis requested a survey of a number of significant mining districts in the West. Olcott started in Colorado and perused Leadville, Silver Cliff, and Caribou, before heading to Lake City in 1880 specifically to examine the Crooke Mining & Smelting Company.[119]

The Crookes were open to showing Olcott the North Star Mine in hopes of securing additional investment. The North Star was probably unlike anything that Olcott had yet seen, and during his visit, he was immediately impressed by the harsh environment. Seemingly as an act of fate telling him that the North Star was to play a role in his future, Olcott was literally struck by a small lightning charge, which electrified him all the more. When Olcott returned to Lake City, he and the Crookes came to a mutual understanding. They realized that Olcott had what it took to bring the mine into substantial production, and Olcott saw the Crookes and the mine as an exciting physical and management challenge. Olcott negotiated a sound deal with the Crookes that included a $25,000 investment in the North Star from Willis and associates in exchange for a monthly salary of $500, or $8,946 today, plus expenses.[120]

While the North Star was arguably more difficult to work than nearly all the other mines in the county, it exemplified the typical operation above treeline. Olcott kept a crew of eight miners busy developing the North Star vein through three levels, with the lowest tunnel as the principal point of entry. Each tunnel had one small blacksmith shop and either a platform or bin in which the miners stored sacked ore for shipment by burro. The living quarters were within a crude boardinghouse integral with the tunnel house and blacksmith shop at the lower level.

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[118] *"Mining News" EMJ* (12/11/80): 384; Nossaman, 1998: 99, 202.
[119] Nossaman, 1998: 18; Duane A. Smith, *San Juan Gold: A Mining Engineer's Adventures, 1879-1881* (Montrose, CO: Western Reflections, 2002) 6.
[120] Nossaman, 1998: 18; Smith, 2002: 29, 115.

Though the operation was seasonal in theory, winter came early at 13,000 feet and presented the crew with considerable challenges. As the temperatures plummeted and the winds picked up in fall, the miners may have grown claustrophobic in the cramped quarters. The interior was more like a ship than a boardinghouse. The miners spent nearly all their time in one large room when not at work because the outside was intolerable. They slept in a set of bunks three tiers high, warmed themselves around a single stove, ate meals together, and competed for the few pieces of furniture during leisure. Sacks of provisions were suspended from the ceiling, boxes were stacked along the walls, and tools leaned against the corners. On windy nights, warm air promptly left the drafty building and the stove was insufficient for heat. Damp rags froze and workers could see their breath. The crew simply had no escape from each other, the ambiance of mining, or the cold. But like their counterparts elsewhere in the county's high mines, they labored until Olcott called an end to the season in November or December.[121]

On the opposite side of North Star Peak in Little Giant Basin, the positive climate of 1880 and 1881 fostered not only prospecting, but also the development of several of the ore veins discovered earlier. Prospectors searching the rock formations at the gulch's head found a rich vein that carried silver and industrial metals exposed at the surface and claimed it as the Potomac. They had no trouble finding buyers, who organized the Potomac Silver Mining Company and immediately began development. As early as 1879, prospectors were driving a tunnel south into a cliff on the floor of Little Giant Basin to undercut the Big Giant vein at depth. They erected several buildings including a tunnel house to support activity underground and, in 1880, found investors who furnished capital for major development. A small crew of miners drove the tunnel to the impressive length of 400 feet where they struck a vein laced with gray copper and silver ore. Excited, the investors increased the crew to seven miners who began extracting and stockpiling the ore. Down the gulch to the north, a party of prospectors hoped for the same result and pushed an exploratory tunnel toward the Black Prince vein.[122]

The King Solomon Mine was Little Giant Basin's most important operation, although it, like most of the producers in the Las Animas district, remained small, shallow, and labor-intensive. In 1879, the Ressouches brothers realized that their King Solomon would never pay in desirable quantities without capital for development. Despite the regional economic slump at the time, they interested Robert Hook, a lawyer who practiced in Silverton during the warm months and in Chicago during the winter. Hook convinced other investors in the Windy City of the King Solomon's potential, and together they organized the Solomon Silver Mining Company to work the property. The Ressouches brothers retained a significant share of the company and probably personally oversaw development in 1880 while Hook acted as superintendent.[123]

Once the King Solomon began proving its potential in 1881, the Ressouches and Hook elicited additional money from the Chicago investors to pay for an expert engineer capable of increasing production. The nationalistic Ressouches brothers had an individual in mind, who was Victor Vincent, a fellow Frenchman. While Vincent actually had little direct experience with

[121] Smith, 2002:115.
[122] _Denver Republican_ (9/24/81):5; *"Mining News" EMJ* (2/21/80):137; *"Mining News" EMJ* (3/13/80):189; _Rocky Mountain News_ (10/19/79):4.
[123] Nossaman, 1993:23; _Rocky Mountain News_ (8/26/79):5.

mining, he was an accomplished engineer in France, as well as a talented artist. Vincent had aspirations of becoming a well-practiced American mining engineer and came to the Animas River drainage in the late 1870s. Hoping that the King Solomon would be his first step in a career, Vincent convinced the Ressouches to hire him. During the year, Vincent was given charge of a crew of sixteen, who increased development of the vein while bringing ore to daylight.[124]

Within the Las Animas district, the movement of prospecting and claim development crept over to the northwest face of Kendall Mountain above Silverton. After the sale of the Ingersoll Tunnel, Thomas Higgins pursued other interests, including backing his wife Mary Anne in a lease on the Grand Central Hotel in Silverton in 1881. He also invested in two highly promising claims staked in Swansea Gulch during the late 1870s. One, the Lackawanna, was within a short walk from Silverton and consisted of a group of claims that covered several veins on the gulch's east side. The other, the Scranton City, lay at treeline at the base of a cliff on the gulch's west side. In light of the coming railroad and the smelter in Durango, Higgins sensed that the time was right to bring the claims into production and hired several miners to work with him in initial development. At the same time, prospectors were at work driving tunnels and sinking shafts into six other claims on Kendall Mountain.[125]

The Eureka district, and especially the core area around California Gulch, drew more interest among new investors than perhaps any other portion of San Juan County. Capitalists local and distant organized at least ten new companies, which developed seven mines into substantial operations and speculated on numerous other claims. In addition, the six companies and partnerships already in production during the late 1870s continued to conduct development and store their ore.

Increased activity fostered the growth of Eureka and Animas Forks, which evolved from tenuous camps into small towns with business districts. By 1880, Eureka had a population of around 125 residents, although less than half lived in the town year round. A full assemblage of businesses satisfied their needs, as well as those of individuals who came to find work or examine the surrounding mines for investment. Thomas G. Andrews and Peter Tallman opened a combination restaurant and hotel. H. Bert Clifford ran another, while the wives of local investors kept several boardinghouses. Tallman also tended a mercantile that competed with Engleman's store, and Henry Helmboldt established a branch meat market. Tallman and Andrews served liquor in their hotel, and other entrepreneurs opened two saloons in 1881. That year, the townsite company also formally platted and surveyed Eureka. While Winspear's smelter was silent, the sawmill was not and produced construction materials desperately needed.[126]

Several individuals noteworthy in Colorado's history claimed Eureka as home. One was James R. McKinney, who arrived in Eureka in 1879 to direct the Moline Silver Mining Company

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[124] Nossaman, 1998: 307.
[125] *"Mining News" EMJ* (8/13/87): 119; Nossaman, 1993: 38; Nossaman, 1998: 44.
[126] *Colorado Business Directory* (Denver: 1879); J.A. Blake: 196; *Colorado Business Directory* (Denver: 1881); J.A. Blake: 168; Nossaman, 1993: 211, 125; Susanne Schulze *A Century of the Colorado Census* (Greeley: University of Northern Colorado, 1976): 1880-5.

for investors in Illinois. The company developed the Confidence prospect in Eureka Gulch and the Sultana Mine on Sultan Mountain. The venture was largely a failure, although the Sultana produced in later years, and McKinney sought income by opening a livery stable in Eureka. He ran the business for several years before moving to Colorado Springs, where he became involved with the Exchange National Bank. Through this organization, McKinney invested in Cripple Creek when that district boomed and realized a huge fortune. He reinvested some of this in Colorado's beet sugar industry, which assumed a prominent role in national production.[127]

Theodore B. Comstock opened an assay shop in 1879. Described by peers as overly energetic, Comstock was born into an upper class family in Cutahago Falls, Ohio in 1849 and immediately embraced the sciences. He gravitated toward geology at Cornell University, establishing the school's renowned geological department. In 1873, Comstock combined a lust for adventure with his penchant for science and joined Captain W.A. Jones' exploratory party to Yellowstone in 1873, producing the first geological report of the area. He subsequently led his own expedition into Canada's Northwest Territory and made some of the first scientific observations of the far north. Afterward, Comstock decided to use his geological knowledge for profit and came to the Animas River drainage to examine the possibilities of establishing an ore treatment facility, knowing that this would be difficult due to the complexity of the ore. He solved some of the region's treatment problems and later moved to Arizona, founded the University of Arizona School of Mines in 1891, and maintained a consulting practice as a mining engineer.[128]

Animas Forks did not grow quite as dramatically as Eureka, in part because the town was already established. A basic business district included several mercantiles, a drugstore, several lodging establishments, a blacksmith, and an assayer. Animas Forks also boasted two ore treatment facilities and a sawmill. One of these was Charles McIntyre's Greenleaf Mill, which ran intermittently because not well-suited for the district's ore. The other was Eclipse Smelter, which James Cherry built in 1880 as part of one of the district's promising new ventures. Cherry and fellow investors organized the Eclipse Mining & Smelting Company with a plan of buying several proven properties and building the smelter to treat the ore. Like McIntyre, Cherry also forecast treating custom lots from local outfits to increase income. He purchased the Eclipse, Red Cross, and Mountain Queen mines at the head of California Gulch, the latter of which had been ready to provide ore since 1877. In 1880, Cherry erected the smelter in the Animas drainage several miles south of Animas Forks, testing Mountain Queen ore in 1881 with complete success. At least, this is what the eastern investors believed. The smelter actually had great trouble with the complex ore, and Cherry realized that he would need more capital to refit the facility. However, without informing the investors, Cherry had applied some Eclipse capital and most of the proceeds from the test run to another mining scheme that collapsed. In 1881, the

[127] Carl Abbott, Stephen Leonard, and David McComb, *Colorado: A History of the Centennial State* (Niwot, CO: University Press of Colorado, 1994 [1982]): 181; *Colorado Mining Directory*, 1883: 654; Nossaman, 1993: 336.
[128] Nossaman, 1998: 210; *"Obituary" EMJ* (8/7/15): 243; Spence, 1993: 58.

multiple failures came to a head. As the investors discovered the truth, Cherry disappeared and the smelter abandoned like so many other failures.[129]

The Eclipse was one of two monumental failures that gave remote investors pause. The other was the Bonanza or Mineral Point Tunnel. Franklin Pratt, a businessman, but no mining engineer, underestimated the cost of boring a mile-long tunnel in the San Juans. The operation started well, and Pratt took the highly progressive approach of using rock drills to expedite the drilling and blasting process. In 1878, Pratt lured drill expert Whittemore away from the Highland Mary to install a compressed air system at Mineral Point. The system was the second in the county and among the earliest in Colorado. As noted above with the Highland Mary, rock drills and air compression were new technologies in the late 1870s, and became indispensable for mining around twenty years later. The system and general expenses of operating in the San Juans consumed $300,000 to $400,000 by 1880, which placed Pratt in a difficult position. He had a tunnel only 1,000 to 1,500 feet long to show for such an astounding cost, with triple the distance yet to go. The Mineral Point Tunnel Company went bankrupt in 1881, and the Silver Peak Mining Company of London bought the property and continued work. They suffered a similar fate and suspended operations in 1884.[130]

Despite the failures, a number of investors maintained a general sense of confidence in the operations around Animas Forks. In Placer Gulch, Rasmus Hanson discovered what he thought was an extension of the Sunnyside Vein, which he named the Sunnyside Extension. L.C. Osborne may have grubstaked Hanson because Hanson granted him a share of the claim. The Mastodon Mining & Reduction Company continued developing the adjoining Mastodon, and nearby, the Gordon Mining Company developed the Sound Democrat. This promising property was under female directorship, rare in western mining. In 1881, Canadian Martha A. Gordon organized the company to speculate.[131]

Eureka enjoyed its share of mining ventures during 1880 and 1881. Mercantile owner Milton Engleman received news that miners struck rich gold ore in the Sunnyside on the east shore of Lake Emma, named for his wife. The word was welcome, but the operation uncertain because of conflict among the owners. In particular, when Engleman began development during the late 1870s, he offered interests in the property to his in-laws for capital. They squabbled over profits, control, and ownership, which poisoned the relationships between Emma, Milton, and the family. Barely in control of the Sunnyside, Engleman ordered the ore to be stockpiled instead of sold. On California Mountain above the Sunnyside, Ruben McNutt discovered rich ore in his Washington claim and sold to the Colorado Mining, Smelting & Investment Company.[132]

In 1881, several new companies began work in Picayune Gulch, east of Lake Emma. Chicago investors established the Treasure Mountain Mining & Milling Company and developed the Pacific on Treasure Mountain. New York capitalists organized the Great Animas Gold & Silver Mining Company with two purposes. One was to speculate with hardrock claims and the

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[129] Marshall and Zanoni, 1998: 142; Nossaman, 1998: 111-4, 203-4; *"San Juan Mining News"* *EMJ* (9/11/80): 170.
[130] *Colorado Mining Directory*, 1883: 672; Nossaman, 1993: 194; Nossaman, 1998: 98.
[131] *"Mining News"* *EMJ* (8/7/80): 93; *"Mining News"* *EMJ* (7/19/90): 81; Nossaman, 1993: 202; Nossaman, 1998: 106.
[132] Nossaman, 1993: 206; Nossaman, 1998: 124; *"San Juan Mining News, Colorado"* *EMJ* (10/2/80): 2.

other was to operate what may have been the first large-scale placer mine in the county. In particular, the company began processing the gold-bearing gravel of Picayune Gulch with hydraulic placer methods. Around one mile up the Animas River canyon from Eureka, the Silver Wing Company continued to drive a deep tunnel to undercut its claims at depth. Miners did so with rock drills, marking another early use of the machines in the San Juans.[133]

The Mineral Point district finally saw its first serious activity since the mid-1870s. Because the region was near Hinsdale County, the few productive mining outfits in the district did not wait for the railroad to arrive at Silverton and instead shipped to the Lee and Crooke smelters. The Polar Star on Engineer Mountain was the largest, and because the Crookes owned the mine, the ore naturally went to the Crooke Smelter. The Red Cloud was the other major operation at Mineral Point. In 1879, E.B. Greenleaf's Mineral Mountain Mining Company bought the Red Cloud and adjoining claims from Pratt, possibly when he needed capital to save the Mineral Point Tunnel from going bankrupt. The company then invested in a concerted development campaign. James Trezona, a Cornish miner with extensive experience in California, Nevada, and Michigan, hired thirty miners and sank several shafts on the Red Cloud Vein with steam equipment. The company was rewarded at the end of 1880 with a rich strike and sustained production.[134]

Most other operations in the Mineral Point district were little more than prospects. Chicago interests established the Palmyra Mining Company and installed one of the district's first steam hoists and sank a shaft. The Colorado Mining & Land Company, the Chicago & San Juan Mining Company, and other interests developed other prospects.[135] James K. Herring oversaw development of the Maid of the Mist on the divide between Mineral Point and Poughkeepsie Gulch. Herring earned minor fame in 1883 as groom in North America's highest-altitude wedding to Mary Beck at Mineral Point. Herring purchased a share in Sound Democrat Mine and served as superintendent at the Red Cloud under Trezona. In 1880, he was given charge of the Maid of the Mist.[136]

As can be expected, the town of Mineral Point enjoyed a growth due to activity in the district. The town center was a cluster of around forty cabins, a mercantile, butcher, saloon, and blacksmith. A boardinghouse provided accommodations for local miners, while visiting dignitaries chose between the Forest House and Mineral Point hotels. The population was around 200, but this included the workforce scattered amid surrounding mines.

The Poughkeepsie Mining District deviated from the sluggish trend in the rest of the county and saw major activity between 1879 and 1880. Firstly, in terms of location, Lake City and Ouray were almost as easy to reach as Silverton. Thus when the Greene Smelter closed, the

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133 Colorado Mining Directory, 1883: 637, 678; Nossaman, 1993: 250.

134 Colorado Mining Directory, 1883: 653; *"Mineral Point Mines, Colorado" EMJ* (9/4/80): 155; *"Mining News" EMJ* (8/28/80): 143; *"Mining News" EMJ* (11/27/80): 351; Nossaman, 1998: 117.

135 Colorado Mining Directory, 1883: 624, 660, 663; *"Mineral Point Mines, Colorado" EMJ* (9/4/80): 155; "Mining News" *EMJ* (11/27/80): 351; Nossaman, 1998: 119.

136 Henn, 1999: 47; *"Mineral Point Mines, Colorado" EMJ* (9/4/80): 155.

mining outfits found it economical to pack their ore, however small the production, to the Lee or Crooke smelters in Hinsdale County or to the Windham and Norfolk & Ouray smelters. Either trip remained protracted, however, and therefore costly.

Secondly, Horace Tabor's interest in the district stimulated confidence that, in actuality, may have been disproportionate with the prospects. In 1878, Alfred Hard, a principal with the Mastodon Company, purchased the Alaska Mine in Alaska Basin, which descended northeast into Poughkeepsie Gulch. He convinced Tabor to provide capital for development, and they organized the Alaska Consolidated Mining Company. Tabor was a national celebrity through his fortune made at Leadville and a romance with the diva Baby Doe. The Alaska proved rich, and Tabor announced that he would finance a concentration mill in Cement Creek. While the mill was never built, the success of the operation, its association with Tabor, and his personal examination of the mine made a news sensation.[137]

By 1880, the district featured nine mines in production. Of these, only the Alaska, Bonanza, Red Rogers, and Old Lout were well-developed, the rest shallow and small operations. Two prospectors staked the Bonanza in 1877, which the Kalamazoo Bonanza Mining Company bought in 1879, driving the Bonanza Tunnel, and sinking a shaft. The Old Lout yielded small amounts of ore from 1877 until 1879, when it saw substantial development.[138]

Business entrepreneurs arrived in the district on the heels of Tabor and the swarm of prospectors that followed. As early as 1877 or 1878, freight packers traveling between Silverton and Ouray maintained a camp on Lake Como, which became the seed for a small mining hamlet. William Boot took time from his Mineral Point mercantile to open the first store and saloon in 1879, and others established a restaurant. The Poughkeepsie post office established in 1880, when Lucius B. Kendall began printing the *Poughkeepsie Telegraph* newspaper.[139]

Kendall was overly optimistic about the future of Poughkeepsie, however, as the boom died within a year. In 1881, the Alaska went bust, Tabor lost interest, and most prospectors were unsuccessful. Nearly all the nascent mines were quickly exhausted. When the prospectors, business owners, and most of the mining outfits left for winter in 1881, they did not return. Poughkeepsie lost its post office, although the store may have opened seasonally for several years afterward. The Poughkeepsie district would not participate in the boom that swept the rest of San Juan County when the railroad arrived in 1882.[140]

The Early 1880s Boom, 1882 – 1885

In 1881, the Denver & Rio Grande Railroad prepared to lift the mining industry of San Juan County out of its slump. The railroad was not motivated by altruism, however, and stood to gain huge profits. The carrier organized the subsidiary Denver & Rio Grande Extension and

[137] *Colorado Mining Directory*, 1883: 611; Frank Fossett, *Colorado: Its Gold and Silver Mines, Farms and Stock Ranges, Health and Pleasure Resorts* (New York: C.G. Crawford, 1880): 528; Henn, 1999: 59; Nossaman, 1993: 173, 250.
[138] *"Mining News" EMJ* (8/7/80): 93; Nossaman, 1998: 118.
[139] Bauer, et al., 1990: 116; Nossaman, 1993: 226.
[140] Bauer, et al., 1990: 116; Henn, 1999: 59; Nossaman, 1998: 101.

began grading a narrow gauge line up the Animas River canyon from Durango to Silverton, despite the challenges construction presented.

In the summer of 1882, the first formal train arrived in Silverton bearing capitalists and dignitaries. It was greeted by jubilant spectators, as well as 1,200 tons of ore that had been stockpiled in anticipation of the railroad's completion. Finally, the county had an all-season link with the outside world and New York & San Juan Smelter, the largest ore treatment facility in southwestern Colorado. The railroad was revolutionary for day-to-day life, business, and mining. Commerce exploded because a wider array of goods became readily available at a much lower cost,. During the mid-1870s, residents paid as much as $400 per ton of freight from Denver, a cost which fell as low as $100 when the Denver & Rio Grande established its railhead at Durango. The Denver & Rio Grande Extension, also known as the Silverton-Durango railroad, reduced the cost to $16 per ton, which tumbled to $12 when regional business interests protested the rates. The railroad also opened the county to affluent capitalists who could travel more comfortably and stay in one of the hotels in Silverton.[141]

At the same time, John Porter and Thomas Bowman brought the New York & San Juan Smelter, popularly known as the Durango Smelter, into action. The smelter was large enough to process ore in economies of scale, which allowed the New York & San Juan company to undercut smaller facilities in the mountains. The combination of rail service and the discounts offered by the Durango Smelter dramatically reduced mining overhead. Whereas freighting outfits charged $35 to $40 to haul a ton of crude ore to the Front Range for treatment, a mere $12 would send the same material to Durango. Delighted, mining companies reassessed the worth of their properties because abundant medium-grade ores were now profitable to produce.[142]

While popular history claims that the discount service offered by New York & San Juan crushed the local smelting industry, this was not completely true. Smelters continued to operate in Lake City, Ouray, and Telluride because the cost of freighting the ore over to Silverton for shipment remained high, and in Silverton, the industry did not collapse; it merely adjusted. The complex ore and numerous small mines in the county guaranteed a market for a few custom independent smelters and samplers.

As early as 1881, Seth R. Beckwith forecasted the need for a local smelter in the vacuum left by the removal of the Greene facility. He, Edward C. Dean, Lemon G. Hine, and Almon M. and Henry H. Clapp organized the Martha Rose Smelting & Mining Company in hopes of filling what was a void, despite the presence of the Durango Smelter. Beckwith was an experienced metallurgist who had surveyed mining districts in Arizona, Nevada, and Colorado. With British capital, Beckwith and Arthur Macy, another metallurgist, began construction of the Martha Rose Smelter on the northwest edge of Silverton in 1882. They competed aggressively with the New York & San Juan for ore contracts and locked in the Potomac, Silver Lake, Gray Eagle, and a few nascent operations in the Ophir area.[143]

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[141] *"Mining News"* EMJ (12/30/82): 350.
[142] *Report of the Director of the Mint*, 1882: 545; Henderson, 1926: 11; *"Mining News"* EMJ (9/16/82): 151; Nossaman, 1998: 215; Smith, 1992: 27.
[143] *Report of the Director of the Mint*, 1882: 545; *Colorado Mining Directory*, 1883: 650; Nossaman, 1998: 204, 206; Rocky Mountain News (5/10/82): 2.

Beckwith started the smelter in September, confirming claims that the Animas River drainage's mining industry was prolific enough to support both a local facility and the Durango Smelter. After a successful trial run, Beckwith and Macy ordered their workers to dig into the 1,000 tons of stockpiled ore. Like most smelters, the Martha Rose furnaces had to be stopped periodically to remove slag and input more ore, but after the third or fourth day, no new charges were added. The operation stalled due to financial, legal, and management issues and the owners spent additional money suing each other over the problems. Even though the Martha Rose was an engineering success, it became a financial failure soon idle.[144]

Ore samplers, however, continued to serve the needs of the small mines that yielded complex payrock. Although the New York & San Juan certainly wanted the business, their small difficult batches of ore were ultimately not financially feasible due to the adjustments and interruptions required for custom treatment. As a result, Sweet's Sampler thrived. Sweet also wisely adapted to the railroad and Durango Smelter combination by expanding the sampler's niche, but within the terms of his arrangement with the New York & San Juan Company. In addition to providing custom treatment, Sweet bought ore, tested it to identify the best smelting methods, segregated the payrock, then brokered shipments to the Durango Smelter. This strategy was so effective that, in 1883, Germans Edward G. and Gustavus H. Stoiber came from Leadville to open their own sampler near the Martha Rose.[145]

The rise of concentration mills in the Animas River drainage was another response to the New York & San Juan. As aforementioned, concentration mills were not intended to produce matte or refined metals, but merely separated the metalliferous ore content from waste. By concentrating the ore, mining companies could avoid shipping waste-laden payrock to the Durango Smelter and the fees levied for full treatment. The concentrating process began when crushers pulverized crude ore into gravel, following which Cornish rolls, pan grinders, stamp mills, and ball mills gradually reduced the gravel further into particles ranging from sand to slurry. Screens segregated particles by size, followed by concentration in jigs, vanners, and other appliances using gravity and water currents. While the process seems simple, it was nothing of the sort. The character of the ore's host rock, the chemical compounds of the metals, and the different types of metals conspired to render concentration in the Animas River drainage a science fraught with difficulty and the potential for failure. Particle size, the behavior of crushed material and metals, and the specific gravity of the rock types required calculation, experience with machinery and metallurgy, experimentation, and outright cunning to win them from the host rock.

Few metallurgists and engineers in the Animas River drainage possessed all these abilities, but several persevered during 1882 and 1883 to make concentration a viable adaptation to the changed circumstances of the ore treatment industry. Although the Niegolds pioneered ore concentration at Niegoldstown, Theodore B. Comstock developed truly effective methods using his assay shop in Eureka as a front to understand the character of the county's ores. When the

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[144] *Report of the Director of the Mint*, 1882: 545; *"Mining News" EMJ* (12/30/82): 351; Nossaman, 1998: 206; *Rocky Mountain News* (10/17/82): 6.
[145] Henderson, 1926: 49; Warren C. Prosser, *"Silver Lake Basin, Colorado" EMJ* (6/20/14): 1229; Sloan and Skowronski, 1975: 29.

railroad arrived in 1882, Comstock applied his knowledge and understanding of scientific processes to complete an efficient sampler in Silverton. What separated Comstock's facility from the Sweet and Stoiber samplers was that, in addition to small-batch sampling, the Comstock Sampling Works also included a complete concentration process that separated metalliferous material from waste without smelting. Comstock contracted with the North Star on Sultan Mountain and other mines for ore, enjoyed early success, and shipped the products to smelters in Denver, Omaha, and St. Louis for final refining. He carefully avoided doing business with Sweet and New York & San Juan because they were now staunch competitors.[146]

Comstock's precedent of concentration began to take hold in the region, and the county saw construction of three mills in 1882 and five more facilities the following year. Late in 1882, George Ingersoll erected a small mill at Green Mountain Mine in Cunningham Gulch. The Green Mountain Mill proved a success probably because the Green Mountain ore was fairly straightforward. The other two mills treated custom ores solicited from mines in the Las Animas and Eureka districts. The Solomon Silver Mining Company built one of the two custom mills in the western portion of Howardsville. J. Woodbury Jones built the Middleton Mill at a new settlement between Eureka and Howardsville. Jones and New York investors organized the Uncompahgre Mining & Smelting Company and built the mill to process ore from both their Uncompahgre Chief Mine and other contributors. The Solomon Mill was an outright failure even though it featured adequate equipment. The mill's simplicity, juxtaposed with complex ore and improper adjustments were to blame. The Middleton Mill proved only partially successful because it was tailored for ore in the district's northern reaches, which differed greatly from material produced elsewhere. Thus the mill treated payrock produced from a relatively narrow geographic area.[147]

Of the five mills erected in 1883, three were for in-house use while the other two accepted custom ore. Milton Engleman financed one of the in-house mills at the Sunnyside Mine, despite a conflict with his extended family. Engleman hired John H. Terry to build the facility at Eureka in 1883, with Terry fresh from milling the complex gold ores of Gilpin County. Terry was Comstock's equal in designing an effective process, in part because the Sunnyside ore was similarly complex gold compound that resisted traditional methods. Terry built a ten-stamp mill at Lake Emma which used mercury to amalgamate with free-gold and concentration machinery to recover the material that would not amalgamate. The mill produced concentrates and some gold bullion, which the Englemans in turn used to fund their legal squabbles.[148]

Comstock built the other successful in-house concentration mill at the North Star Mine on Sultan Mountain. When planning his sampler, Comstock forecast that the North Star Mine would become one of his largest clients due to proximity and the affinity of his process to North Star ore. Further, the mine was on the brink of becoming a major producer. In 1881, eastern investors organized the Sultan Mountain Mining Company, purchased the North Star, and hired Oliver Posey as manager. Posey drew John Williams and the Sultan Tunnel into the company

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[146] *"Mining News" EMJ* (8/26/82): 112; Nossaman, 1998: 210-3.
[147] Colorado Mining Directory, 1883: 679; *"Mining News" EMJ* (12/30/82): 350, *"Mining News" EMJ* (12/29/83): 401; Nossaman, 1998: 262.
[148] Marshall and Zanoni, 1998: 119; Ransome, 1901: 176.

and began production. In 1882, Comstock offered to build a concentration mill adjoining his sampler and lease the facility to the North Star. Posey agreed, and Comstock's mill began in earnest in 1883.[149]

Gladstone, largely idle since the lixiviation mill failure of 1879, hosted the county's third in-house concentration plant. Theodore Stahl operated an assay shop in Howardsville during the late 1870s and became involved with the Gladstone Mining & Reduction Company, which attempted to restart the lixiviation mill in 1881. Although the operation was a failure, Stahl became aware that prospectors had found an unusual vein on Bonita Mountain that featured a combination of silver and bismuth. They claimed it as the Sampson, which Stahl purchased in 1882 to recover the metals, especially the bismuth. Satisfied by his assay experiments, in 1883 Stahl organized the Southern Colorado Bismuth & Silver Mining Company, allocated investors, and began development of the Sampson. He built a surface plant at the mine, a concentration mill near Gladstone, and the second tramway in the San Juans linking the two. During 1883, Stahl's miners made a rich strike that ordinarily would have elated owners, but in fact confounded the operation. In particular, they encountered gold, and exploration revealed that with depth, the gold content increased while the silver and bismuth decreased. Whereas Stahl thought he had a silver and bismuth mine, the Sampson turned out to be a gold mine. He produced some ore and shipped it to distant smelters in hopes of enough income to refit the mill. Regardless, the Sampson Mill drew the first substantial population to Gladstone in years, and the workers filled the available housing.[150]

Like the in-house mills, the custom concentration plants built in the county in 1883 met with mixed success. Cherry's idle Eclipse Smelter below Animas Forks was one custom facility converted from a failed smelter with limited success. As with the Middleton Mill, the metallurgist found the ore differed in character depending on the source, and batches from different portions of the Eureka district must be treated variably. After three years of experimentation, intermittent operations, and constant adjustments the Eclipse investors withdrew.

The other custom plant was the product of an entirely new center of activity in the county's northwestern portion. As early as 1874, prospectors found mineralized veins along both sides of the main and middle forks of Mineral Creek, but because the formations were scattered and offered largely low-grade ore, the drainage attracted only minor attention. The Silver Crown on Mill Creek, western tributary to Mineral Creek, was the most promising mine during the late 1870s and saw some development. At the same time, prospectors examining Red Mountain Creek on the north side of Red Mountain Pass found deposits of silver ore. In 1881, John Robinson prospected the east side of Red Mountain Creek and staked the Guston, and John H. Haynes located the Congress. These were promising discoveries, and yet, from outward appearances, were too low in grade to generate serious interest. However, these initial assessments proved deceiving. Convinced that it was only a matter of time before they found a significant vein, Robinson returned in 1882. Near camp, they discovered rich samples of float,

[149] Colorado Mining Directory, 1883: 658; *"Mining News"* EMJ (10/21/82): 217; Nossaman, 1998: 202, 213.
[150] Bauer, et al., 1990: 62; *"Mining News"* EMJ (9/22/83): 187; *"Mining News"* EMJ (10/13/83): 235; Nossaman, 1998: 310.

chunks of ore broken off a parent vein and scattered on the ground by erosion. The party traced the float to its source and unearthed a vertical stock of ore they named the Yankee Girl. The find was so large and pure that it incited a true rush to Red Mountain valley. The event was at first a local, and quickly a statewide phenomenon. When Robinson and Haynes turned their attention back to the Guston and Congress, they found that at depth, these ore bodies were as significant as the Yankee Girl, which further fueled the rush.

By 1883, prospectors organized the Red Mountain Mining District, established several camps, and staked hundreds of claims. The district extended north from Red Mountain Pass and encompassed the valley on the west side of the Red Mountains, which lay mostly in Ouray County. The Mineral Creek district was to the south and the Poughkeepsie district to the east, both in San Juan County. The Red Mountain district developed quickly due to the proximity over Red Mountain Pass of commercial centers, communication systems, and transportation routes.

Just as San Juan County residents laid the foundation for the Red Mountain rush, they were also poised to profit from the event. The county was the main port of entry into the Red Mountain district, and Silverton the starting point for two routes. One logically followed the main fork of Mineral Creek to the base of Red Mountain Pass, where a settlement known as Sweetville began to grow in 1882. E.T. Sweet's saloon was the first business and became a seed for the camp. C.P. Mallett opened a restaurant, followed by William Emerson's butcher shop and Frank W. Barnes' lumberyard. The rival camp of Chattanooga materialized adjacent. In 1883, the two camps merged under the name of Chattanooga and one secured a post office. Afterward, T.E. Guerin started the Enterprise Restaurant, prospector Charles Robinson and Benjamin Brown opened mercantiles, and J.W. Shields erected a hardware store. Chattanooga was ready to serve the basic needs of prospectors and investors in the Red Mountain district.[151]

Other entrepreneurs completed key infrastructure that deepened the relationship between the Red Mountain district and Chattanooga. In 1883, the San Juan County commission awarded George W. Seaman a contract to grade a wagon road from Chattanooga. At the same time, Silverton pioneer Henry Adsit, George H. Brown, and James Downey organized the Red Mountain Sampling & Concentrating Company and built a custom mill at Chattanooga. This was San Juan County's second concentration facility built in 1883 and apparently modeled after Comstock's dual flow path. The intent was to provide processing for the Red Mountain district's low-grade material. The same year, the Mineral Creek Concentrating Company prepared to build a mill at Chattanooga, although it may have been the same facility.[152]

The other route from Silverton into the Red Mountain district ascended Cement Creek, from which prospectors crossed west over several passes between the Red Mountain peaks. The traffic increased business in the Gladstone mercantile, which already did a sound trade with the Sampson miners. But Gladstone failed to grow, and entrepreneurs established two nearby and competing settlements in 1883. The most promising was Del Mino, which George W. Bachman and William Bowman started at the mouth of Prospect Gulch. Other businessmen founded Vernon at the mouth of Georgia Gulch a short distance south of Del Mino. During 1884, Mineral

[151] Bauer, et al., 1990: 32; Nossaman, 1998 :278-9.
[152] *"Mining News"* EMJ (8/25/83): 119; Nossaman, 1998: 289, 291.

Creek became the most popular route, and traffic in Cement Creek declined and neither hamlet survived. Del Mino's buildings were moved to Gladstone.[153]

In stark contrast, Silverton literally boomed due to the railroad, its role as Red Mountain gateway, and as the center of the county's growing mining industry. Thomas Blair and Dempsey Reese saw their quiet hamlet evolve into a noisy hub of industry, freight, commerce, finance, and communication. By end of 1882, Silverton had eleven telephone subscribers. In 1883, the San Juan County Bank was formally chartered as the First National Bank of Silverton. Green Street became the commercial district and its side streets offered diverse businesses and services. Silverton hosted the first mining business exchange in the San Juans. Cushing M. Bryant, a successful metallurgist from Boston, opened Bryant's Mining Exchange in 1882, as a clearinghouse stocked with reference books and periodicals as well as access to investments. In 1883, Henry Adsit, Edmund Sweet, W.G. Melville, and other investors organized the Silverton Electric & Gas Light Company, although they did not immediately act.[154]

As the county's main point of contact with the outside world, Silverton was the principal cultural center. John and Amanda Cotton ran Cotton House, a community performance and celebration hall of sorts. The saloon was one of the most important social institutions in any mining camp, and Silverton featured around thirty, as well as two dance halls, mostly on Blair Street. The saloons in Silverton served as communication centers, public meeting halls, and entertainment centers. Silverton's residents even finally found time for God during the early 1880s. The Congregational Church Society built the first church in 1881, and the Catholics built their church in 1883. Many of Silverton's residents brought the tradition of fraternal orders with them, which was another important institution on the mining frontier. Fraternal orders provided social contact, assistance, guidance, death benefits, and even a primitive form of unemployment support. Men joined the Masons, the Odd Fellows, the Order of Eastern Star, and the Woodmen of World, while some women belonged to the Women of Woodcraft and the Rathbone Sisters.[155]

These and other organizations served as surrogate families for the few residents bold enough to winter in the county, and the organizations hosted holiday celebrations. Silvertonians and regional residents made sure that they enjoyed every holiday to the fullest and orchestrated social events on the slightest pretense. In 1876, young men established a baseball league and the older residents organized dances that drew men from miles away. Summer was a time for the Animas River drainage residents to celebrate their mining culture and, starting in 1882, miners' contests became a part of every July Fourth event.

A few visionary residents, mostly from Silverton, continued Dempsey Reese's low-level promotional campaign during the early 1880s, although by now, Silverton earned a name in the greater mining industry. As a showing of local pride, some of the mine owners in the Las Animas district contributed show-quality ore specimens for presentation and a contest at the

[153] Bauer, et al., 1996: 43; Nossaman, 1998: 289.
[154] Nossaman, 1998: 38, 68, 302, 236, 304, 306.
[155] Ronald Brown, *Hard Rock Miners: The Intermountain West, 1860-1920* (Texas A&M Press, 1979) 45; Henn, 1999: 151; Nossaman, 1998: 317, 323; Wolle, 1995: 422-4.

National Exhibition in Denver in 1882. Several local voices and experts maintained contact with reporters for the *Rocky Mountain News*, various mining industry journals, and the United States Mint. The most reputable individuals such as Theodore Comstock even produced their own articles on the region for publication.[156]

Paralleling the rise of positive attributes, crime and vice increased in the Animas River drainage, although it never approached the levels misrepresented by popular history. Through 1878, Howardsville, Silverton, and greater San Juan County were able to claim only one shooting each. By 1881, there was certainly more violent crime such as shootings, but it was proportional to the overall increase in population and occurred mostly among the rough element in Silverton. Robbery and theft, reliant on the anonymity of a large population, also increased. To prevent crime from reaching the epidemic proportions experienced in other boom towns, Silverton fathers hired legendary Bat Masterson to keep order while other concerned citizens formed midnight vigilance committees, which made use of the noose on more than one occasion. In contrast to another myth of the mining frontier, the Animas River drainage was nearly bereft of prostitutes. “Aunt Jane” Bowen brought the first of these service workers to Silverton around 1878 as the town grew and found the market quite limited. The entire Animas River drainage was unable to support more than around twelve prostitutes into the early 1880s. To be near the potential customers, the prostitutes set up shop on Blair Street, which was the region’s only red light district. Amusingly, to distinguish themselves apart from the strip of sin, those respectable citizens who already lived on Blair Street renamed the ends of the avenue Empire Street.[157]

While the Red Mountain rush was certainly an important local event, the county’s established mining industry was even more significant. The three public samplers, the Martha Rose Smelter’s brief life, and four successful concentration mills directly reflected a highly productive and growing industry. The number of mines either in development or production between 1882 and 1886 doubled. In particular, the county hosted around ninety-one small mines, eight medium-sized operations, two large producers, and two placers. A small mine is defined as a shallow operation with basic surface facilities, a handful of miners, and limited output. A medium-sized mine had between five and thirty workers, fairly extensive workings, and a surface plant with at least several buildings. A large mine had extensive workings, a surface plant with substantial buildings and some machinery, a workforce greater than fifty, and a significant output. While the number of operations doubled, their tonnages of ore mushroomed by a factor of ten. The ore value soared from $53,000 in silver, $10,000 worth of gold, and $16,000 for lead in 1882, when the railroad arrived, to $749,000 in silver, $40,000 worth of gold, and $207,000 in lead by 1885. Mineral exploration continued largely as before, and prospectors developed around 375 claims, only a slight increase from the late 1870s.[158]

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[156] *Rocky Mountain News* (6/20/82): 2; *Rocky Mountain News* (7/18/82): 8; *Rocky Mountain News* (7/22/82): 2; *Rocky Mountain News* (9/15/82): 2.

[157] Robert L. Brown, *An Empire of Silver* (Denver: Sundance Publications, 1984) 53; Nossaman, 1993: 166; Smith, 2002: 80; Wolle, 1995: 422.

[158] Henderson, 1926: 216 for production figures. The number of mines derives from a survey of 1879 and 1883 *Colorado Mining Directories* and weekly county summaries in *EMJ*.

Las Animas Mining District

In contrast to the rest of the county, the roster of active mines in the Las Animas district barely increased after 1882, although almost every significant operation began sending ore down to Silverton. At the Aspen, the New York & San Juan company appointed Thomas Hackett as foreman because of his experience driving the Ingersoll Tunnel. Under Hackett, a large crew of miners drilled and blasted six to seven tons of ore per day, which Sweet's Sampling Works prepared for shipment to the Durango Smelter. By 1883, the Aspen featured at least 7,000 feet of underground workings.[159]

To the southwest, new properties high on the flank of Kendall Mountain began to make good on their promise of ore. In 1882, the Lackawanna Tunnel & Mining Company drove two tunnels to undercut the J.B. Smith and A.J. Craine veins. A short distance up Swansea Gulch, miners pushed Thomas Higgins' Scranton City Tunnel toward another vein. Almost one mile to the west, above Silverton, prospectors discovered a vein with potential in Idaho Gulch and staked the Idaho Group of claims. During 1883, a small party of miners leased the property and shipped ore to a Denver smelter for testing and treatment. The ore was visually impressive but difficult to treat and therefore less profitable than the lessees hoped for.[160]

In Little Giant Basin, the operators of the Big Giant Mine encountered similar problems when their tunnel reached the target vein. The ore assayed well but was too complex to treat at a profit, and the operation stalled. The nearby Solomon and Potomac mines more than made up for the Big Giant's lack of production. At the Potomac, miners enjoyed the relatively easy work of drilling and blasting ore from the vein's surface and shipped the particularly rich payrock to Durango.[161]

Still aspiring to become a mining engineer and operator, Victor Vincent deepened his involvement with the Solomon Mine, which proved his undoing. In 1882, Vincent interested fellow Frenchmen Jules Rifflard and Richard Salembier in the Solomon and discussed leasing the property from the Solomon Silver Mining Company. The trio agreed, Vincent appealed to the wealthy Arthur C. King in New York City for capital, and they organized the French Silver Mining Company. The outfit retained the Solomon company's crew of twenty miners and kept them busy all winter producing ore. After encountering a 10"-wide vein of solid copper and galena ore, the French petitioned the Ressouches brothers and Solomon Silver Mining Company to sell the claims. The owners agreed, but only on condition of regular payments and specified underground development should the French default and abandon operations.[162]

After signing the sale contract, Vincent was suddenly caught in a difficult position. In an unrealistically short time, King began demanding returns on his investment while the Ressouches reminded Vincent about their payment schedule. To appease King, Vincent procrastinated on the required development and directed the miners to extract ore as fast as they could. After several

159 Nossaman, 1998: 100, 203, 307; Ransome, 1901: 162.

160 *Report of the Director of the Mint*, 1882: 547; *Report of the Director of the Mint*, 1883: 409; *Rocky Mountain News* 10/17/82): 6; *Rocky Mountain News* (7/21/82): 2; *Rocky Mountain News* (8/30/83): 2.

161 *Report of the Director of the Mint*, 1882: 547; Nossaman, 1998: 206; *Rocky Mountain News* (6/24/82): 3; *Rocky Mountain News* (8/18/82): 2.

162 *"Mining News" EMJ* (11/11/82): 259; Nossaman, 1998: 308.

months, the Ressouches found out about the neglected development and immediately ordered a stop to ore production, which left Vincent in an impossible situation. He was not allowed to produce ore until he paid the Ressouches, and he could not pay the Ressouches without mining ore. The French defaulted on the contract and the Ressouches attempted to reclaim the Solomon Mine, but the French resisted. At a deadlock, both parties filed suit at the end of 1883 and shut down the operation. Deflated, Vincent quit the French and returned to France.[163]

To the southwest Silver Lake Basin began to resound with activity. In 1881, several prospectors imitated John Reed and made the dangerous ascent into the basin, where they examined the west wall a short distance south of Reed's claim. After climbing rock cornices, they found a rich vein, staked it with the Iowa and Stag claims, and began development of a tunnel and shaft. At the end of the season, the party had ore samples assayed in Silverton. The report surprisingly found that the ore was not only rich with silver and industrial metals, but also gold. In 1882, the party returned and began production. The members enticed a crew of miners to make the sheer cliff at the Iowa their home for the working season with all the supplies and lumber necessary to build a basic surface plant.[164]

While the Iowa miners acclimated, John Reed labored on Silver Lake a short distance to the north. During 1880 and 1881, he traced the Silver Lake vein for a considerable distance with shallow excavations hewed into solid bedrock. In 1882, he produced several tons of ore from a tunnel he drove while lamenting the slothful progress due to the short working seasons. To be caught by a heavy snow in the basin would be a life-threatening event, which forced him down relatively early each year.

During a stay in Silverton in 1883, Reed convinced John W. Collins that the Silver Lake and Round Mountain claims would pay well if worked, but required an initial investment. For a share of the Silver Lake, Collins and Reed formed a partnership, ascended into the basin, and began production. Reed and Collins also packed in enough lumber and equipment to build a small blacksmith shop and cabin. They hired a small crew of miners to begin a second tunnel. Once the miners reached the vein, the party produced around five tons per day and packed it down to Sweet's Sampler.[165]

On the east side of Silver Lake Basin, Julius Johnson drove a tunnel underneath the Royal Tiger claim. An old-time prospector, he leased the property from McPherson Lemoyne. The lease ended around 1883 when Lemoyne sold the Royal Tiger to Innis, who hoped to approach his fabled lake of gold from the opposite side of the mountain should the Highland Mary fail, which it was.[166]

After ten years of confusing instructions, conflicting orders, and decisions that railed against common sense, Edward Innis finally ran out of money. In 1885, he closed the Highland Mary. Innis' reliance on a psychic confirmed the suspicions of workers and caused a minor sensation in the Colorado press. *Rocky Mountain News* announced: "The Silverton *Miner*

[163] *Report of the Director of the Mint*, 1882: 548; Nossaman, 1998: 308.
[164] Ransome, 1901: 157; *Rocky Mountain News* (8/1/82): 3; *Rocky Mountain News* (9/19/82): 3.
[165] *Report of the Director of the Mint*, 1883: 409; Henderson, 1926: 49; Nossaman, 1998: 307; Ransome, 1901: 149; *Rocky Mountain News* (8/30/83): 2.
[166] Nossaman, 1998: 325; Prosser, 1914.

pronounces the Highland Mary Mine a howling failure. This mine has been worked, says the *Miner*, under the direction of spirits."[167] Innis left the county broke and embarrassed, with little recognition that, despite the complete lack of ore production, he had made the Highland Mary one of the most advanced operations in the San Juans to date. In the process, he squandered around $1 million (or $19,000,000 today) and paid his seeress $50,000.[168]

Eureka Mining District

Unlike the Las Animas district, Eureka enjoyed a major boom between 1882 and 1885. Capital flowed, the number of substantial operations increased, and ore production rose as a result. California and Placer gulches, in the district's northern portion, saw the most activity. After limited success with the Alaska Mine, Alfred Hard settled in Animas Forks or Eureka. Hard served as manager of the Mastodon Mining & Reduction Company in Placer Gulch, which was so productive that he planned for a mill. When not at the Mastodon, Hard worked as a superintendent at several other mines and participated in new ventures. In particular, Hard and his Cleveland friends organized the Silver Lead Mining Company in 1882 and speculated on claims near Eureka.[169]

Rasmus Hanson was easily as busy as Hard, if not as successful. Born in Denmark in 1847, Hanson immigrated to Quebec at age twenty-one, and moved on to Chicago. The opportunity for adventure drew Hanson west, as far as Cheyenne where financial circumstances forced him to work for the Union Pacific Railroad. He became interested in mining, saved pay, and tried his luck prospecting in Nevada. Unsuccessful, Hanson migrated to Central City in 1870, Clear Creek County, and ultimately Park County, where he prospected and worked as a miner. In 1873 or 1874, Hanson realized that the San Juans presented possibilities, being recently opened.

He built a cabin and realized his dream in 1880 by discovering the Sunnyside Extension at the head of Placer Gulch. As noted above, he worked the claim with L.C. Osborne, but Osborne apparently tired of the labor and leased the property to Hanson in 1882. Hanson struck rich ore during the year and realized enough income to buy the property in 1883. From that point, Hanson engaged in a cautious development strategy anathema to most profit-hungry mine owners. Specifically, he did not overcapitalize the operation and instead reinvested his profits in development and improvements. Progress was slow, but steady, and once the mine was ready for major production, Hanson stood to profit significantly. This pattern characterized the first years of the Sunnyside Extension, and in 1885, Hanson was ready to treat ore in his own mill and save the fees levied by custom plants. He leased the Greenleaf Mill at Animas Forks. The Greenleaf, however, performed no better on Hanson's ore than on material from the rest of the Eureka district, so he relinquished the lease, planned his own mill, and patiently saved his money. Hanson attempted to increase his income by working the Atlantic for the Red Gulch Mining &

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167 Rocky Mountain News (8/10/85): 6.
168 Denver Times (7/10/01): 5; Eberhart, 1987: 345; *Rocky Mountain News* (9/14/58): 65.
169 Colorado Mining Directory, 1883: 650, 672.

Milling Company at the same time as the Sunnyside Extension. A fire in the Atlantic tunnel house, however, destroyed his equipment.[170]

To the west in California Gulch, new owners of the Mountain Queen prepared to bring the mine into production. When James Cherry left the county following the Eclipse failure, investors sold company assets to two camps. One bought the smelter and refitted it as a concentration facility. The other group purchased the Mountain Queen, originally supposed to provide the smelter with excellent silver ore. While sources conflict regarding the exact date, S.W. Thorne likely bought the mine in 1882 for the high price of $125,000, which inspired confidence among other investors. Thorne pursued a development campaign and brought the mine into meaningful production. Shortly afterward, Thorne formalized the operation as the Mountain Queen Mining Company.[171]

Despite the positive economic climate of the early 1880s boom, some of the established operations ran into considerable difficulty. After significant investment in advanced equipment, Matt France drove the lower tunnel on the Silver Wing and finally reached the target vein. Unfortunately, the vein did not feature ore in the same amount or character as it did near the surface, and instead offered complex, low-grade material that was difficult to treat. Although France may have been confident that he could find profitable ore, investors were unwilling to risk more money and suspended work. France probably produced small amounts of ore from the upper workings in an attempt to pay the costs of further exploration. Conversely, mining engineer J.F. Taylor at Mineral Point Tunnel in California Gulch, previously the Silver Peak Mining Company, grossly underestimated the cost of driving the mile-long tunnel. By 1884, the tunnel was still far from its destination and had not encountered any of the hidden veins that were expected. Taylor had little to show, his British investors granted no more capital, and the operation went bankrupt due to unpaid debts. The town of Animas Forks lost a major employer, and the tunnel remained closed for decades.[172]

Numerous other operations and a large population at Animas Forks mitigated the loss. During the early 1880s, Animas Forks had a distinct business district, numerous cabins, a population of at least 160 residents with an additional 300 scattered amid the surrounding mines. The business district catered to the needs of workers primarily and visiting company officials secondarily. This can be expected because of the town's role as the Eureka district's northern commercial hub and the eastern gateway into the county. Eureka was the second most important town in the mining district and the commercial hub for its central portion. The population was similar to that of Animas Forks, but the surrounding mountains featured fewer mines and the area population was therefore less. Thus, Eureka did not grow as quickly as Animas Forks and had a smaller business district.[173]

The southern portion of the Eureka district finally saw activity during the early 1880s as prospectors began to develop claims in Minnie and Maggie gulches. Oliver and Frank Gorsage

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[170] Brown, 1984: 92; *"Mining News"* *EMJ* (7/19/90): 81; Nossaman, 1989: 178; Nossaman, 1993: 193, 202; Nossaman, 1998: 261.

[171] Marshall and Zanoni, 1998: 143; Nossaman, 1998: 265.

[172] Nossaman, 1993: 121.

[173] *Colorado Business Directory*, 1884: 200; *Colorado Business Directory*, 1885: 228; George A. Crofutt, *Crofutt's Grip-Sack Guide to Colorado: A Complete Encyclopedia of the State* (Omaha: Overland Publishing Company, 1885) 90.

built cabins at the mouth of Maggie Gulch and worked the Auburn, Charity Ann, Minnie, Silver Lead, and other nascent mines. Their camp evolved into the settlement of Middleton, which attracted a mercantile and the Middleton Smelter. The Hover Brothers found the pasture offered by the wide Animas River valley was excellent for cattle and established a dairy. Middleton was never formally platted as a town, but it remained an important local settlement for decades.[174]

The mines on the east side of Cunningham Gulch were among the county's earliest producers and enjoyed additional improvements during the early 1880s boom. It remains debatable whether the east side was in the Eureka district's far southern extent or the east edge of the Las Animas district. In either case, Reese, Mulholland, Blair, and Mickey Breen sold the Green Mountain Mine to British interests in 1881, who in turn leased it to George Ingersoll and partner. The concentration mill that Ingersoll built in 1882 functioned correctly, unlike most, and provided Ingersoll sound returns for several years. Nearby, Christian Schoellkopf kept twenty miners busy extracting a substantial tonnage of ore from the Pride of the West. Around 1880, he developed the vein through three tunnels, and each had its own tunnel house and ore bin. To the north, another party began preparing the Old Hundred for production.[175]

Mineral Point Mining District

The Mineral Point district enjoyed a small wave of interest during the early 1880s. Even though the district was far from Silverton, the samplers there provided mining companies with an alternative to the smelters in Hinsdale County, and the cost of goods and materials was less due to the railroad. The Polar Star and Red Cloud continued to be the principal operations. By 1882, the Crookes developed the Polar Star to the point where the underground workings were accessed through tunnels on both the San Juan and Hinsdale county sides of Engineer Mountain. The mine was more important to the Crookes than ever because their smelter was in financial difficulty and they needed the high-grade ore. Greenleaf and his Mineral Mountain Mining Company maintained production at the Red Cloud through two shafts and expanded work to the nearby Burrows No.2. In addition to these principal producers, a few partnerships began shipping high-grade ore from shallow mines such as the Big Giant, Bill Young, San Juan Chief, and Palmyra.[176] The remote town of Mineral Point changed little during the early 1880s. The population increased slightly to 200, which supported two mercantiles. The town featured the Forest House and Mineral Point Hotel.[177]

Mineral Creek Mining District

While Silverton was popularly known as a mining town, the definition came mostly from a role as the milling, ore shipment, and business center of San Juan County. In actuality, few

[174] Nossaman, 1998: 262.
[175] Nossaman, 1998: 101
[176] Nossaman, 1998: 123.
[177] *Colorado Business Directory*, 1884: 276; *State Business Directory*, 1885: 326; Crofutt, 1885: 120.

mines of significance lay within a reasonable distance by foot, at least until 1882. At that time, the development of some of the county's largest and most important operations granted Silverton a direct association with ore production. The mines were centered on the Hercules and North Star vein system at the base of Sultan Mountain, an easy walk from town.

As noted above, the Sultan Mountain Mining Company purchased the North Star in 1881, hired Oliver Posey as manager, and began heavy production. The company gladly leased the concentration mill that Theodore Comstock built at the mine and enjoyed substantial profits. The mill generated so much concentrate that the Denver & Rio Grande graded a siding just for the mine. However, the available ore underground began to dwindle and the company responded by selling the entire operation to Lucius B. Kendall for $75,000 in 1884. Kendall obtained the money from investors and profits earned from the Bonanza Mine in the Poughkeepsie district. He astutely observed that the Sultan Mountain company merely extracted the shallow ore and failed to fully develop the vein at depth, leaving vast ore reserves. Kendall sold a one-third interest to W.M. McKelvey for $72,500, and they organized the Silverton Mining Company. Through the sale, Kendall recovered his own costs and had plenty of capital for formal development. Posey was out of a job, although the Congress and Yankee Girl mines, two of the best in the Red Mountain district, now consumed his attention. He purchased them in 1882 with George Crawford of Pittsburgh, in addition to the National Belle in 1884, and soon realized a fortune. Kendall and McKelvey did well also, because the North Star became one of the county's longest-lived producers.[178]

A short distance to the south, several other companies were at work on the Hercules and Little Dora veins. One outfit had been driving the Empire Tunnel toward the Little Dora in 1881 in anticipation of the railroad and struck the formation. When trains began service, the company sent its ore to the Durango Smelter. After John Williams sold his interest in the Sultan Tunnel, he turned his attention to the Victoria section of the vein system. Knight, Slocum & Company did a little work on the system and likely started the Montezuma Tunnel. In 1881 or 1882, Williams became involved with the Victoria Consolidated Mines Company, which purchased the incomplete Montezuma and Ajax tunnels and began pushing them toward the Victoria and Hercules veins. By 1884, Williams had both tunnels in production.[179]

During the mid-1880s, subtle change began to creep through the county. The first sign was that many small pocket mines and shallow operations either curtailed or suspended production altogether. Another indicator was that investors grew tight with the capital necessary to develop small mines into sound producers. In 1886, a combination of internal and external problems brought to an end the boom stimulated by the railroad and Porter's smelter. Miners exhausted the shallow veins, overestimated their ore reserves, and found that the substantial veins decreased in value and increased in complexity with depth. In short, miners had finished off the easily treated, shallow ore and were left with deeper unprofitable material. Outside the

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178 *"Mining News"* *EMJ* (8/4/83): 71; *"Mining News"* *EMJ* (6/14/84): 448; Nossaman, 1998:265; Smith, 1994: 37.

179 *Colorado Mining Directory*, 1883: 680; *"Mining News"* *EMJ* (12/22/83): 387; *"Mining News"* *EMJ* (11/8/84): 320; *Silverton Standard* (3/12/10): 1.

district, a synergy of forces eroded confidence in the silver market and not only caused the value of the white metal to slip, but also made investors wary. In particular, opponents of the silver standard shifted Treasury policy in favor of paper currency and opposed the free coinage of silver. In 1885, the value of silver decreased from $1.12 per ounce to $1.06 and continued a downward trend until it bottomed out at $.94 in 1888. The watershed year, however, was 1886, when silver reached $1.00 per ounce, which seemed to be the threshold for mining investors. The prices for industrial metals fell in parallel, and they constituted a significant portion of the county's ore. Copper dropped from $.21 to $.16 per pound, and lead decreased by a penny to $.04 per pound.[180]

The net result was that the mine owners and operators in San Juan County saw their profits evaporate and closed many of the remaining operations. In the Las Animas district, almost all the mines went idle except for the Aspen, North Star, and Titusville (recently developed on Kendall Peak). In the Eureka district, the roster of productive mines fell until the Sunnyside, Hanson's Sunnyside Extension, and the Mountain Queen remained the only reliable principals. Mineral Point's miners exhausted the shallow ore, and investors were unwilling to risk more capital on deeper work. Cement Creek was quiet and grew even more so when the Sampson Mine, the most promising operation, went bankrupt in 1885. To the west, activity in the Mineral Creek district contracted around Sultan Mountain and Chattanooga, which shrank in size and depended on Red Mountain district traffic more than ever.

A third symptom of the countywide problems was that well-funded companies scaled back their operations and tried cutting costs, much of which was labor. In 1885, S.W. Thorne reduced the wages of his miners at the Mountain Queen from the already low rate of $3.00 per shift to $2.50 without reducing the price of room and board in tandem. Miners protested and threatened to strike. At the Aspen Mine, John Porter decreased wages from $3.50 to $3.25. For additional savings, however, he stopped providing miners with the luxury foods they had grown accustomed to. Pay and food being sacred to miners, they still threatened to strike and Porter, unwilling to negotiate, tested the miners' will.[181]

Unfortunately for Thorne and Porter, they underestimated the miners' resolve and set in motion the county's first serious labor dispute. The miners walked away from both operations, and the Aspen crew appealed to the Silverton chapter of the Knights of Labor, the most powerful miners' union in Colorado during the 1880s. The union met with Porter, who proved intractable, and word quickly spread and other groups of miners threatened to strike in sympathy. Porter and Thorne's actions appeared to initiate a wage-cut trend that other mine owners throughout the county would imitate. To nip this in the bud, miners in support of their Aspen and Mountain Queen brethren gathered in huge numbers in Silverton and pressured Porter to accede. Tensions ran high and the fate of the region's entire mining industry teetered on Porter's decision.[182] Backing up their threat in writing, a reporter for the *Engineering & Mining Journal* noted: "At a

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[180] Brown, 1984: 191; *"Mining News"* *EMJ* (8/14/86): 119; *Report of the Director of the Mint*, 1894: 20; Saxon, 1959: 7-9, 14-7; Smith, 1994: 184.

[181] *Rocky Mountain News* (1/31/85): 1.

[182] *Rocky Mountain News* (1/31/85): 1.

meeting of miners held at Silverton, a resolution was passed and signed by all who were present, pledging themselves not to work for less than $3.50 a day."[183] Unwilling to precipitate a catastrophe, Porter conceded and his miners went back to work. Thorne instead closed the Mountain Queen. When the investors found out about this and Thorne's other mismanagements, they ousted him. The Aspen Mine, a bellwether of the Las Animas district, went silent for the first time in over ten years. It was now obvious that a depression was at hand.

The Late 1880s Slump, 1886 - 1889

San Juan County entered a dark period in 1886, and the principal mining interests of the county had reason to believe that silver's value would continue to slide. And yet, they instituted a handful of significant projects using mostly their own capital. The projects did not involve fabulous discoveries, new veins, or rich ore. Instead, they were an attempt to improve efficiency through mechanization and other infrastructure improvements, increase production, and reduce the extraction cost per ton of ore mined. Some of the projects were costly, and they collectively maintained some momentum to mining industry in the county.

The Las Animas district hosted a significant share of the activity. Howardsville assayer Thomas Trippe spearheaded one of the county's most important projects in 1888 when he convinced investors to build a $50,000 concentration mill for the Titusville Mine. Trippe asserted that separating the waste from the metalliferous content and then shipping the concentrates to the Durango Smelter would provide significant cost savings. Instead of building the mill at the mine, Trippe sited it on Deer Creek near the Animas River where he could harness water power. Moving the ore to the mill, however, was a problem and in response, Trippe contracted for a Huson aerial tramway to carry the ore for a distance of around 8,000 feet. This may have been the county's third major tramway system. Because the construction season was short, the mill was not ready when winter set in. Trippe, however, had been courting St. Louis investors who accepted his word as an experienced mining expert that the operation was one of the best in the region. There was certainly some truth in this because the tramway was the second ever built in the Las Animas district, and the mill was one of a few constructed within the last five years. Trippe then negotiated a deal for an astounding $250,000, which he divided among his investors.[184]

The North Star Mine on North Star Peak was among the few operations to weather the 1886 recession, but not without difficulty. The Crookes finally wearied of the high operating costs engendered by the challenging location and floundered for ways to trim the budget. With their Lake City smelter closed, the Crookes accepted the reality that they had to send the ore to the Durango Smelter. The teamsters took the shortest route to the railroad at Silverton, leading mule trains on a well-built trail that wound around the exposed east summit of North Star Peak, down Little Giant Basin, and to a transfer station in Arrastra Gulch. There, workers hefted the sacked payrock into wagons and completed the final leg to Silverton. This cumbersome process

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[183] *"Mining News"* EMJ (2/14/85): 112.
[184] *"Mining News"* MSP (3/31/88): 205; *"Mining News"* EMJ (10/5/89): 299; *"Mining News"* EMJ (11/22/90): 605; Ransome, 1901: 161.

consumed a huge proportion of the profits, and so the Crookes finally decided to invest in a concentration mill to separate out some of the waste. Why they waited until 1889 is a mystery since the benefits of concentrating ore for a mine such as the North Star were well known by then. Regardless, the Crookes invested $40,000 to $50,000 in a facility similar in scale to Thomas Trippe's Titusville Mill. The North Star facility, however, was not nearly as well planned. The Crookes could have followed Trippe's template with the Titusville and sited the facility on the floor of Cunningham Gulch. The distance from mine to mill had the ideal fall line for an aerial tramway. Instead, the Crookes chose a location at the head of Little Giant Basin along the Silverton route, which required that the crude ore be packed around North Star Peak first. In addition, the physical environment presented the same impediments that convinced Trippe to build his mill lower down on the Animas River. When finished during 1889, the *Engineering & Mining Journal* praised the mill as the highest in the nation at 12,700 feet. This, however, was an exaggeration because the mill actually lay at around 12,160 feet. The Crookes ran the mill until 1892, when they moved it down to the mouth of Boulder Gulch.[185]

At the time that Trippe and the Crookes were building their mills, the New York & San Juan Mining & Smelting Company was reorganized as the San Juan Smelting & Mining Company and consolidated its assets to achieve the business practice known as vertical integration. The massive company controlled coal mines, coke ovens, the Durango Smelter, transportation, and several silver mines including the Aspen complex. Given the low price of silver, San Juan Smelting & Mining decided to remedy the awkwardness of managing the Aspen's five separate tunnels and improve efficiency by driving a central haulageway to undercut the vein system at great depth. In 1888, the company commissioned the Amy Tunnel, named for Henry Amy, manager of the Durango Smelter, on the north base of Hazelton Mountain, 1,000 feet lower than the mine's early workings. In so doing, miners could work the ore veins from the bottom up and haul the ore through the tunnel to a proposed concentration mill. By 1889, miners drove the tunnel more than 1,000 feet where they struck the ore system and brought the property back into profitability. In later years, the tunnel was renamed the Aspen to reflect its association with the Aspen ore system.[186]

The Eureka district had grown relatively quiet except for two of its principal mines, which were the Sunnyside and Sunnyside Extension. The high gold content of their ores was the reason that these two mines did well during the recession. Although the value of silver ebbed, that of gold did not, but the recession created difficult economic conditions. As a result, the owners of the mines attempted to reduce their operating costs in the same manner as Trippe and the Crookes. Both, however, needed no outside investors and instead had their saved earnings for exactly such purposes.

Rasmus Hanson, owner of the Sunnyside Extension, continuously if not cautiously reinvested his profits in formal development for long-term operations. Progress was slow for several years because Hanson's funds were limited, but by 1886, he finally shifted from development to substantial production. He generated so much gold and silver that his income

[185] *"Mining News"* EMJ (6/29/89): 595; *"Mining News"* EMJ (9/21/89): 252; Ransome, 1901: 23.
[186] *"Mining News"* MSP (5/5/88): 285; *"Mining News"* EMJ (5/12/88): 347; Ransome, 1901: 162; Smith, 1982: 56; Smith, 1992: 27.

partially offset the decline of the other mines in terms of the county's overall production figures. Hanson also saved enough capital to build his own mill. Thus, he organized the Sunnyside Extension Mining Company and began construction at the mine in Placer Gulch. Originally, Hanson entertained grand plans of electrifying the facility with power generated at a hydro plant on the Animas River, but quickly shelved the idea. In 1889, Hanson finished the mill and found it to be a metallurgical success.[187]

John Terry combined elements of Trippe's Titusville model and Hanson's electrification plan when he erected a mill in Eureka Gulch for the Sunnyside Mine. He was unsatisfied with the small capacity, inefficiency, and remote location of the stamp mill at Lake Emma and petitioned Milton Engleman to fund a new facility. Like Hanson, Terry wanted to electrify the mill, and similar to Trippe, he thought a lower location and an aerial tramway were best. Also like Hanson, Terry was unwilling to incur too much debt and so planned to build the system in financially sustainable phases. Thus, he began construction in 1889 at a confluence deep in Eureka Gulch, around one mile west of the town. The mill featured two processes that relied on mercury to amalgamate with free gold and concentration equipment to recover the material that resisted amalgamation. A small hydro-power plant was installed at the mill, which provided lighting and probably ran the machinery. When finished in 1890, the facility performed well and allowed Terry to increase production at the mine, but he waited until capital reserves were replenished before adding the tramway.[188]

The other major project in the county was a fifth mill erected during the late 1880s. This one went up within sight of Silverton on the base of Sultan Mountain at what was now known as the Victoria Mine. During the mid-1880s, John Williams brought either the Ajax or Montezuma tunnel into production under the Victoria company and demonstrated that the Hercules and Little Dora vein system were productive. On this premise, even though the value of silver was at a low point in 1888, Williams managed to sell the Victoria company to a group of Boston capitalists. They reorganized Williams' outfit as the Victoria Mining & Milling Company and continued production. It remains uncertain who proposed the idea of a mill, but Williams was convinced that shipping concentrates to the Durango Smelter was far less costly than waste-laden ore. In 1889, the investors fronted the money for the mill and secured Alonzo Smith to build it. Smith claimed he had superior experience from his participation in erecting Colorado's first stamp mill, which is unproven. The new Victoria Mill and the nearby North Star complex, which may have been the most productive mine in the county during the late 1880s, contributed greatly to Silverton's popular image as a gritty mining town.[189]

Otto Mears backed the last major project completed in the Animas River drainage during the late 1880s, and it had a regional impact. After assembling a network of lucrative toll roads in the eastern San Juans, Mears saw a railroad as the next logical step in his transportation empire and proposed a line from Silverton northwest up Mineral Creek, over Red Mountain Pass, and down into the Red Mountain district. No one but Mears, John Porter, and the most powerful

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[187] *"Mining News"* *EMJ* (12/29/88): 551; *"Mining News"* *EMJ* (9/21/89): 252; *"Mining News"* *EMJ* (12/7/89): 505.
[188] Marshall and Zanoni, 1998: 119; Ransome, 1901: 176.
[189] *"Mining News"* *EMJ* (12/1/88): 465; *"Mining News"* *EMJ* (9/21/89): 252; Silverton Standard (11/9/89): 2.

mine owners thought that it could be done, and they brought their capital to bear and completed the Silverton Railroad in 1888. The railroad astonished the mining industry and the Denver & Rio Grande directors, who claimed that such a venture was impossible. The mine owners in the Red Mountain district had a direct interest in the new line because the railroad reduced their high operating costs and restored profitability despite the low value of silver. Porter in particular wanted the railroad because he needed the ore for the Durango Smelter, which had trouble securing enough payrock due to the recession. Even though the Silverton Railroad better served the Red Mountain district than Silverton, the railroad benefited San Juan County. In essence, the railroad ensured that the county, and especially Silverton, remained the all-season portal into the Red Mountain district. This was crucial during the late 1880s because, despite the new mills, the rest of the county's mining industry was in poor condition.[190]

[190] Whitman Cross, Earnest Howe, and F.L. Ransome, *Geologic Atlas of the United States: Silverton Folio, Colorado* (Washington, .D.C: U.S. Geological Survey, Government Printing Office, 1905) 26; Henn, 1999: 134; Sloan & Skowronski, 1975: 35; Smith, 1982: 50; Smith, 1994: 166; E.F. Tucker, *Otto Mears and the San Juans* (Montrose, CO: Western Reflections, 2003) 91.

The Value of Silver Restored, 1890 – 1893

The residents of San Juan County were rewarded for their perseverance through uncertain times when the politics surrounding the value of silver turned in their favor. During the late 1880s, western legislators clamored for a return to a pro-silver policy to bolster sagging mining industries in their states, as well as their own personal silver stock portfolios. Well organized, they succeeded in 1890 in passing the Sherman Silver Purchase Act, which required the federal government to buy 54 million ounces of silver per year at $1.05 per ounce. The figures fostered a demand and price capable of resuscitating the west's silver mining industry, creating jobs, revitalizing regional economies and improving the popularity of the legislators among constituents.[201]

San Juan County was caught up in the return to mining, and more than just its economy was revitalized. The mountains boomed with sound, and an atmosphere of industry and purpose returned. During 1890, investors loosened their purse strings and purchased some of the proven mines, invested in mills and machinery to lower operating costs, and enlarged existing operations. The net result was an increase in the number of operations, amount of ore produced, and population. During the late 1880s recession, the county featured between ten and twenty small mines, around seven medium-sized operations, and one substantial producer. During the early 1890s, this increased to at least twenty small mines, ten medium-sized operations, and two substantial producers. The production of metals almost doubled from the 1890 figure of $337,000 in silver, $187,000 worth of gold, and $156,000 in lead.[202]

During the revival, mining companies in the county and Red Mountain district sent more ore through Silverton than the Durango Smelter could process. Otto Mears saw this as an opportunity, organized the Standard Smelting & Refining Company, and built a second smelter in Durango in 1892. Mears' strategy was threefold. First, he attempted to compete directly with the Durango Smelter and subsume a share of the smelting business. Second, Mears operated the smelter in coordination with his Silverton Railroad, which strengthened both companies. Last, Mears wanted to provide a low-cost treatment facility for the mines that he and friends operated and pocket the savings. Although the facility was equipped to treat the copper-rich ores of the Red Mountain district, it also processed similar payrock from San Juan County. The San Juan Smelting & Mining Company responded by adding several furnaces to its Durango Smelter, lowering its fees, and improving the returns. The Crookes also attempted to profit from the high volume of ore and built a silver leaching mill at the mouth of Boulder Gulch, near Howardsville.[203]

Las Animas Mining District

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[201] Brown, 1984: 193; Smith, 1982: 92; Ken Reyher, *Silver & Sawdust: Life in the San Juans* (Montrose, CO: Western Reflections, 2000) 179; Stephen M. Voynick, *Colorado Gold: From the Pike's Peak Rush to the Present* (Missoula: Mountain Press Publishing Co., 1992) 62.
[202] Henderson, 1926: 216 for production figures. Active mines were derived from a survey of *EMJ* and *Silverton Standard*.
[203] *"Mining News" EMJ* (2/6/92): 187; Nossaman, 1998: 252; Ransome, 1901: 23; Smith, 1982: 101; Smith, 1992: 28; Tucker, 2003: 114.

In the Las Animas district, the key mining outfits that managed to survive the recession were among the first to boom in response to positive climate of 1890, and several of these were in Silver Lake Basin. What followed laid the groundwork for that basin to become one of the most advanced centers of mining technology in Colorado. Benjamin W. Thayer and James H. Robin thought they had outsmarted the recession when they examined the Iowa Mine in 1888 and found a vein that offered an unusual combination of gold and silver. The Sunnyside Vein system was the only other similar known ore formation. The partners leased the property in 1889, began production, and were elated when the Sherman act restored silver's value and rendered the new ore even more valuable than before. Thayer and Robin increased the workforce to expedite development and discovered a second vein of galena, which ensured even greater profits.[204]

Thayer and Robin were well on their way to realizing a dream shared by other local businessmen who dabbled in mining. Thayer arrived in Silverton in 1881 with the railroad and found a job in a mercantile. Dissatisfied, he migrated to Durango in search of opportunity and married Nellie, daughter of John L. Pennington. Probably with Pennington's capital, Thayer returned to Silverton in 1883, opened his own mercantile, and invested in real estate. A solid businessman, Thayer ascended into Silverton society, where he met Robin.[205]

Born on the Isle of Jersey in New York, Robin was one of the first entrepreneurs to establish a business other than a mine in the Animas River drainage. In 1875, Robin and several brothers leased a brick yard near Silverton, which generated handsome profits that they reinvested in real estate. The brick yard also demonstrated that construction materials, always in demand, provided surer income than uncertain mining ventures. With this in mind, Robin and John Pennington pooled their resources, established a sawmill on Cement Creek in 1880, and sold the lumber in a yard in Silverton. At the same time, Robin maintained a real estate office and speculated with his own money. He cemented his role in Silverton society by entering local politics and working as a community activist alongside his wife Amelia. Once Robin had enough capital, he ventured into more uncertain mining projects, including the Iowa.[206]

During the summer of 1891, the Iowa consumed of Robin and Thayer's attention. They hastily repaired the buildings up on Kendall Peak's cliff, brought in additional supplies, and made arrangements for a small crew of miners to stay the winter. When the mine became snowbound, all the crew could do was develop the several veins and stockpile ore for the coming thaw. And when it arrived in June, Robin and Thayer eagerly received the precious payrock and reports that the veins looked better than ever. Thayer and Robin realized that their meager investments would constrain production and more money was necessary for the mine to blossom. Robin approached Gustavus Stoiber, a trained mining expert with funds, and together, the men organized the Iowa Gold Mining & Milling Company in 1893. Stoiber served as president, Robin secretary, and R.W. Watson and H.W. King as vice-presidents.[207]

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[204] *"Mining News" MSP* (11/2/89): 339; *"Mining News" MSP* (3/1/90): 140.
[205] Nossaman, 1998: 62.
[206] Nossaman, 1989: 62, 238; Nossaman, 1993: 32, 60, 310.
[207] Colorado Mine Engineers' Reports: Iowa Mine; Iowa Gold Mining & Milling Company *Stock Prospectus* Denver, CO, 1896; *"Mining News" MSP* (11/21/91):331; *Silverton Standard* (8/20/92.

While the Iowa was a confirmed bonanza, developments on the Silver Lake claims a short distance north dwarfed Robin and Thayer's relatively simple operation. After running the Stoiber Brothers Sampling Works for four years, brothers Edward and Gustavus had a significant disagreement in 1887 and divided their mutual assets. Gustavus assumed the sampling works and Edward the Silver Lake claims. Gustavus' choice was the safer because the sampling works provided a reliable source of income, while Edward based his decision on the educated guess that Silver Lake would provide great rewards for its high risk.[208]

The Stoibers were proper, conservative Germans reared in a privileged socioeconomic climate. Edward was born in 1854, began studies in engineering at a young age, and attended the famed School of Mines at Freiberg. In 1879, he and Gustavus sought their fortune in Leadville where Edward experienced immediate success as a mining engineer and metallurgist. Competition among professionals increased in Leadville while the Animas River drainage begged for metallurgists, and so the Stoibers came to Silverton in 1883 and built their sampling works. While on business in Denver, Edward met Lena Allen Webster, described as a very liberated divorcée. Lena embodied the image of frontier woman and was well-suited for the remote and industrial environment to which Edward brought her.[209]

When Edward assumed the Silver Lake, he spent two years sampling, examining the property's geological features, conducting assays, staking claims with Lena, and calculating the most effective manner of development. Unlike most mine owners, Edward took a primary interest in the low-grade ore and considered high-grade material to be merely a bonus. The main problem, however, was that the costs of shipping the low-grade payrock from the basin and processing it in the sampling works exceeded the returns. Stoiber realized, however, that if he could mine and concentrate the ore in large volumes with a highly efficient system, the economies of scale would render the low-grade material profitable through a nominal cost per ton. Devising an efficient system and working out the economic calculations was easy for the German engineer, and by 1890 he had a plan devised.

During the late spring when Silver Lake Basin's snow blockade stabilized, a small army of workers with mule trains packed in thousands of board feet of lumber, tons of hardware and machinery, and the basic necessities of life. This they assembled into the largest surface plant and mill yet in the county. When finished, the mill was able to generate 50 tons of concentrates per day, which provided Stoiber his economy of scale. Because Silverton lacked a facility or storage area capable of accommodating the hundreds of tons of concentrates and high-grade ore that Stoiber expected to store at a time, he built his own. Stoiber chose the abandoned Little Dutch Smelter site on the west side of Arrastra Gulch's mouth. While the exact structures remain unknown, they certainly included large bins, freight platforms, and a corral and stable for the constant procession of draft animals.

The crown jewel to Stoiber's instant empire was an electric power plant that he commissioned on the Animas River. In 1890, electricity was a revolutionary technology under

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[208] Bureau of Mines, *Manuscripts MSS Box 640, v27* (Denver: Colorado Historical Society) 20; Sloan and Skowronski, 1975: 29.

[209] Henderson, 1926:4 9; Allen Nossaman, *Personal Interview,* Durango, 2002; *"Obituary"* *EMJ* (5/5/06): 865; Prosser, 1914; Sloan and Skowronski, 1975: 29.

experimentation, and the San Juans served as a cradle for its application to mining. In 1888, the Virginius and Tomboy mines above Telluride installed the first electric plants in the San Juans, followed by John Terry's small facility at the Sunnyside Mill in Eureka Gulch. These early power plants were small and generated direct current (DC), which was able to run variable speed motors but only could be transmitted short distances before suffering a debilitating power loss. As a result, DC current had to be consumed near the point of generation, giving mining engineers pause for thought. What, they reasoned, was the advantage of electricity if it had to be generated on-site? Even if a DC power plant could be run by hydropower, a costly steam engine and boiler usually had to be kept on standby in case the water system failed. Why not do away with the electrical equipment and merely use the steam engine alone to operate mine machinery for a fraction of the capital? Alternating current (AC) provided a partial answer to this problem. AC current could be transmitted for miles without power loss, but as of 1890, AC motors were unable to run variable speed equipment. AC current could, however, energize lighting and run constant speed motors that operated with little drag, such as those used in machine shops and some mill applications. With this in mind, progressive electrical engineers near Telluride finished the first AC power plant in the San Juans and Colorado at Ames in 1891, which set the precedent.[210]

Stoiber was not far behind. Around the same time, he completed what appears to have been the second AC power plant in the San Juans and Colorado. According to archival references, a power plant built on the Animas River, most likely at the concentrates storage terminal, and power lines carried the electricity two miles up to Silver Lake Basin, which was too far for DC current. Given this, Stoiber's power plant had to generate AC current, which lit the interiors of the buildings and ran several small motors in the mill.[211]

At the beginning of November 1890, Stoiber started the mill and it ran to perfection, although the electrical equipment may not have been working initially. Over the course of the summer, mule skinners hauled up supplies and coal so the mine and mill could run through the winter. After around a year, Stoiber and Lena pored over the balance sheets of their Silver Lake Mines Company. The conclusion was $255,000 net, or around $5,148,286 today, which constituted around twenty-five percent of San Juan County's total production. This was far from pure profit, however, because an operation as large as the Silver Lake Mines Company at an elevation of 12,000 feet was very costly.[212]

After two years of constant production and milling, Stoiber declared the Silver Lake a success. While his strong work ethic may have prevented him from the retirement sought by other successful mine owners, Stoiber instead spurred him to expand operations in 1893. Lena, personnel manager for the company, requested a second boardinghouse at the mine and increased the workforce to 130. Like the first boardinghouse, it featured uniquely luxurious amenities in such as running water and steam radiators.[213]

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[210] W.S. Burbank, E.B. Eckel, and D.J. Varnes, "The San Juan Region," *Mineral Resources of Colorado* (Denver: Colorado Mineral Resources Board, 1947) 396; *"Mining News"* *EMJ* (12/29/1888): 551; Smith, 1982: 98.
[211] *"Mining News,"* *EMJ* (4/26/90): 479; *"Mining News,"* *EMJ* (11/15/90): 581.
[212] Ransome, 1901: 149.
[213] *"Mining News"* *EMJ* (9/9/93): 273.

While the Silver Lake was clearly the most significant operation in the Las Animas district, if not the county, other mines participated in the wave of renewed activity. At the Titusville, new director Thomas Kane started up the mill and tramway in 1890 on stockpiled ore, and the facility apparently recovered a satisfactory amount of the metalliferous content. Kane ordered his miners to increase production, and when the tonnage they generated exceeded the mill's capacity, he ordered the mill to operate around the clock.

In Dives Basin, Martin Van Buren Wason and Theophile Benjovsky finally reopened their Dives Mine in 1890 after patiently waiting for the value of silver to rise. Their operation was small but sound. At the North Star, the Crookes found that the run-of-mine ore now provided excellent returns, and in 1891 saw profits increase when miners happened into a vein rich with high-grade material. To increase production, the Crookes increased the workforce to thirty. In 1892, they moved the North Star Mill from Little Giant Basin down to the mouth of Boulder Gulch to process ore from their other holdings in the county. Meanwhile, several lessees at the Highland Mary wisely remembered the silver veins that Innis left in place in the upper workings during his misguided search for gold. They had an easy time bringing the workings into minor production.[214]

Mineral Creek Mining District

The Mineral Creek district finally assumed a position of prominence in the county during the early 1890s, after receiving little attention for decades. While it saw no developments quite as grand as the Silver Lake, Mineral Creek surpassed the Eureka district in terms of investment, large operations, and production. Ore poured from the Hercules and North Star ore systems on Sultan Mountain and comprised a significant proportion of the county's total production, but not without challenge.

Ever since Lucius Kendall bought the North Star Mine in 1884, his Silverton Mining Company concentrated the ore in the mill that Theodore Comstock built. Over time, however, the mill recovered less and less of the metals content. Comstock based his concentration process, highly successful at first, on the character of the ore that was available during the early 1880s. Most of this material came from upper, oxidized areas of the ore system. As the Silverton company developed the deep reaches of the system, its miners entered a zone where the ore became increasingly complex and resistant to Comstock's concentration process, however. By 1890, company directors conceded that too much of the metals content was leaving as tailings and admitted that the facility had to be refitted at great cost. They consulted an expert who reiterated that the mill would actually have to be almost totally rebuilt. Under contractor John Thexton, the Denver & Rio Grande built a siding to deliver the construction materials and equipment, and a large crew installed a system to power the mill by water. By October, Thexton opened the mill cautiously. The company was relieved to find higher recovery of metals content, and during the year, the North Star produced well over $100,000. In 1892, the Silverton

[214] Bureau of Mines *Manuscripts MSS Box 640, v. 27*: 6;*"Mining News,"* EMJ (3/28/91); *"Mining News"* EMJ (9/9/93): 273; Silverton Standard (5/24/90).

company optimistically and increased the workforce to thirty-five miners, but mill returns fell off dramatically the following year. Company directors scaled back operations and let some miners go. The company faced the decision of permanently reducing operations, and hence income, or parting with yet more capital to troubleshoot problems. They chose the latter course, which began a protracted and costly trial-and-error process of making the mill effective.[215]

The Victoria Mining & Milling Company followed a similar trajectory, sited as it was adjacent to the North Star on the same ore system. The company produced heavily through 1890 and its mill ran with some success at first, but when mill trouble materialized, the directors lost confidence and engaged in avoidance. The company put the entire operation up for lease, hoping that someone else would solve the milling problem while paying the lease royalties. In 1891, the partnership of Morrison & Fitzgerald took a three-year lease and found enough ore to keep the mine in production. Within the first year of their term, the Victoria company went bankrupt due to unpaid debts, however. The sheriff seized the mill and Little Dora Mine, appointed a receiver, and put them up for sale in 1891. It is unclear whether the partnership was allowed to continue work in the interim. Threatened by the loss of their entire investment, company principals repaid outstanding debts during 1892 and repossessed the mine. In an attempt to restore the operation to profitability, they found additional capital in 1893 to refit the mill and improve the flow of ore by building an aerial tramway up to the Little Dora.[216]

A third company floundered, despite huge capital investment. In 1889 or 1890, the San Bernardino Syndicate of London spent a considerable sum on a mill and tramway for the San Juan Tunnel and adjoining San Bernardino claim, both on Sultan Mountain. The investors immediately overextended themselves, went bankrupt, and sold to other British capitalists who organized San Bernardino Silver Mines, Ltd. The mine appeared to be a ready-made producer, except that ore was not much different from that at the North Star and Victoria. The complex material confounded the mill, and after several years of struggling, the company failed.

The area around Chattanooga, at the head of Mineral Creek, was a center of activity. The town of Chattanooga was a key stop on the Silverton Railroad, which, coupled with road traffic to the Red Mountain district, incubated it from too much contraction during the late 1880s recession. Chattanooga featured a tiny business district that included a mercantile and a combination saloon, restaurant, and boardinghouse run by James Sheridan.[217]

When the value of silver increased in 1890, Sheridan and other Chattanooga residents grew optimistic that several important mining ventures would revive the town. To the south lay the Bonner, in which Gustavus Stoiber recently invested. The mine was small but began to yield payrock in 1890. The other was the Silver Ledge between the town and Red Mountain Pass. The Silver Ledge vein was discovered in 1883 but lay fallow until J.C. Kingsley sank a shaft in 1890. A catastrophic fire in the shaft house the following year cooled his interest. Several miners were at work at the bottom of the shaft during the event, but pursued their work unaware. When the

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[215] *"Mining News," EMJ* (9/9/93): 273; Ransome, 1901: 251; *Silverton Standard* (5/17/90): 1; *Silverton Standard* (7/14/90): 2.
[216] *"Mining News," EMJ* (3/1/90): 256; *Silverton Standard* (1/25/90): 2; *Silverton Standard* (4/25/91): 2; *Silverton Standard* (10/10/91): 5; *Silverton Standard* (3/26/92): 2; *Silverton Standard* (5/13/93): 2.
[217] *Colorado Business Directory*, 1892: 152; *Colorado Business Directory*, 1893: 182.

fire unleashed the signal bell cord, it drifted down to their station and the miners realized that something was wrong. When the ore bucket followed with a crash, they knew it was time get out. The fire apparently turned them back down the shaft, which was wise because a full box of dynamite exploded and scattered burning debris. The miners managed to survive without suffocating, however.[218] Shortly after the fire, Kingsley sold the Silver Ledge to the partnership of O'Brien and Anderson, who repaired the damage. The partners then leased the mine to a British syndicate in 1891, which purchased the property but defaulted on payments. William Feigel bought the mine at bankruptcy auction and finally brought it into meaningful production.[219]

Eureka Mining District

In the Eureka district, the Sunnyside and Sunnyside Extension remained the dominant operations and followed similar development paths. The advantage that both mines had over most others in the county was both fiscally prudent management and gold ore. Like Stoiber's Silver Lake Mine, the Sunnyside and Sunnyside Extension possessed a preponderance of low-grade ore over rich material, which the managers made profitable. Any remaining rich material could then be pure profit.

John Terry was already processing the Sunnyside's low-grade ore with the Midway Mill that he built in Eureka Gulch in 1889. His economic calculations were proving correct and the Sunnyside remained profitable, although how much so was uncertain due to secrecy. Until 1890, most of the profits, with deductions for improvements such as the mill, went to the feuding Engleman family. Then, Milton Engleman, the family's principal contact with Terry, died. Terry saw in this an opportunity to take possession of the mine as no one in the Engleman family was willing to assume Milton's administrative duties. They sold to Terry, and with the Englemans out of the equation, Terry had more money to devote to the mine. By the early 1890s, the operation featured several principal tunnels driven on the vein, a large surface plant at the lowest entry, a mill on Lake Emma, the Midway Mill in Eureka Gulch, and a herd of pack animals that fed the lower mill in an endless procession. The next large project would be a tramway to replace the tired animals, but Terry put this on hold.[220]

Rasmus Hanson was sole owner of the Sunnyside Extension almost from the beginning of operations and cautiously invested in improvements. With the new Hanson Mill in regular operation by 1890, Hanson increased the workforce to around twenty-five miners and ten surface employees. They generated forty to fifty tons of ore per day, ran the mill around the clock, and produced $15,000 per month. Some of the ore came from the adjoining Mastodon Mine, which Hanson linked to the Sunnyside Extension through underground workings. By 1891, Hanson felt that he had enough capital to finance the next move toward efficiency, a tramway from one of the main tunnels down to the mill. Once complete, Hanson's operation began to approach

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218 *Silverton Standard* (6/28/90): 2; *Silverton Standard* (4/11/91): 3.
219 *Silverton Standard* (6/6/91): 2; *Silverton Standard* (10/24/91): 2.
220 Marshall and Zanoni, 1998: 119.

Stoiber's Silver Lake Mine, although Hanson's workforce was a fraction of that employed by Stoiber.[221]

Just as the Sunnyside Extension appeared to reach a peak of production and complexity, Hanson curiously sold the operation in 1892. Perhaps Hanson knew something about the ore reserves that the British buyers did not. They paid Hanson $200,000, retained him as manager, but ran into trouble, possibly as early as 1893. Based on Hanson's ten-year record of extracting ore that assayed well, the new owners supposed that plenty such material remained. They miscalculated, however, and exhausted the rich ore within a year or two, leaving low-grade material that resisted treatment in the mill. Despite Hanson's efforts, and possibly to his embarrassment, production declined, and he ran the mill only intermittently, while deciding how to remedy the problem.[222]

Ordinarily, Animas Forks could be expected to celebrate the sale of the Sunnyside Extension and the financial success of one its residents. Few people were present to do so, however. In 1891, a fire that started in the Kalamazoo House burned most of the business district, and most of the residents left. The population that stayed was tiny, no one replaced the lost buildings, and the town had almost no businesses. The Postal Service revoked the post office later that year.[223]

Even though the Sunnyside was going well and smaller operations were active in the area, the town of Eureka remained small and relatively quiet. The town contracted during the late 1880s recession and did not recover as well as could have been expected. Around 120 residents lived in and around the hamlet, and the business district featured only the Helmboldt meat market, a mercantile run by W.G. White, and a hotel operated by Esther Ekkard.[224]

Elsewhere in the Eureka district, a few other mines showed promise, if not regular production. On the northeast flank of appropriately named Galena Mountain, the Swartz brothers reopened the Hamlet, initially developed during the early 1880s. They drove several tunnels on the vein and shipped ore regularly for several years. The Tom Moore, between Eureka and Animas Forks, began production in 1893. The Green Mountain and Pride of the West were the principal operations in the district's southern portion and contributed to a growing energy in Cunningham Gulch. Joseph Williams, Morgan Jones, and partners took a lease on the Green Mountain in 1889 and struck an outstanding vein just in time for passage of the Sherman act the following year. They enjoyed the results for three years when Gustavus Stoiber and James Robin assumed the lease and increased the workforce. Christian Schoellkopf still owned the Pride of the West, which featured three tunnels that penetrated the vein at different elevations. He reopened the mine in 1890 and planned to undercut the vein with a tunnel driven from the floor

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221 *"Mining News,"* _*EMJ*_ (7/19/90): 81.
222 Jonathan Horn, *Gold Prince Mine, Mill, and Aerial Tramway National Register of Historic Places Registration Form* (Montrose: Alpine Archaeological Consultants, Inc., 2010) 3.
223 Bauer, et al, 1990: 12; Jonathan Horn, *Animas Forks National Register of Historic Places Registration Form* (Montrose, Alpine Archaeological Consultants, Inc., 2010) 11.
224 _*Colorado Business Directory*_, 1891: 394; Schulze, 1977: 1890-7.

of Cunningham Gulch. To expedite the project, Schoellkopf installed a compressor and rock drills, a considerable investment.[225]

Cement Creek Subdistrict

The increase in the value of silver revived an interest in Cement Creek, quiet since the mid-1880s. Nearly all the properties there were dormant and had seen little work except for prospecting, and so appeared to offer more potential than those in the county's other districts. Most of the activity materialized around Gladstone, abandoned since 1887. Paul McCann was the first investor of note to arrive, examining the idle Sampson Mine for its gold potential as early as 1889. McCann had extensive experience with mining and milling ventures in Clear Creek County and qualified to render objective judgment on the property. He felt that it could be made to pay if the mill was equipped appropriately, so he purchased the mine in 1890 and put a crew to work installing new machinery.[226]

Willis Z. Kinney represented Henry Soule and Cyrus Davis, wealthy eastern investors. They reopened the Harrison Mine, a short distance south of Gladstone, and appointed Kinney as manager by 1890. The mine appeared to offer enough ore to justify a mill, which Perry Fisher erected in 1890. While the operation was not a huge success, it kept the Fisher Mill busy at least on a seasonal basis. The company workers lived in Gladstone and were the first inhabitants to occupy the town since around 1887. A small crew of miners employed by John M. May joined Kinney's workers in town, from whence they commuted up the South Fork of Cement Creek to the Big Colorado. May felt that conditions were right to begin developing the upper portions of a vein on that property, and when his miners proved ore, he commissioned a deep haulage tunnel from the valley floor in 1893.[227]

Kinney and the Fisher Mill figured prominently in development of the Gold King. Olaf A. Nelson worked as a miner in the Sampson and became familiar with the local geology and the trend of the main gold-bearing vein. Nelson felt that the Sampson company was working the wrong portion of the vein and that he could locate a richer segment. Nelson spent time searching the area downslope from the Sampson property for traces of the vein, found promising ground, and staked the Gold King claim around 1887. During the next several years Nelson devoted time to exploring the claim at depth and struck the Gold King Vein. Nelson subsequently followed the course taken by many prospectors. He sought financial assistance and approached Kinney around 1892. The following year, Kinney sent several of the Harrison miners to conduct further exploration; they brought around forty-five tons of ore to the Fisher Mill for testing. Like the rest of the Sampson Vein, the ore proved complex but rich, and Kinney's enthusiasm convinced Davis and Soule that they probably had a bonanza worth pursuing. They leased the claim from Nelson and began developing the Gold King Mine, which became one of the county's best

[225] *Silverton Standard* (11/23/89): 2; *Silverton Standard* (5/10/90): 1; *Silverton Standard* (5/23/91): 2; *Silverton Standard* (5/20/93): 2; *Silverton Standard* (12/9/93): 3.
[226] *"Mining News," EMJ* (5/25/89): 485; *Silverton Standard* (8/8/91): 2.
[227] Brown, 1984: 71; *Silverton Standard* (10/4/90): 2; *Silverton Standard* (8/8/91): 2; *Silverton Standard* (12/26/91): 2; *Silverton Standard* (6/9/93): 3.

producers. But before Kinney could make much headway with the Gold King, San Juan County faced one of the worst economic disasters in the history of the mining industry.[228]

The Silver Crash, 1894 – 1897

Almost immediately after the Sherman Silver Purchase Act was signed into law, reformers rebelled against what they perceived to be a massive government subsidy for mining and profiteering among powerful capitalists, and they clamored for repeal. At the same time, a national economic crisis loomed, creating political instability and factions in both the federal government and Great Britain, one of the main consumers of American silver. Repeating the cycle of the mid-1880s, the increasingly dour climate contaminated investment in silver and the industries that depended on it, causing the metal's value to slip. The price of silver eroded from a high of $1.09 in 1891 to $.99 and kept going down to $.78 by mid-1893, an all-time low that forced mining companies in San Juan County to assess the viability of their operations. As with the 1886 cycle, some of the small mines closed, but many companies were able to get by because they were more efficient than before and the smelters in Durango improved their operations.[229]

Then, in 1893, the political factors noted above came together to bring the ruin 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, effective November 1893, hoping to prevent an economic crash. At the same time, Britain adopted a gold standard and abolished silver, as well as ceasing minting of Indian rupees. The market for silver promptly evaporated and the metal's value plummeted to $.64 by March 1894. The result was cataclysmic. Mines across the west suspended operations and thousands of workers suddenly found themselves jobless. A financial panic swept the west and rippled out to the rest of the nation, ushering in a depression that lasted through much of the 1890s.[230]

Like the rest of Colorado, the San Juan region, which relied to a great degree on silver, was devastated. All the mining companies in San Juan County that depended on the high price of silver closed, and the rest faired little better. Some estimates suggest that as many as 1,000 workers in the county lost their jobs, from a total population in the county of 1,600 in 1890. Residents with enough security to stay witnessed a mass exodus. With little ore coming down from the mountains, the San Juan Smelting & Mining Company and Otto Mears shuttered their smelters in Durango, and Mears and the Denver & Rio Grande reduced service on their railroads.[231]

A review of the county finds that while nearly all the medium-size and small mines suspended work, each district featured a handful of companies that appeared to be surviving and even thriving in some cases. As the depression dragged on through 1896, the impossible happened. A number of mines reopened, and the county's production figures increased to record

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[228] W.Z. Kinney, *Correspondence: Exhibit A, 1932*; Nossaman, 1998: 313; Wolle, 1995: 418.
[229] Henderson, 1926: 216; *Report of the Director of the Mint*, 1894: 20; Saxon, 1959: 7, 8, 14, 16.
[230] Brown, 1984: 194; *Report of the Director of the Mint*, 1894: 26, 30; Saxon, 1959: 7, 8, 14, 16; Smith, 1982: 92; Smith, 1994: 184, 187; Stone, 1918, V.1: 437.
[231] Schulze, 1977: 1890-7; Smith, 1992: 68.

levels. Between 1894 and 1897, the county featured twenty small mines, eleven medium-sized operations, and two large mines. In terms of production, 1894 was a poor year and the county's mines generated $221,000 worth of silver, $340,000 in gold, and $132,000 in lead. By 1896, these figures climbed to $1,515,000 worth of silver, $909,000 in gold, and $169,000 in lead. This railed against the downward trend in the rest of the state. Four principal reasons explain why the mining industry survived and kept the county from collapsing.[232]

Even though the Standard and San Juan Smelting & Mining Company smelters in Durango suspended during 1894, mining companies still had several outlets for their ore. The Sweet Sampler was purchased in 1892 and renamed the Keith Sampler, and Gustavus Stoiber sold his sampler in 1894 to partners that reorganized it as the Silverton Public Sampler. These two facilities received enough business to prevent them from closing and were able to ship their concentrates and matte by rail to smelters on the plains In 1894, Thomas F. Walsh initiated one of the most important ore buying firms and built the first new smelter at Silverton in nearly a decade. Walsh's motives were twofold. On one hand, he felt that if he provided relatively low cost ore treatment, companies in the county and Red Mountain district would generate enough payrock to keep the facility afloat until better times returned. On the other hand, Walsh needed a smelter to process the ore from his own mines, the Mountain Queen and others leased in the Eureka district. Walsh, Charles J. Hughes, and Albert Smith incorporated the Silverton Smelting & Mining Company and purchased the abandoned Martha Rose Smelter because it featured the building and original infrastructure, which saved them capital. During the winter, workers repaired the facility and installed new equipment, and by spring, Walsh had the facility operating. After several weeks of operation, the smelter appeared to be a success. Walsh became a local hero for delivering a functional smelter to the county in its darkest hour of need.[233]

The Omaha & Grant Smelting & Refining Company, one of the most powerful smelting firms in the Rocky Mountain West, saw the void left by the closure of the Durango Smelter. With aspirations of a monopoly, Omaha & Grant leased the Durango Smelter from the San Juan Smelting & Mining Company in 1895. During 1896, the directors realized that production in San Juan County started to recover while the rest of the state suffered and interpreted this trend as a harbinger of an enormous revival. The firm strategically used the poor economic climate to convince San Juan Smelting & Mining to sell the Durango Smelter.[234]

Another reason why the county's mining industry seemed to weather the depression lay in the ore that the solvent companies produced. Their payrock contained a higher proportion of gold than most of the ore bodies in the region, and the value of this precious metal held a constant value of around $20.70 per ounce. Because the ore featured a combination of gold and silver, as the mining companies produced more gold, they generated more silver in parallel. Nearly all the mines that continued operations from the early 1890s into the depression were proven gold producers, including the Green Mountain, Iowa, Mastodon, Silver Lake, and

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[232] Henderson, 1926: 216 for production figures. The estimate for active mines was derived from a survey of *EMJ* and *Silverton Standard*.
[233] Thomas A. Rickard, *"Across the San Juan Mountains,"* *EMJ* (July, 1903); Sloan and Skowonski, 1975: 51, 121; Wolle, 1995: 431.
[234] Ransome, 1901: 23; Smith, 1982: 101; Smith, 1992: 77.

Sunnyside. In a few cases, mine owners reassessed their idle properties for gold ore and reopened them if warranted.[235]

Perhaps the most important factor of why the county overcame the depression and dismal value of silver was a dramatic change in attitude toward ore production and the required investment. A handful of mine owners responded to the Silver Crash not by curtailing operations but by taking the opposite approach. They expanded operations and poured capital into underground development, mechanization, and mill improvements on a proportion that the county had not yet seen. The purpose was to produce and concentrate ore in economies of scale that were great enough to dramatically reduce the cost per ton. The owners calculated that this offered the double benefit of not only offsetting silver's low value, but also rendering low-grade ore profitable to produce, a key factor since the principal mining districts were awash with the material.

The strategy of economies of scale was an excellent model for companies with large ore reserves, but it required one resource difficult to secure during the mid-1890s depression, capital. Only four or five mining companies in the county were able to implement the strategy, and they were so successful, their enormous yield skewed the county's production figures and made the overall mining industry appear to be in a better state than it actually was. Most of the small and medium-sized operations were either closed or not doing well. Some mining experts credited Edward Stoiber and John Terry with pioneering the economies-of-scale practice, and Frederick Leslie Ransome observed:

> The success of Messrs. Stoiber and Terry in handling low-grade ores has demonstrated that when wasteful and inadequate methods are replaced by modern appliances and shrewd management, mines carrying abundant low-grade ore may be made profitable, even with the present low price of silver.[236]

The *Silverton Standard* offered a more detailed explanation:

> In 1893, when the price of silver was cut in two, or reduced nearly one-half, many of the low-grade producers were closed, but about all of these have resumed operation, and many more new producers of like character have been added to the list. At the time the operators of the silver mines were confronted with a situation which seemed to preclude further effort. Edward G. Stoiber, then proprietor of the Silver Lake plunged into problem with more than a million to lose if he failed, but emerged successfully, after employing every close value-saving appliance which the character of his low-grade lead-silver ores suggested. He saved the values so well that his concentrates of $7 ores enabled him to continue mining profitably. When this had been done the other owners of low-grade mines proceeded to the building or alteration of mills which enable them to operate, and all along the line, throughout the entire San Juan region, there has been a marked advancement in the economy and better value saving of mill enterprises.[237]

[235] Saxon, 1959: 78, 14, 16.
[236] Ransome, 1901: 23.
[237] *Silverton Standard* (1/11/02).

Out of self-interest as well as a desire to support the central San Juans, Otto Mears also made major contributions that helped the region weather the depression. He understood that the mining industry relied on his roads, railroads, ore production, and financing. To prevent a complete shutdown of the Red Mountain district, he maintained service on the Silverton Railroad even though it meant no profits. On his roads, Mears softened his tolls and even suspended them at times, and he continued production at his mines to keep ore going through Silverton. Mears' greatest contribution, however, was the construction of another railroad, even though the project over-extended his finances. In 1895, he and other Colorado capitalists incorporated the Silverton Northern Railroad to build a line up the Animas River from Silverton to Animas Forks. Because Edward Stoiber would see direct service to his terminal and the railroad would carry John Porter's coal, both men were heavy investors. Further, Stoiber promised Mears all the ore traffic that he could generate, and in return Mears assured him a half rate. The railroad company purchased Mears' Animas Forks Toll Road as the rail bed and began construction in fall 1895. With the region in depression, the project created quite a stir, and the county was elated at the prospect of direct rail access for its principal centers of mining. Track gangs labored between snowstorms throughout the winter until they finished the line to Howardsville by May 1896. The following month saw the crew move camp to Eureka, where Mears stopped work due to the financial burden. Despite its short length, the Silverton Northern would prove to be Mears' most profitable railroad because it served one of the richest portions of the San Juans.[238]

Bear Creek Mining District

The constant value of gold was the force that drew prospectors into the southeastern reaches of San Juan County while silver values declined. In the spring of 1893, E.L. Roberts of Silverton and D. Preston Bell of Durango prospected Bear Creek, the first principal drainage south of the Las Animas district, and they found ore at the drainage head. With interest in silver already waning and mines closing, prospectors were eager for a gold discovery. When word of the Bear Creek strike began circulating, around 500 wealth-seekers eagerly hastened to the site, began staking claims, and organized the Bear Creek Mining District. Among the new properties were the Bonita and Sylvanite, named after a type of telluride gold ore, and both seemed to offer excellent potential. By June, community organizers attempted to formalize the collection of prospectors' tents on the valley floor as a camp. Within a short time, someone secured a post office under the name of Sylvanite, although the settlement was popularly known as Bear Creek. R.W. Bastin & Company began carrying in supplies via pack train, and a few local investors perused the claims in hopes of securing the best ones while the prices were low. Among these were Ira Scott, his wife, and Judge E.T. Wells, and they bought the Sylvanite and immediately put five men to work on development. When winter arrived, everyone left the remote region, and

[238] Henn, 1999: 134; Michael D. Kaplan, *"The Toll Road Building Career of Otto Mears, 1881-1887,"* The Colorado Magazine, Vol. L2, No.2 (1975): 168; Sloan and Skowonski, 1975: 34, 127, 150; Tucker, 2003: 91, 104.

as they waited to return the next year, the economy collapsed and set the stage for a full rush during 1894.[239]

When the spring arrived, many of the original prospectors returned, followed by a large number of others. Sylvanite grew in size and may have attracted a few of the businesses expected in a prospecting camp, such as a mercantile and saloon. Lute Johnson, publisher of the Creede *Candle*, thought enough of the settlement to haul in a press and began printing a newspaper. Johnson had an easier time packing the press from Creede than prospectors experienced with their goods from Silverton. While Silverton was only eighteen miles away and Creede fifty, the glaciated peaks of the Las Animas district presented a major obstacle. Bear Creek, on the other hand, drained east into the Rio Grande River valley, a direct and gentle route to Creede. Thus, Creede became the district's principal point of entry.[240]

The Bear Creek excitement followed the course typical of short-lived rushes. During 1894, fortunate prospectors identified and claimed the few obvious veins, while others left. Because of the decrease in population and the seasonality of Sylvanite, the Postal Service revoked the post office at the end of the year. Regardless, some prospecting continued, and the most promising claims demonstrated ore below the surface. The Sylvanite and Bonita yielded several tons of payrock for testing, and gold was proven on the Elk Horn, Gold Bug, Good Hope, and Kankakee. With the above claims proven, investors had enough confidence by 1895 to purchase them and begin development. Scott and Wells used some of the profits from their Sylvanite Mine to buy the Good Hope. A.L. Emigh, Freeman Thomen, and others organized the Golden Shear Mining Company and bought the Bonita. Thomen came from Creede and discovered the Sunnyside, the first vein developed in that area. F. Nathan & Company of Kansas City bought the Gold Bug for $25,000, established the Gold Syndicate Mining Company, and planned an 800-foot tunnel to undercut the vein.[241]

Isolation was an impediment and kept the new operations small and seasonal. By 1896, two years after the initial rush, Sylvanite had seen much speculation but relatively little work at depth. All the productive mines were shallow, poorly equipped, and the extent of their ore reserves unknown. Unlike the rest of San Juan County, nearly all the work was by hand, and not until 1896 did Bear Creek begin receiving even small pieces of machinery. Scott and Wells installed a hoist and compressor at the Good Hope, likely the first apparatuses of their kind in the area. Most of the mining outfits did not follow this example. They had little need, because by the end of the season, they reached the end of their profitable ore and abandoned further efforts.[242]

When the spring thaw of 1897 granted a return to the Bear Creek district, only the Bonita, Gold Bug, Good Hope, and Sylvanite mines reopened. The Golden Shear company produced small batches of ore in the Bonita, the Calaverite Mining Company employed nine miners at the Sylvanite, and the Wonder Leasing Company did well with the Good Hope. The Gold Syndicate company was the largest operation and kept several miners driving the main tunnel toward the

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[239] Bauer, 1990: 138; *"Mining News," EMJ* (9/30/93): 351; *"Mining News," EMJ* (2/9/95): 133; *Silverton Standard* (5/13/93): 3; *Silverton Standard* (6/17/93): 2.
[240] *Silverton Standard* (5/25/95): 3; *Silverton Standard* (8/26/99): 1.
[241] Bauer, et al., 1990: 138; *"Mining News," EMJ* (2/9/95): 133; *"Mining News," EMJ* (10/24/96): 397.
[242] *Silverton Standard* (6/6/96): 5.

Gold Bug and around fourteen others producing ore. Finally, miners struck the vein at depth, but the company kept the findings a secret, which raised suspicions that the vein was bereft of ore. This proved false, and the vein offered enough payrock to allow the company to outlast most of the others that remained in the district.[243]

Las Animas Mining District

When Edward Stoiber began implementing the economies-of-scale concept during the early 1890s, he did so with a huge mill, an army of workers, and electricity. Stoiber understood that more improvements were necessary for the strategy to fully reach its potential. He revisited the mill, his power sources, and transportation system for ways to increase production and reduce costs. Because the mill already had a high treatment capacity and was relatively efficient, it needed no major changes. Instead, Stoiber and the expert metallurgist Robert J. McCartney tinkered with improvements to some of the concentration equipment. They invented one of the best vibrating tables for concentrating San Juan ores, the so-called Stoiber-McCartney table.[244]

A small power plant wired electricity up to the mine, where it was used primarily for lighting and secondarily to run simple appliances. Because motor technology was nascent, steam powered the energy-intensive machinery, which kept a herd of mules busy packing the fuel coal required. To reduce the expense of both the coal and packing, Stoiber installed more motors at mine and mill in 1894 and built a second power plant on the Animas River, which also provided some current to his brother's Iowa Mine. He chose a site on the south side between Arrastra Gulch and Silverton for the plant, which had a generator house, boiler house, a set of massive coal bins, and direct rail service. Several years after construction, newspapers claimed that the power plant was the most complete privately owned AC facility in the nation and saved Edward $15,000 in coal per year, or $330,096 today. Along with the power plant buildings, in 1895 masons also erected what was the largest and best appointed residences in the San Juans with hot and cold water, sinks, bathtubs, toilets, and steam heat. Edward and Lena named the power plant and mansion complex Waldheim, German for forest home.[245]

Stoiber realized that his transportation system was an outstanding resource to look for savings. Nearly everything hauled up to the mine and all the concentrates sent down from the mill moved by mule train, at a cost of around $4.00 per ton. While mules were well-suited for the trip to Silver Lake Basin, they were slow and cumbersome. Of greater importance, mules were costly to purchase and maintain and requiring the constant supervision of mule skinners. His master plan called for replacing the mules with a tramway, and Stoiber's desire for savings forced the issue in 1895. Like Terry, Stoiber wanted to minimize his debt. Given this, he designed the system in two segments that linked the mill with the shipping terminal on the Animas River. Stoiber contracted with William M. Frey, tramway expert from Leadville, to build

[243] Colorado Mining Directory, 1898: 295; *"Mining News"* EMJ (8/28/97): 255; *"Mining News,"* EMJ (11/13/97): 586; Silverton Standard (9/11/97): 2; Silverton Standard (10/23/97): 8.
[244] *"Mining News,"* EMJ (8/20/98): 226; *"Obituary,"* Mining Reporter (2/18/04): 173; Silverton Standard (12/3/98).
[245] *"Colorado's Wealth in Water Power,"* Denver Times (12/31/98): 10; Rickard, 1903: 60, 68; Silverton Standard (6/30/94); Wyman, 1993: 3-4.

the first, 8,700 feet in length. By November, Frey completed construction and watched with the press as the system started without incident.[246]

Gustavus Stoiber and James Robin were also busy improving the Iowa Mine. Through the Iowa Mining & Milling Company, they made the Iowa second only to the Silver Lake in terms of implementing economies of scale. Following Edward's example, they focused on large-scale production and savings, including improvements at the mine, widespread adoption of mechanization, a mill, and a tramway. Like Edward, they insisted on enacting the plan in manageable steps. The first was the construction of a large concentration mill to separate out the waste and retain a portion of the treatment fees paid to smelters. Unlike Edward, Gustavus and Robin sited their mill not at the mine but instead on the floor of Arrastra Gulch, almost directly over the obsolete Little Giant arrastra. This location was inefficient in the beginning because it required mule trains to carry down the crude ore, but the location made shipping out the concentrates easier. Workers broke ground for the mill early in 1895 and built a highly functional facility capable of concentrating 150 tons of ore per day.[247]

A tramway was the next logical step. Stoiber and Robin contracted with the Trenton Iron Works of New Jersey for a Bleichert system in 1896 and then directed their attention to mining operations and claim development. They hired more miners to drive two tunnels into the vein system to work it simultaneously at different elevations. In keeping with proper mining engineering, Gustavus planned a third tunnel from the lowest elevation possible to serve as a haulageway for the ore produced in the upper levels. Vertical raises linked the lower and upper tunnels and served as conduits for ore. Miners in the upper workings dumped ore into the raises, which rolled down and collected in bins over the haulage tunnel, where other miners sent it out directly to the tramway. While this extensive vertical development was costly and ambitious, it ultimately lowered production costs and created a lasting underground infrastructure. At the same time, external infrastructure in the form of a surface plant was necessary to support the work underground. The new tunnels and facilities initially taxed the company's coffers but paid off in the long run.[248]

In 1896, Gustavus, Robin, and the other Iowa investors were well on their way to building an empire as large as Edward's Silver Lake. The party gained advantage when they purchased the Tiger Mining & Milling Company, which just began work on the Royal Tiger Mine directly across Silver Lake from the Iowa. The outfit had done little with the property and was eager to sell because it could not bear the costs of development. Once Gustavus and Robin erected a surface plant, they invested in underground development and brought the mine into production.[249]

In the climate of the mid-1890s depression, the success of the Stoiber brothers was impressive and railed against the statewide trend. When Edward built the Waldheim power plant,

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[246] Silverton Standard (11/9/95); Silverton Standard (1/28/98).

[247] Iowa Gold Mining & Milling Company, 1896; *"The Silvery San Juan Has Enjoyed a Year of Unparalleled Prosperity in all Lines of Industry"*; Silverton Standard (11/9/95).

[248] *"Mining News," EMJ* (12/19/96): 589; Iowa Gold Mining & Milling Company, 1896; Silverton Standard (4/25/96).

[249] *"Mining News," MSP* (12/12/96): 487; Walter H. Weed, The Mines Handbook: A Manual of the Mining Industry of North America (New York: Stevens Copper Handbook, 1925) 730.

he intended to provide electricity to both his and the Iowa Mine. At the same time, Gustavus installed one of the largest compressed air systems in the county at the Iowa and provided air for drilling in Iowa and also the Silver Lake. Gustavus convinced the Postal Service to locate the misspelled post office of Arastra at the Iowa in 1895, while Edward housed most of the combined workforce at the Silver Lake. In addition, Gustavus, Robin, Joseph Bordeleau, Frank B. Brown, and R.S. Courtney organized the Silverton Deep Mining & Tunnel Company to drive an ambitious haulage tunnel from Arrastra Gulch to undercut the Silver Lake, Iowa, and Titusville mines. They fully expected to encounter Edward's Silver Lake first and the Iowa second. In the spring, miners began the tunnel high up on the west side of Arrastra Gulch and worked into the fall.[250]

Eureka Mining District

While sources claim that John Terry was instrumental in developing the strategy of economy of scale at the Sunnyside, his participation was, at first, somewhat accidental. Like the Stoibers, Terry had a master plan for the Sunnyside that included extensive underground workings, an advanced surface plant at the mine, and a tramway that delivered ore to a large mill. He completed several of the most expensive pieces, and then the Silver Crash forced him to put the plan on hold. Even though Terry reinvested his profits to minimize his debt, he still financed some of the improvements with credit, problematic when his funds ran short in 1894. To make matters worse, the vein pinched out and required Terry to pay for a costly exploration campaign. When the economy soured, creditors demanded payment on Terry's debt, which he was unable to pay. They threatened foreclosure, and Terry held them at bay with a clever argument. He explained to the creditors that if they seized the property now, it would sell for a fraction of its worth given the poor economic climate and they would recover only a portion of the outstanding debt. Instead, if they waited, it was only a matter of time before Terry found a continuation of the vein. The creditors agreed, and in 1895, Terry vindicated himself by contacting the rich elusive vein. He paid off all his debts, began buying out other investors for sole ownership, and saved for further improvements.[251]

By 1896, Terry felt financially secure enough to construct the next phase of his plan. Like the Stoibers, he replaced costly mule trains with a tramway from the mine to the Midway Mill. Next, Terry installed vibrating tables in the mill. The improvements had the desired effect of lowering some costs, increasing the tonnage of ore sent to the mill, and recovering a higher proportion of the metals content.[252] Terry also entertained the long-term goal of building a third, larger mill at Eureka and extending the tramway. The fact that the vein proved to be inconsistent, however, eroded his confidence in the financing. A group of New York investors took an interest in the Sunnyside and made Terry an offer of $450,000 over time with a $100,000 advance as earnest money. Terry accepted. The investors hired mining engineer Thomas A. Rickard as

250 *"Mining News," EMJ* (7/27/95): 86; *"Mining News," EMJ* (8/31/95): 206; Prosser, 1914; Silverton Standard (5/4/95).
251 Marshall and Zanoni, 1998: 120.
252 Burbank and Luedke, 1969: 56; Ransome, 1901: 176.

manager. The Sunnyside was not Rickard's only charge, however, as he oversaw other large mines through his Denver consulting practice. From the comfort of Denver, Rickard reviewed Terry's plans and supported the idea of a third mill in Eureka. Rickard dispatched a subordinate to the Sunnyside as acting manager to begin preparations for the new mill and tramway.[253]

After spending a considerable amount of capital on the new mill, overhauling the Midway Mill, and other improvements, investors were horrified when miners lost the vein again. Rickard recommended an exploration campaign, but the investors did not want to risk further loss. After a half-hearted attempt to find the vein, they allowed the property to revert to Terry, who now had $100,000 to invest. Between 1896 and 1897, his miners struck the vein and produced so much ore that Terry ran both the Midway Mill and the old facility on Lake Emma. He resumed construction on what became known as the Eureka or Terry mill, its tramway, and a power plant.[254]

Mineral Creek Mining District

The other two mines that explored economy of scale were the Victoria and North Star on Sultan Mountain in the Mineral Creek district. Physically, both operations conformed to the same template as the Silver Lake and Iowa and were ready to produce. They featured several tunnels on a shared vein system, extensive workings, fully equipped surface plants, and mills at their lower tunnels. The Victoria also had an aerial tramway linking its upper tunnels with the mill. The character of the ore and the efficiency of the mills, however, differed from the Silver Lake and Iowa. The ore was a complex compound of silver and industrial metals, which had plagued the expert mill men for four years. The Silverton Mining Company refitted the North Star Mill in 1890 and again in 1894. The Victoria company changed its mill in 1893 and 1894. However, the Silverton company principals gave up on the mill and compensated by focusing on the highest grades of ore and leasing sections of the vein to independent partnerships for added income. More than forty miners shipped high volumes of ore to the Durango Smelter until 1897, when they exhausted the profitable material. Plenty of low-grade ore remained, but because the investors were unwilling to refit the mill again, the company closed the mine.[255]

The Victoria company, on the other hand, triumphed and its mill proved effective, rendering the low-grade ore in the mine profitable to produce. It seems curious that the Victoria Mill was effective while the North Star Mill was not because both companies were adjacent and worked the same vein system. In 1895, the Victoria hired Thomas Kane as manager, formerly superintendent of Colorado Mining & Land Company at Mineral Point. Kane ran a workforce at least as large as that of North Star and produced and milled around forty tons per day through 1896. However, during 1897, the ore changed in character again and the Victoria company

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253 Henn, 1999: 34; *"Mining News," EMJ* (4/25/96): 406; *Silverton Standard* (4/18/96): 1.
254 Henn, 1999: 34; *"Mining News," EMJ* (10/9/97): 435; *"Mining News," EMJ* (4/30/98): 531; *Silverton Standard* (10/2/97): 1.
255 *"Mining News," EMJ* (3/30/95): 301; Ransome, 1901: 23; *Silverton Standard* (6/9/94): 3; *Silverton Standard* (6/23/94): 3.

scaled back operations, reverted to the small amount of high-grade ore that was left, and then suspended.[256]

One last factor contributed to sound production in the county during the post-Silver Crash depression. Some mine owners attempted to realize at least some income from their properties rather than let them remain idle. At the same time, investors saw the dismal conditions as an opportunity to snatch up otherwise productive mines at reduced prices. Both groups then tried to mechanize operations to the extent their capital allowed to reduce operating costs. Nearly all the county's districts saw at least several such ventures.

The Mastodon Mine in the Eureka district was well-positioned to be reopened. The mine was quiet during the early 1890s because its richest ore was exhausted. Rasmus Hanson was familiar with the property because it was connected with the Sunnyside Extension, which he sold in 1892. Hanson managed the Sunnyside Extension for the new owners, and the operation was failing because, like the Mastodon, the rich and easily milled ore had been exhausted. He leased the Mastodon in 1894 or 1895, developed the vein, and began treating the ore with limited success in the Hanson Mill. Between this and shipping the ore to Silverton, Hanson demonstrated to the Sunnyside Extension owners that the Mastodon was worth their attention, and since it was adjacent, could be worked in tandem. They agreed and either leased or purchased the property, which provided enough ore to postpone the inevitable failure of the entire operation.[257]

A.L. Jones, an investor in Denver, was convinced that the Silver Wing Mine offered great potential because it possessed plenty of low-grade ore although closed since the early 1880s. Jones envisioned a large operation similar to the North Star or Victoria, with multiple tunnels, a mechanized surface plant, and a large mill at the lower tunnel. He enlisted Chicago capitalist E.W. Morrison, and together they bought machinery, water rights, timber rights, and numerous claims on the Tom Moore Vein. Not only was the operation similar to the North Star, it suffered a similar fate. In 1895, Jones hired a large workforce of forty-five to install the machinery, develop the upper workings, drive the lower tunnel, and prepare a site for a new mill. The following year, while the mill was still under construction, Jones shipped high tonnages of ore to the Durango Smelter.[258] After the mill was finished, the company found that the payrock was too complex for the new facility and reverted to shipping the ore to the Durango Smelter. Of the failure, the *Silverton Standard* stated: "A magnificent mill is connected with the property which has thus far been unused. We are informed that the ores of the Wing are better adapted to smelting than milling."[259] In response, Jones hired more miners and improved efficiency, without running the mill.

Cement Creek Subdistrict

[256] *"Mining News," EMJ* (9/14/95): 258; *Silverton Standard* (7/27/95): 4.
[257] *Silverton Standard* (8/10/95): 2; *Silverton Standard* (2/29/96): 8.
[258] *"Mining News" EMJ* (9/14/95): 258; *Silverton Standard* (5/1/8/95): 3; *Silverton Standard* (8/10/95): 1.
[259] *Silverton Standard* (12/25/97): 1.

In the Cement Creek drainage, Willis Kinney continued work on the Gold King, which he and backers Cyrus Davis and Henry Soule purchased. In 1895, they formed the Gold King Mining & Milling Company to allocate capital and pursue the rich gold vein that awaited underground. The following year, Kinney had enough funds to commission Tunnel No.1 high up on the mountainside in the vicinity of the original discovery. Before reaching the target ground, the miners struck an unexpected vein that they termed the Davis. Around 200 feet of exploratory drifting proved that the vein was nothing less than a bonanza. After striking the Davis Vein, miners then encountered the Gold King Vein, as expected. With miners extracting payrock from not one but now two fabulous veins, Kinney immediately planned the facilities to produce in economies of scale. To minimize debt, he built the facilities incrementally. He started with a ten-stamp mill on the east edge of Gladstone in 1896 and enlarged it fourfold the following year. He also erected an aerial tramway to deliver the ore from the mine. In a few years, the Gold King produced enough ore to contribute materially to the county's production figures, and this trend would only intensify.[260]

Mineral Point Mining District

The Mineral Point district had no massive mines to sustain activity during the Silver Crash, and its small operations wilted in the poor economic climate. The town of Mineral Point was nearly abandoned. The nearby San Juan Chief Mine was the only center of noteworthy activity. Ed M. Brown tinkered with the property during the early 1890s and even built a mill in preparation for production, but the Silver Crash brought this to an end. In 1895, owner George S. Orth & Company of Pennsylvania tried to get things moving again by conducting underground development and enticing Brown to return. He did, but because the ore was complex and the mill ineffective, he continued only limited development for several more years and waited for the value of silver to rise.[261]

Ice Lake Mining District

Ice Lake Basin, locked in the high peaks at the head of the South Fork of Mineral Creek, saw limited activity. In 1890, William Sullivan began work on the Bandora Mine, proved rich silver ore, and sold it to Colorado Springs investors the following year. They organized the Bandora Mining & Milling Company but did little with the property until 1893, and nothing after the Silver Crash. Unwilling to wait for the price of silver to be restored, they reopened the mine in 1896 under superintendent James B. Snow and began production. Because the mine was far from Silverton, the cost of importing supplies and packing out the ore was too high to sustain the operation. Thus, the owners built a mill to separate out waste from the ore, and either they or the county commission contracted with Ben Harwood to improve the existing trail into a road. This

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[260] Kinney, 1932; *"Mining News,"* *EMJ* (6/19/97): 639.
[261] *Silverton Standard* (7/27/95): 1.

had the added benefit of making the basin more accessible for other ventures. By 1897, the owners leased the Bandora to Patterson & Johnson, who enjoyed a sound yield.[262]

The Great Mining Revival, 1898 – 1910

As the decade of the 1890s waned, a variety of factors contributed to a revival of silver mining across the west and especially in Colorado. Even though the value of silver did not recover from the Silver Crash of 1893 and hovered at around $.60 per ounce, the residents of San Juan County saw their mining industry blossom. With the exception of isolated years, miners produced more gold, silver, and lead than any time in the past. Given the low value of silver, several factors help explain the trend.

First, the nation's economy recovered from the depression, and while the rebound started in the east, it reached the west by the late 1890s. As the economic climate stabilized, investors felt secure enough to risk capital, and mining companies were able to find financing such as loans and credit for their projects. Second, transportation improved, railroad traffic increased, and goods and services were readily available again. Third, mine and mill owners, tired of bearing the costs of idle, profitless properties, were more than willing to extend themselves to bring their operations back into production or sell or lease them to investors who would. Fourth, the demand for industrial metals such as copper, lead, and zinc greatly increased due to the revival of industry. Fifth, advances in mining technology and engineering decreased the costs of ore production, and improved milling methods recovered even more of the metalliferous content than ever. Some of these were developed in response to the Silver Crash.

The last and sixth factor was the production and concentration of low-grade ores in economies of scale through massive investment and mechanization. As noted above, John Terry and the Stoiber brothers pioneered this practice. When capital and credit became available again by the late 1890s, other large mining companies in the county and throughout Colorado imitated them and profited from the abundance of low-grade ore. While the movement gave rise to gigantic operations, smaller outfits were also able to profit when they supplanted labor with machinery and ensured the production of high volumes of ore per shift.

The revival was dramatic in San Juan County at all levels. By 1900, the county population rose 2,300, 700 more than the last peak of 1890. The number of mines nearly tripled from those that were active the depression. In 1898 and 1899, the county featured approximately seventy-five small outfits, twenty-five medium-sized operations, and five large producers. These figures shifted as companies expanded their operations, and the numbers of medium-sized and large mines increased. Between 1900 and 1905, there were fewer small outfits, but the medium-sized mines rose to thirty-three and the large producers jumped to fourteen. The buoyant conditions stimulated a wave of prospecting in turn. In 1898 and 1899, prospectors developed around 25 new properties, and by the early 1900s, they worked at least 100. The production of metals fluctuated during the revival but changed little on average. Yields of approximately $1

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[262] *"Mining News," EMJ* (10/3/91): 393; Silverton Standard (6/6/96): 5; Silverton Standard (8/1/96): 3.

million in gold, $400,000 to $500,000 in silver, $300,000 to $400,000 in copper, and as much in lead per year were the norm.[263]

If the number of mines increased, then production should have risen in concert, and yet it remained static through the revival. What accounted for this trend? First, many of the new mines were failures and produced little ore. Second, the quality of ore decreased and offered a smaller metals content, which was troublesome because the material was already low in grade. Third, some large companies exhausted their ore reserves, and even though the mines were physically substantial, their production was not as high as might be expected.

While the revival brought San Juan County out of the post-Silver Crash depression, it changed the corporate landscape of the mining industry. The massive amounts of capital required to mine and mill economies of scale, and the proportional profits to be made, attracted companies that were larger, and capitalists who had more power than in years past. Most of the substantial companies consisted of groups of wealthy investors with interests in other mining regions and even separate industries. These companies had plenty of capital, developed individual mines into major operations, and were satisfied with regular ore production. Some of the companies owned proven mines and mills throughout the San Juans and considered their overall profitability most important, even if a few of the individual operations failed. Companies sought domination within the industry, speculated with prominent mines as if they were no more than prospects, and worked through subsidiaries. These entities contributed to an atmosphere of corporate mining in the county, although a high number of modestly sized operations maintained a strong local presence.

The American Smelting & Refining Company (ASARCo) was among the first of the massive corporate entities to affect San Juan County. The company was organized in 1899 by some of Colorado's and the nation's most powerful smelter men. They were bent on nothing less than national domination of the smelting industry, which they hoped to achieve through the business trust of ASARCo. James B. Grant of the Omaha & Grant Smelting & Refining Company was among the organizers, and he included the Durango Smelter in the new trust. In the same year, ASARCo acquired Otto Mears' Standard Smelter, and in so doing, controlled a significant share of the smelting capacity that served the San Juans.[264]

The company was adamantly antilabor and had the support of Frank Guiterman, manager of the Durango Smelter. Guiterman detested organized labor from personal experience quashing strikes at Telluride, and he carried his policies over to the Durango Smelter. In 1899, the State of Colorado mandated the eight-hour law for mill workers, and clever Guiterman told his workers that he would uphold the law but pay them for only eight hours instead of the usual ten-hour shift. Guiterman underestimated the power and unity of the workers, who belonged to the Mill and Smelterworkers' Union, and they struck and literally shut down both plants. Chapters in

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[263] Henderson, 1926: 216; Schulze, 1977: 1890-7; Schulze, 1977: 1900-10. The number of active mines was derived from a survey of *Colorado Mining Directory*, *EMJ*, and *Silverton Standard*.

[264] James E. Fell, Jr., *Ores to Metals: The Rocky Mountain Smelting Industry* (Lincoln, NE: University of Nebraska Press, 1979) 223, Ransome, 1901: 23; Smith, 1982: 101; Smith, 1992: 78.

Pueblo, Denver, and other smelting centers in Colorado followed in sympathy, and the Western Federation of Miners threatened similar action at many mines in Colorado.[265]

The result of the massive strike was profound. At first it paralyzed Colorado's mining industry, and as mines began to close, the demand for coal slackened and railroads curtailed traffic. Some of the mining districts in the San Juans were definitely in trouble, although Silverton offered enough ore treatment to soften the blow in the Animas River drainage. The mining industry became polarized as prolabor individuals sided with the strikers and antilabor forces, mostly mine owners, argued that the action was to everyone's ruin. In heavily unionized San Juan County, mine owners felt threatened by the potential for sympathy strikes. Newspapers fed the fires of tension and harped on the fact that if the strike in Durango forced the closure of mines, 500 workers in Silver Lake Basin and Arrastra Gulch alone would be jobless. After several weeks, the Colorado Supreme Court declared the eight-hour day unconstitutional, the wages and shift issue was back to where it started, and the strike collapsed. Everyone breathed a sign of relief as mining returned to normal in the Las Animas district.[266]

Despite the near monopoly that ASARCo held over the smelting industry, mining companies in the Animas River drainage generated enough ore to support at least one niche smelter. Unable to compete with the Durango plant, Thomas Walsh closed his Silverton Smelter in 1898 or 1899. The San Juan Smelting & Refining Company filled the void with the Kendrick-Gelder Smelter, built at mouth of Cement Creek in 1900. Like Walsh's facility, the Kendrick-Gelder Smelter specialized in treating ores rich in pyrite and copper, which attracted mining companies in the Red Mountain district. Because some of the operations in the Las Animas district had similar payrock, they found the smelter to be of benefit.[267]

In 1907, the vagaries of economic cycles again impacted San Juan County. This time, a national recession struck, and it nudged San Juan County into decline. The year began like many others during the revival. Mining companies generated almost $1 million in gold and $105,000 in zinc, then being recovered as an important industrial metal. Miners also produced $776,000 in silver and $662,000 in lead, both in greater quantities than previous years. The county was so productive that it ranked second only to Leadville in terms of lead and copper in Colorado. As the recession set in, prices ebbed until silver averaged a lowly $.56 per ounce and copper dropped from $.17 to $.13 per pound. At the same time, many mining companies were experiencing only low-grade deposits. The large companies with concentration mills were able to subsist on ore valued at $6 to $12 per ton, but the value had to be double for those companies without. Many small outfits simply lacked such payrock and were forced to close. Production in the county declined after 1907, peaked briefly in 1910, and then abruptly dropped off. The number of active mines fell from the heights of the early 1900s to around ten small outfits, fifteen medium-sized operations, and five large producers. Mining in the county contracted

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[265] Fell, 1979: 227; Smith, 1992: 78-9.
[266] *Denver Times* (6/7/99): 2; Fell, 1979: 230; Smith, 1982: 128.
[267] *"Mining News," EMJ* (7/14/00): 48; *"Mining News," EMJ* (5/15/09): 1019; *"Mining News," EMJ* (1/26/01): 28; *"Mining News," MSP* (5/22/09): 708; *Silverton Standard* (1/8/10); Sloan and Skowonski, 1975: 121, 142.

around those large companies that were savvy and wealthy enough to profit from their low-grade ore reserves.[268]

In the face of low metals prices and poor economic conditions, some of the large mining companies again made a concerted effort to cut their operating costs. Management closely examined budgets, and, in what was becoming a wearisome pattern, identified labor as a place to seek savings. The companies tried to get more out of their workers for less money by either increasing hours or reducing pay, which set the stage for inevitable conflict. Both labor and the companies were well prepared. Willis Kinney and Franklin L. Ross represented the San Juan Mine Owners' Association, and the Silverton Chapter of the Western Federation of Miners was a shield for the miners. Ross was related to J.B. Ross and a partner in the Ross Mining & Milling Company. Kinney himself rose from humble working-class roots, as the son of a leather merchant. In search of opportunity, he journeyed to Pueblo in 1880 and worked in a smelter then as a miner in Silver Cliff, before moving to the San Juans in 1883. Prior to his success with the Gold King, Kinney managed the Harrison Mine.[269]

In response to the mining companies' desire to either extend the miner's work day or reduce pay, the miners' union demanded a wage of $3 per eight-hour shift, which the mine owners' association vehemently protested. As tensions rose in 1907 and a strike seemed imminent, the Deputy State Labor Commissioner made a trip to Silverton to mediate. The miners' union and more than one thousand members proved to be a resolute opponent. To avoid a shutdown of the mining industry, risky in the poor climate of the recession, Kinney and Ross acceded to the miners' demands.[270]

The economic climate was especially unkind to the county's milling industry. Collectively, the small mining companies constituted the principal customer base for the independent mills. The small outfits were unable to afford their own concentration mills and had to send their ore to these facilities, which either purchased the material or treated it for a fee. Most of the large mining companies, in contrast, did little business with the independent mills because they concentrated their own ores in-house. Some companies, such as at the North Star, even accepted custom business to offset the waning production from their own mines. When the small outfits began to run out of ore valued above the $12 to $24 per ton threshold, they sent less to the independent mills. As a result, the demand for custom treatment slumped, which caused the independent milling business to collapse. Only the Silverton Public Sampler, Silver Lake Mill, and Kendrick-Gelder Smelter accepted custom business after 1907.[271]

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[268] George E. Collins, *"Mining in the United States During 1908: Colorado,"* EMJ (1/9/09): 104-5; George E. Collins, *"Mining in the United States During 1909: Colorado,"* Engineering & Mining Journal (1/8/10): 97-8; Howe Cross, 1905: 26; *Mineral Resources*, 1908: 395; Saxon, 1959: 7, 8, 14, 16; Henderson, 1926: 216 for production figures. EMJ and Silverton Standard for number of active mines.

[269] Brown, 1984: 71; Kinney, 1932; *"Mines of Cement Creek: Wonderful Progress made during the past Seven Years and a Great Future planned by People of Enterprise,"* Silverton Standard (10/19/01); Sloan and Skowronski, 1975: 49.

[270] *"Special Correspondence from Mining Centers,"* EMJ (7/20/07): 133; *"Special Correspondence from Mining Centers,"* EMJ (7/27/07): 180.

[271] *"Mining News,"* EMJ 4/18/08): 832.

The reason why the Kendrick-Gelder Smelter survived was because it was a niche facility that processed ores primarily with a high copper and pyrite content. The Durango Smelter, and the independent mills that did business with Durango, shunned such ores because they were incompatible to process alongside the region's lead-zinc material. In 1905, J.B. Ross purchased the smelter from the San Juan Smelting & Refining Company, which was in trouble, to treat pyretic ore from his mines in the Red Mountain district. His Ross Mining & Milling Company owned the Congress on Red Mountain Pass, the Galty Boy in Cement Creek and the Champion, all of which yielded pyretic ore. Ross also operated the Silver Wing, Bandora, and other lead-rich mines at times to fuel the smelter with fluxing-grade ore. The firm also hoped to attract custom ores from independent mines in the Red Mountain district. The Ross brothers did well with the mining business but not with the smelter. Their mines provided enough ore to pay most of the operating costs, but little custom ore came down from Red Mountain. Thus, the Ross brothers shut down the smelter in 1908 and sold the facility to wealthy New York investor W.B. Lowe a year later. Lowe attempted to modify the furnaces to treat lead-zinc ores typical of San Juan County in hopes of securing local business. The facility proved unable to economize production sufficiently, and in 1910, Lowe closed Silverton's last independent smelter.[272]

Las Animas Mining District

The Las Animas district featured several of the county's most significant companies during the late 1890s revival, and although they were among the largest in the county, the companies were local entities because their directors began in Silverton. These included Edward Stoiber's Silver Lake Mines Company and Gustavus Stoiber and James Robin's Iowa Mining & Milling Company. At Silver Lake, Edward continued to reinvest capital. As aforementioned, Edward planned a tramway from the mine down to an ore storage terminal, with the first 8,700-foot long segment, built to a short distance above the Iowa Mill. In 1898, he finished the system. He contracted again with William Frey who began construction on the tramway's second segment and on a massive terminal that replaced the original. In addition to receiving ore, the terminal served as a base station for the mine and included assay, machine, and carpentry shops. In total, the ore bins had the capacity for 16,000 tons of material, and the two tramway segments totaled almost 15,000 feet, making it one of the longest systems in the state.[273]

The underground workings in Silver Lake Basin took the form of an ore factory with more than a dozen miles of passages and levels linked by a central internal shaft. An electric hoist raised a cage in the shaft, and miners pushed loaded cars off the cage and across a long set of ore bins directly over the Stoiber Tunnel. Mules pulled trains of cars under the bins, workers filled them, and they continued out to the mill. To expedite the blasting process required to break the ore loose, Edward employed compressed air rock drills. When he wanted to increase the number of machines, he realized that a new compressor would have to be hauled up to the mine

[272] *"Mining News,"* EMJ (5/15/09): 1019; *"Mining News,"* MSP (5/22/09): 708.
[273] *"Mining News,"* EMJ (8/20/98): 225; *"Mining News,"* EMJ (8/27/98): 256; Prosser, 1914; Ransome, 1901: 156; *"The Silvery San Juan Has Enjoyed a Year of Unparalleled Prosperity in all Lines of Industry".*

and sought an alternative. In keeping with his progressive attitude, Edward decided to experiment with revolutionary electric models, since the mine already had an electrical infrastructure. By January 1899, miners were using the drills with success, drawing the attention of mining experts.[274]

In 1900, ten years after Edward began at the Silver Lake, he finally accomplished his vision. When the *Silverton Standard* received the news of the tram terminal under construction in 1898, the editors postulated that Edward would eventually build a mill on the site. Fulfilling the predictions, Edward did just that in 1900. With McCartney's assistance, Edward personally designed the new mill and selected the equipment, and then pushed its construction around the clock throughout the year. The mill and associated facilities were among the largest and most advanced ore treatment complexes in the San Juans, if not Colorado. The main building alone covered two acres, and the ore delivery structure and terminal built in 1898 occupied additional ground. With an array of advanced equipment, the mill was able to treat an astounding 1,000 tons of ore every 24 hours, more ore than many mines generated in a month. In general arrangement, the Silver Lake was now like Terry's Sunnyside, only the facilities were at least twice the size.[275]

While the Iowa Mine was not quite as extravagant as the Silver Lake, Gustavus Stoiber and James Robin were almost matching Edward's improvements one-for-one. They already owned the Royal Tiger Mine, across Silver Lake from the Iowa, and incorporated this sound producer into the Iowa operation. In 1898, Stoiber and Robin organized the Tiger Mining & Milling Company to finance an aerial tramway to the Iowa, a compressed air line from the Iowa, and additional surface facilities. The double-rope tramway allowed miners at the Royal Tiger to send ore over the lake and into the Iowa terminal, where workers coupled the buckets onto the main line. The buckets then coasted down to the Iowa Mill, emptied by workers, and sent back up to the Royal Tiger for filling. To power a number of new drills at the Royal Tiger, Stoiber and Robin increased the capacity of the compressed air system at the Iowa.[276]

Imitating Edward, Gustavus and Robin decided to build a storage terminal on the Animas River for concentrates from their Iowa Mill and smelting-grade ore from the mine. Gustavus chose a site on the north side of the river slightly east of Arrastra Gulch. Crews then erected the facility in 1899, completed a tramway to the mill, and secured direct freight service from the Silverton Northern Railroad.[277]

In addition to aggressively pursuing improvements at the Silver Lake and Iowa, Edward and Gustavus continued to fiddle around with their joint tunnel project, originally known as the Silverton Deep. The idea behind the tunnel was to undercut the ore systems of both mines at great depth, provide a platform for miners to stope the veins 700 feet upward to the existing workings, and serve as a central artery through which the deep ore could be hauled out. Such a project would be an engineering feat on par with similar tunnels in Creede, Idaho Springs, and

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[274] Arthur Lakes, *"The Silver Lake Mine,"* Mines and Minerals (Apr 1903): 389; Ransome, 1901: 156.

[275] Bureau of Mines, *Manuscripts MSS 640 V.27*: 19; *"Mining News,"* EMJ (12/1/1900): 648; *"Mining News,"* EMJ (5/11/01): 600; *"Mining News,"* Mining Reporter (12/4/00): 361; Ransome, 1901: 156.

[276] Colorado Mining Directory, 1898; *"Mining News,"* EMJ (8/27/98): 256; *"Mining News,"* MSP (5/14/98): 519.

[277] *"Mining News,"* EMJ (7/14/00): 48; *"Mining News,"* Mining Reporter (1/25/00): 52; Silverton Standard (1/26/00).

other important Colorado mining districts. The Stoibers started the tunnel in 1895 but put the project on hold. With both mines highly productive by 1897, they renewed their interest in the tunnel and renamed it the Unity, probably to reflect their fraternal cooperation. Teams of expert miners resumed work on the tunnel, and around 1898, Edward installed a mechanized surface plant that included an aerial tramway tied into the Silver Lake system. Edward provided the Unity crew with plumbing, steam heat, and electric lighting. In 1901, miners made the connection with the deepest workings in the Silver Lake Mine, around 3,000 feet to the south.[278]

During the early 1900s, large corporate entities from outside the county targeted well-developed properties in the Las Animas district for acquisition. The North Star Mine was one of the first to draw interest. After operating the property for more than twenty-five years, the Crookes decided to sell after realizing around $2.5 million in ore. In 1900, they were approached by wealthy and experienced investors with the Smuggler-Union Mining Company. This outfit was one of the largest in Telluride and held the Contention Mining Company as a subsidiary. Some of the investors were from Boston, others associated with the powerful Calumet & Hecla Mining Company in Michigan, and the rest were local to the San Juans. The Contention directors offered the Crookes a fair price, and they accepted.[279]

Like the Stoibers, the Contention company intended to build a mill on the Animas River, secure a siding from the Silverton Northern Railroad, and send the ore down through Little Giant Basin via tramway. The Contention company wasted no time in pursuing its production scheme, but there was one important impediment to the plan. The summit of North Star Peak lay between the mine's surface plant and Little Giant Basin, the tramway route to the mill. Further, the route itself was not straight and featured a crook like Stoiber's Silver Lake system. After considering these factors, the engineer bored a tunnel from the North Star workings through the peak and blasted a room out of the north cliff. In the room, workers erected a terminal for a double-rope reversible tramway, which descended to the abandoned North Star Mill in Little Giant Basin. They converted the mill building into a midway station, and a Bleichert system continued down to the Contention Mill on the Animas River. The tramway was unique because of the refitted mill and two different legs.[280]

Once the mill and tramway were finished, the company increased the workforce to 100. Miners engaged in development and ore production, and others started up the Contention Mill on the river. After only a year, however, the entire operation collapsed. Bulkley Wells, the colorful manager of Smuggler-Union, had neglected to adequately develop the ore veins in the North Star and did not ensure that the concentration process in the mill was truly effective. During the winter of 1902, Wells closed the mine and mill as a monumental failure, and the company looked to its other mines to recover the loss.[281]

278 Lakes, 1903; *"Mining News," EMJ* (12/8/00): 677.
279 Bureau of Mines, *Manuscripts MSS 640 V.27*: 16, 18, 27, 59; *"Mining News," EMJ* (7/20/01): 77; *"Mining News,"* Mining Reporter (1/9/02): 30; *"Mining News"* Mining Reporter (1/30/02): 146.
280 Bureau of Mines, *Manuscripts MSS 640 V.27*:59; *"Mining News,"* Mining Reporter (11/7/01): 369; *"North Star Group,"* Mining Reporter (10/2/02): 270; Prosser, 1914.
281 Colorado Mine Engineers' Reports: Shenandoah-Dives; Prosser, 1914; *Silverton Standard* (1/2/04).

In 1901, Edward Stoiber's Silver Lake empire was the subject of the second acquisition in the Las Animas district by a major corporate entity. The Guggenheims, empire builders on a national scale, offered Edward a stunning $2.5 million for the Silver Lake collection, or $54 million today. Some sources claim that Edward accepted around $1.3 million in cash and the rest in stock. The only stipulation that Edward had was that he be retained as a consultant until the mill was finished and treating ore successfully, which was proven in May. Satisfied that his legacy was fully functional, Edward and Lena retired to Denver and traveled Europe.[282]

The Guggenheims continued Edward's operation. They purchased the Titusville for $500,000 and the Scranton City because these mines lay long the same geological features as the Silver Lake workings. Immediately after the transactions, Samuel I. Hallett, a talented mining engineer and metallurgist, arrived from Aspen to replace Robert McCartney as manager. Hallett maintained the Silver Lake Mines Company structure, kept the employees, and hired McCartney as a consultant. McCartney attended to other operations as well, including the North Star Mill on Sultan Mountain. Amusingly, one of the first changes that Hallett instituted was the replacement of some of the concentration machinery in the mill with Hallett tables, apparatuses of his own design.[283] The Guggenheims did not have the personal interest that possessed Stoiber, and problems soon developed. The first drew Stoiber's honesty into question. Within three months of the sale, the principal ore vein pinched out, leaving the costly operation with much less payrock than had been supposed. Possibly at Stoiber's recommendation, Hallett directed nearly all the miners to extract the existing ore and drive exploratory workings in search of the lost vein and others. The miners triumphed, Hallett was relieved, and Stoiber exonerated.

Although Hallett was not as intimate with the mine as Stoiber, he was an effective manager. The workforce produced 260 tons of ore per day, and although this was only one-quarter of the new mill's capacity, it still was more than any other mine in the county. Around 30 percent of the ore flowed out of the Unity Tunnel, which was now a haulageway for the Silver Lake's lower workings, and the remainder came from Silver Lake Basin. The figure was honorable, especially given that the mill reduced the ore to 60 tons of concentrates, which required daily rail service to remove. With all the ore descending to the Silver Lake Mill, Hallett mothballed the old facility in Silver Lake Basin. Shortly after, the Guggenheims dispatched Hallett to Mexico to examine several promising mines there.[284]

In 1903, the Guggenheims merged with smelting giant ASARCo, which controlled the Silver Lake empire both for the mine's profitability and as a source of ore for the Durango Smelter. Under ASARCo, problems with the Silver Lake continued and consumed profits almost as quickly as they were generated. In October 1904, workers in the tramway's turning station above the Iowa Mill stoked their stove a little too high, and the wind blew sparks out of the

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[282] Colorado Historical Society *Manuscripts MSS 640, V.27*: 20; Denver Times (5/2/01): 4; Denver Times (12/29/01): 6; *"Mining News," EMJ* (5/11/01): 600; *"Mining News," EMJ* (8/27 01): 539; *"Mining News," Mining Reporter* (1/9/02): 30; Prosser, 1914; Silverton Standard (6/7/02); Wolle, 1991: 428.

[283] *"Mining News," EMJ* (10/11/02): 494; *"Mining News," Mining Reporter* (9/25/02): 258; *"Mining News," Mining Reporter* (10/30/02): 363.

[284] Denver Times (11/23/01): 9; *"Mining News," EMJ* (3/14/03): 423; *"Mining News," EMJ* (6/20/03): 945; *"Mining News," Mining Reporter* (5/1/02): 437; *"Mining News," Mining Reporter* (6/11/03): 549; Prosser, 1914.

stovepipe onto the building, which caught fire and burned to the ground. The cables on both tram segments released, which dropped the tram buckets and pulled over a number of towers. The system was a total wreck and the conflagration suspended the entire mining operation. The Silver Lake Mill was shut down until the tram system could be repaired, and instead of bringing the original mill in Silver Lake Basin back into operation, the manager laid off half the workforce and curtailed activity at the mine.[285]

After the tramway had been repaired, another catastrophe struck. In 1906, workers at the Silver Lake Mill noticed that a fire had been deliberately started in the office and sounded the alarm. They frantically rushed to the hydrants only to find that someone had cut the hoses. With no way to control the fire, the blaze enveloped the entire building, ancillary structures, and the lower terminal for tramway, which suffered another massive release. The devastation was not total because the ore elevators, powerhouse, shops, and boardinghouse remained intact. Without a mill, ASARCo suspended operations yet again and considered whether the Silver Lake was worth the trouble. The disaster caused a distinct dip in the county production figures for 1906.[286]

ASARCo decided to invest in the Silver Lake one more time and likely consulted with the manager. Guess to revise the original operating strategy. ASARCo floated the idea of reopening the long-quiet Aspen Tunnel, which still offered low-grade ore with a high zinc content. A single mill, however, would not be very efficient for the ore from both mines since it differed greatly, and in response, Guess planned a mill with two separate flow paths. One path would be tailored to ore from the Silver Lake and the other could treat not only high zinc payrock from the Aspen, but also custom orders. By April 1907, the reincarnated Silver Lake Mill was finished and featured split flow paths as planned. The path for Silver Lake ore could treat 200 tons per day and the other path half that, a large downgrade from Stoiber's original design of 1,000 tons per day.

The Iowa Gold Mining & Milling Company, second largest outfit in the Las Animas district and one of the county's most profitable, experienced problems during the early 1900s even worse than the Silver Lake. Gustavus Stoiber and James Robin discovered that the main problem with producing ore in economies of scale was that a mine's life was relatively short when the ore reserves were limited. By 1901, the Iowa showed signs of exhaustion after only six years of intensive mining, and, in response, Gustavus and Robin pursued an aggressive exploration and development campaign to prolong operations. When this failed, they curtailed operations, let go more than half of the workforce, and suspended the mill and tramway. Gustavus and Robin then took the option that companies reserved for times of trouble and leased both the Iowa and Royal Tiger properties while seeking a buyer. In 1902, around forty workers sought ore in both mines, and Al Kunkle struck a fabulous vein in his Royal Tiger lease, but it lasted for only one year. Because of the meager production from both properties, no one

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285 *"Mining News,"* *MSP* (2/4/05): 77; *Silverton Standard* (10/24/04); *Silverton Standard* (12/17/04).
286 *Mineral Resources of the United States* (Washington, D.C.: U.S. Geological Survey, Government Printing Office, 1906) 232; *"Mining News,"* *MSP* (5/5/06): 301.

seriously considered purchasing the complex, including the Guggenheims, who owned the Silver Lake on one side of the Iowa and the Titusville on the other.[287]

The stress of the rapid Iowa's failure proved to be too much for Stoiber and Robin. Depressed and despondent, Robin shot himself in 1903. In 1905, an avalanche wrecked a significant portion of the Iowa Mill. Gustavus died of a massive stroke on the train from the Red Mountain district down to Silverton soon after.[288]

During the late 1890s and early 1900s, the revival in the Las Animas district was by no means limited to large companies. Investors with moderate resources, who greatly outnumbered the Stoibers, Robins, and Guggenheims of the industry, financed and even personally worked a number of small to medium-sized operations. Some of these were continuations from the mid-1890s while a substantial proportion of them were new. Significant fortunes were not won or lost on these mines, by they were an important part of the revival on a cumulative basis.

While most of the companies organized during the late 1890s boom were there to mine, a few sought riches by exploiting investors. For much of its history, San Juan County saw little obvious fraud, but free-flowing capital of the revival proved to be a sound financial resource for a few highly dubious schemes. In 1897, B.F. Kelly and W.H. Bush organized a project so preposterous that only investors as out of touch with reality as Edward Innis could possibly see its merit. Kelly and Bush established the Gold Tunnel & Railway Company to drive the Oro Tunnel no less than 20,000 feet from the Animas River east under Deer Park and Silver Lake Basin, terminating at the Highland Mary Mine. Not only was the tunnel supposed to pierce known veins, but, as with the Mineral Point Tunnel, it in theory was going to discover new formations and repay investors many times over. In 1898, Kelly and Bush collected enough money to secure the Highland Mary and a site on the Animas River, and began work.[289] Silvertonians, well versed in mining, frowned on the project, as the *Silverton Standard* stated: "B.F. Kelly, better known as 'Tunnel Kelly,' if he never was thought of before as being a rustler and 'smart' man, will be now since he and W.H. Bush, the promulgators of the famous Oro Tunnel scheme, have realized out of their enterprise $400,000."[290] The project was a clear sign to the Las Animas district that investors in fact had plenty of capital and were eager to spend it during the late 1890s. The Oro was not Kelly's only venture, and he engaged in similar projects in Clear Creek County. As preposterous as the Oro was, it led to one of the most important operations to develop in the Las Animas district during the revival.

The operation involved the Highland Mary, which Innis left as a ready-made mine when he went bankrupt in 1885. When miners originally drove the Innis tunnel, they pierced several major silver veins but did little with them because Innis was bent on finding the lake of gold. Kelly and Bush also neglected the veins probably because they were focused on their financial scheme and took little interest in what the Highland Mary had to offer. Kelly and Bush were

[287] Silverton Standard (1/18/02); Silverton Standard (2/22/02).
[288] *"Mining News," MSP* (8/12/05): 116; *"Obituary," Mining Reporter* (1/13/03): 61; Sloan and Skowonski, 1975: 163.
[289] *"Mining News," EMJ* (7/3/97): 16.
[290] Silverton Standard (10/8/98).

ousted from the Gold Tunnel & Railway Company in 1900, and Mary B. Murrell of Denver, Toledo investor C.W. Everett, and New York City capitalist John R. Wyatt assumed control. Murrell was probably the first of the partners to realize that at least several silver veins lay undeveloped in the Highland Mary and convinced Everett and Wyatt to organize the Highland Mary Gold Mining & Railway Company to bring them into production.[291]

Because knowledgeable about mining, Murrell assumed the position of manager, extremely rare in the mining industry. In 1902, she hired fifteen miners who repaired the surface plant and began rehabilitating the 6,500 tortuous feet of the winding Innis Tunnel. At the same time, Murrell secured J.A. Snedaker to build the mill originally planned for the Oro Tunnel, but adjacent to the Innis Tunnel where it was actually needed. Snedaker designed an excellent facility that not only effectively concentrated ore, but also included a small hydropower generator for electricity. The mine, however, was a long way from being truly profitable because the underground workings were so disorganized that they interfered with the movement of ore to mill. Under superintendent W.E. Wilson, miners split their duties between ore production and trying to link the disparate levels together through vertical workings. By 1904, he was satisfied with the development and directed the crew to send a steady stream of ore into the mill. The operation enjoyed such a high level of profitability through 1906 that the Silverton Northern Railroad considered grading a line up Cunningham Gulch to the mine.

On the other side of North Star Mountain, the Black Prince had the signs of becoming a major operation. In 1902, W.B. Severn, L.H. Chadwick, and other investors from Chicago and Michigan organized the Black Prince Gold Mining Company with the intent of developing the forgotten Black Prince vein. Severn and partners found that, with Contention's mill and tramway, the Black Prince was almost a ready-made mine. Eager to be done with the North Star debacle, the Contention company was more than willing to sell the Black Prince claims, the tramway, and the mill to Severn and partners.[292]

During the fall, the company put a large crew to work driving the main tunnel toward the vein and erecting a well-appointed surface plant. The conservative *Engineering & Mining Journal* noted: "Black Prince. This company has purchased the possessions of the Contention Mining Company on King Solomon Mtn, near Silverton, and is making many improvements. The old Contention tram is also being extended to the Black Prince lode." The tramway was not exactly "extended" and was, in reality, shortened. Workers erected a new terminal directly under the original Contention system and linked it to the Black Prince with a rail line. When the adjustments were finished, the Black Prince company operated the mine and mill with success at first. However, repeating the same pattern of the preceding twenty-five years, the ore increased in complexity with depth, the mill recovered only a fraction of the metals content, and the mine proved very expensive to operate. Had the investors looked into the histories of the operations that surrounded the Black Prince, they may have been more thorough in their planning. By 1904,

[291] *"Mining News," EMJ* (2/23/01): 253; *"Mining News,"* Mining Reporter (7/11/01): 29; Silverton Standard (10/26/01).
[292] Colorado Mine Engineers' Reports: Shenandoah-Dives Group; *"Mining News"* Mining Reporter (11/20/02).

the company closed the mine but continued to run the mill as a custom facility on ore from other mines in the area.[293]

The Lackawanna Mine, on the north flank of Kendall Mountain above Silverton, was promising enough to draw significant investment. In 1898, George Whitelaw and John Norton, principals with the Four Metals Mining Company in Pueblo, added the property to its growing roster of mines in the San Juans. By driving exploratory passages on several veins, miners found enough ore to sustain a constant but limited production, which encouraged the company to invest in surface improvements. A system for shipping and storing ore was among the new facilities, and it consisted of a double-rope reversible tramway and set of ore bins on the Animas River. The Four Metals Mining Company enjoyed such success with the Lackawanna that one of the directors proposed a concentration mill at the base of the mountain. After several years of regular production, the rest of the directors felt confident enough to agree and financed a modest facility. Workers finished the mill in 1903, which is when trouble began. Similar to the Black Prince, the ore was too complex for the mill and the veins featured less material than expected. By 1904, Whitelaw and partners found the operation became unprofitable and stopped work.[294]

The Las Animas district weathered the 1907 recession better than most, but was not immune to the widespread failure of many of the small and medium-sized mines caused by the poor economic conditions. Some of these, however, were replaced by new ventures of similar size and productivity. In addition, the Silver Lake and the Iowa maintained their status among county's most important operations.

Despite this status, the dismal economic climate and a host of problems gave ASARCo reason to doubt whether the Silver Lake had been worth buying from Stoiber. When the replacement Silver Lake Mill was finished in 1907, ASARCo planned to treat silver-lead ore from the Silver Lake Mine in one of the two flow paths and zinc-rich material from the Aspen Tunnel in the other circuit. The Garfield Smelting Company, a subsidiary of ASARCo, reopened the Aspen, a short distance west of the mill, and was confident enough in the operation to build a new tramway. The arrangement, however, was short-lived. Neither treatment path in the new mill recovered a sufficient percentage of the metals content. ASARCo found that the facility was simply not profitable and suspended operations. ASARCo cancelled production at the Silver Lake and leased out blocks of ground instead of working the mine itself. Garfield decided to continue with its Aspen project and erected its own mill at the tunnel. Garfield's metallurgist had no better luck with the zinc-rich ore, however, and after spending a small fortune on a brand new mill, Garfield suspended work at the Aspen as well.

With an enormous amount of capital invested in both the Silver Lake mine and mill, ASARCo was unwilling to concede defeat. The managers agreed that the split treatment concept in the Silver Lake Mill held great potential, so they went back to the drawing board to refit the

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[293] *"Mining News,"* EMJ (12/13/02): 795.

[294] Bureau of Mines, *Manuscripts MSS 640 V.27*:98; *"Mining News,"* EMJ (2/8/02): 223; *"Mining News,"* EMJ (7/19/02): 93; *"Mining News,"* Mining Reporter (3/12/03): 249; Silverton Standard (1/25/02).

facility. The task likely fell to Louis O. Bastian, a milling expert who served as one of the superintendents for much of the decade and had experience with the facility. By late winter of 1909, ASARCo was ready to try again, brought ore down from the Silver Lake and over from the Aspen, and ran the first tests. To the relief of all, the mill ran as expected, after two years of delays. Management prepared to resume normal operations at the Silver Lake Mine, but before they made headway, the tramway's turning station burned. Yet another disaster struck when a series of avalanches let go following a powerful spring storm in 1911. One slide took out towers for both the Silver Lake and Iowa tramways and laid power lines on the ground, which shorted and started a fire at a transformer station. ASARCo fixed the tramway relatively quickly.[295]

In June, ASARCo sent a crew of eighteen miners to join the lessees at the Silver Lake and they naturally took up residence in one of the boardinghouses. While the massive residential complex was not filled to capacity, Silver Lake lessees and a considerable crew of miners employed at the Iowa made for a population of several hundred. The population, however, was too transitory for the Postal Service to justify maintaining the Arastra office, which was revoked in 1910. By July, the ASARCo miners began production, and as the demand for lead-rich ore increased at the Durango Smelter, ASARCo sent up additional teams until the workforce was around one hundred by the fall. The atmosphere of Silver Lake Basin approached the heyday years under Stoiber and the tramway carried as much as 100 tons of ore per day down to the mill.[296]

The last and final disaster for ASARCo struck in the summer of 1912. Leaving out the intense drama and excitement, the *Mining & Scientific Press* dryly reported that: "A fire occurred on June 30 at the Silver Lake Mine, near Silverton, owned by the American S.&R. Co. Practically all the mine buildings were destroyed, except the boardinghouse, which was saved by dynamiting smaller buildings between it and the blacksmith shop, where the fire started. The upper terminal of the tramway was destroyed, necessitating the closing of the mill."[297] With that, the company finally gave up on the mine, leased out blocks of ground to small parties.

Ironically, the Silver Lake and Iowa mines literally traded roles after the 1907 recession. Whereas the Silver Lake produced heavily and the Iowa was failing before the recession, the Iowa resumed its status as a major operation and the Silver Lake declined. The poor economic conditions facilitated the juxtaposed relationship, but the greatest factor was the difference of management strategy between the conservative ASARCo at the Silver Lake and a new organization that operated the Iowa.

After Gustavus Stoiber and James Robin died, their heirs and the surviving Iowa Tiger Consolidated Mining & Milling Company directors assumed that both the Royal Tiger and Iowa properties were bereft of profitable payrock. Otto Mears suspected otherwise and reasoned that if the Iowa and Silver Lake mines were neighbors on the same general ore system, there was no

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[295] *"Mining News," EMJ* (3/20/09): 625; *"Mining News," EMJ* (4/4/11): 487; *"Mining News" MSP* (2/5/10): 239; Silverton Standard (2/13/09).
[296] Bauer, et al, 1990: 13; Mineral Resources, 1912: 694; *"Mining News," MSP* (7/8/11): 59; *"Silverton, Colorado," MSP* (1/20/12): 150; Silverton Standard (7/15/11).
[297] *"Mining News," MSP* (7/27/12): 126.

logical reason why the Iowa should not match the Silver Lake's eighteen solid years of production. The ore, however, would require expertise to find and attentive management to produce. With this in mind, in 1908, Mears and Jack Slattery approached the Iowa owners with a proposal to lease the entire idle operation. The owners accepted, and Mears and Slattery organized both the Iowa-Tiger Leasing Company and the Mellville Leasing Company, the beginning of a long-lasting and highly lucrative leasing syndicate.[298]

Formally known as John H. Slattery, Jack was a staunch Silvertonian with experience in business and mining. Slattery worked as a civil and mining engineer in the Red Mountain district during the early 1890s left with the Silver Crash of 1893. The collapse of mining made engineering jobs difficult to find, so Slattery chose an industry always in demand. He moved down to Silverton and operated the Bucket of Blood Saloon, subsequently the Hub Saloon, and Grand Hotel. Slattery thus became a community figure, started a baseball club, and even served in the state legislature. Slattery's capital, popularity, business experience, and knowledge of mining made him an excellent leasing partner.[299]

Instead of viewing labor as a resource to be tolerated only by necessity, like Kinney and Ross, Mears and Slattery understood that their success hinged on their miners. Given this, the partners hired the best workforce that could be assembled and gave the miners incentive to find ore and produce it efficiently through a profit-sharing program. Up-front capital for repairs, improvements, equipment, and labor was in excess of what Mears and Slattery were comfortable providing, so they included around five other investors in their small but highly effective leasing syndicate.

Louis O. Bastian, formerly superintendent of the Silver Lake Mill, provided metallurgical expertise and some capital. When ASARCo ran into trouble with the mill, he went into semi-retirement and purchased the Corner Store mercantile in Silverton in 1909, but was easily drawn back into mining probably by Slattery. Matt Delsante was another Silverton resident and immigrant Italian miner familiar with the area's resources. King C. Gillette, of Beverly Hills, was a major contributor of capital. Frank Slattery, Jack's brother, provided management and administrative oversight. James R. Pitcher was Mears' right-hand man and son-in-law. Pitcher met Mears through the Mack Brothers Motor Car Company in New York City as a mutual investor, and they were convinced that the automobile was the wave of the future. Pitcher socialized with Mears and met Mears' daughter Cora, who he married in 1904. The following year Pitcher was appointed secretary and treasurer of the company, but sided with Mears during a stockholder disagreement in 1906 and walked out. Mears brought Pitcher west out of the comfort of New York City to gritty Silverton and offered him the position of manager over the Silverton Northern Railroad.[300]

As a syndicate, the team of seven worked together to lease some of the county's formerly most productive mines, with an emphasis on the Las Animas district. Various combinations of

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[298] *Mineral Resources*, 1908: 396; *"Mining News," MSP* (8/2/08); Sloan and Skowonski, 1975: 285; Tucker, 2003: 114; Weed, 1925: 730.

[299] Sloan and Skowronski, 1975: 285; *Silverton Standard* (4/29/99).

[300] James H. Baker, *History of Colorado* v. 5 (Denver: Linderman Co., Inc., 1927) 153; *Silverton Standard* (4/17/09); *Silverton Standard* (7/3/09); *Silverton Standard* (9/24/10); Sloan and Skowonski, 1975: 51, 242, 333; Tucker, 2003: 115.

two and three of the syndicate members claimed themselves as principals in any given lease while all seven usually contributed capital. As a result, when several names of the syndicate showed up on the paperwork for a lease, it was implied that all seven were actually involved.

During the summer, Mears and Slattery rehabilitated the surface plant and underground workings at both the Royal Tiger and Iowa, and then pursued an organized exploration program for ore. Contrary to the property owners' misconception, the miners found plenty of low-grade material available in the old stopes and began production. The workforce divided itself into six groups. The first two brought the existing ore out of the Iowa and Royal Tiger mines for shipment down to the Iowa Mill, which the third group repaired and operated. The fourth group outfitted the surface plants at both mines, while the last two groups carried out a planned and educated underground exploration campaign. One of these last groups realized that the original Iowa company paid little attention to the geology below the main tunnel level and assumed that ore surely lay deep in the ground. In 1909, miners sank a shaft and discovered an extension of the Melville Vein, which had been previously mined in the upper levels. While additional development demonstrated at least six months' worth of ore at the time, the Melville ultimately yielded for years. Elsewhere in the workings, another crew discovered an entire vein of ore valued at $1,200 per ton, around $40,000 today. In 1910, Louis Quanstrom, the metallurgist in the Iowa Mill, noticed that the proportion of gold recovered from Royal Tiger ore constantly increased and suspected that the miners must have been encountering gold stringers too fine to be obvious. Quanstrom relayed this to the Royal Tiger foreman, who tested the idea by blasting a chamber out of the vein's hanging wall. To everyone's surprise, the shot revealed a hidden, parallel gold vein.[301]

With all the new ore that the Iowa owners originally asserted did not exist, Mears and Slattery kept over one hundred employees busy through 1911 and 1912. The mill workers tried to keep up with the 100 tons of ore sent down to them every day, and the miners made several additional discoveries. Heavy production continued through 1913, and after five years of a continuous yield, Mears and Slattery finally saw operations at the Iowa and Royal Tiger slow.

The 1907 recession did little to stop Martin Houk at the Shenandoah and Trilby mines, in Dives Basin. By the spring of 1908, Houk's Trilby Tunnel was an impressive 2,000 feet long, and miners finally struck the sought-after vein. The findings were troubling, however, as Houk realized that the vein was not quite as rich as he expected. Hoping to find a better section of the Trilby vein, Houk devised a two-pronged approach, driving development workings along the vein from the Trilby Tunnel, and through the Shenandoah. Houk organized the Danville Leasing Company with investors from Danville, Illinois, and briefly brought ore out of both tunnels. When winter closed the pack trails, Houk ordered his miners into an exploration and development phase. Houk's plan paid off in 1909 when miners finally struck a rich copper vein at Shenandoah. However, the crew exhausted the payrock within several months, forcing Houk

[301] Colorado Mine Inspectors' Reports: Iowa; *"Editorial Correspondence: Denver," EMJ* (7/30/10): 230; *"Mining News," EMJ* (10/30/09): 893; *"Mining News," MSP* (7/23/10): 130.

to return to his investors for more money. Although the ore in the Trilby proved unprofitable, Houk kept the Shenandoah in constant but limited production through 1912 when he moved on.

When the Shenandoah came available, Daniel McLean mobilized to lease the historic producer. McLean, who lived in Durango, leased the Dives several years earlier and felt that the basin still had much to offer if managed correctly. In 1913, McLean organized the Dives Leasing Company, sent a crew of miners up to the Shenandoah, and continued where Houk left off. McLean's miners had no trouble finding enough ore to assemble a shipment and sent 132 tons down on mules when the trails were free of snow.[302]

While some of the large operations were able to weather the 1907 recession, many of the small and medium-sized mines became scenes of great disappointment and lost capital. Such was the case with the Lackawanna Mine. A group of miners optimistically took a lease on the property early in 1907, but as the economic climate disintegrated and metals prices slipped, they were unable to find the capital necessary for exploration and suspended operations. At the same time, Henry Frecker, who purchased the Little Nation Mine above Howardsville in 1900, was finally ready for production. During the preceding seven years, he pushed the Tom Trippe Tunnel, the lowest of three entries, toward the Royal Charter Vein as capital came available. In 1907, he finally reached his destination and rounded up the capital for formal development and even a mill, which he planned at Howardsville.

Howardsville was thriving in 1907, although the town remained fairly static. Howardsville continued its role as a hub for Cunningham Gulch and supported a number of service businesses, a railroad station on the Silverton Northern, freight outfits, and slaughterhouses. The late 1890s boom had a limited impact and brought more people and Rickett's Mill, a concentration facility that failed within several years. By 1907, the population was mostly working class and numbered around 150 to 170.[303] As soon as the snow of 1908 melted, Frecker hired a construction gang to build the mill. By July, the facility was complete and featured a battery of ten stamps to crush ore and concentration machinery to separate out the metals. After a week of testing, the mill seemed to fulfill its promise and the *Mining & Scientific Press* hesitantly declared it a success, but in actuality the ore was too complex for the limited facility. The lack of further coverage suggests that Fecker had to close it sometime during the year.[304]

Cement Creek Subdistrict

The Cement Creek drainage saw a small explosion of activity due to the revival, a change from past trends. The drainage drew little interest during early 1880s boom or the late 1880s, and just as investors prepared to develop a few claims during the early 1890s, the Silver Crash wrecked the economy. By the late 1890s, the drainage was poised to boom because it seemed to be one of the last areas in the county where investors might still encounter fresh bonanzas.

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302 *"Mining News," MSP* (7/12/13): 72.
303 Schulze, 1977: 1910-8; Sloan and Skowonski, 1975: 134.
304 *"Mining News," EMJ* (5/16/08): 1025; *"Mining News," MSP* (5/2/08): 580; *"Mining News" MSP* (7/4/08): 6; Silverton Standard (4/18/08).

The Gold King Mining & Milling Company, organized by Willis Kinney, Cyrus Davis, and Henry Soule, was already in bonanza. In 1897, Kinney built a mill at Gladstone and a tramway up to Tunnel No.1, which allowed the mine to rank among the county's gold producers. Like many other managers of large mines, Kinney envisioned increasing production through more development and better surface facilities. Financing such a strategy, however, required an enormous capital investment. Funded by stock, creation of subsidiary companies, and debt, Kinney began a major improvement campaign in 1900. Kinney began two new tunnels to undercut the vein system and work it simultaneously from different levels. He organized the American Mine & Tunnel Company to drive the American Tunnel into the mountainside between Tunnel No.1 and Gladstone, and the Anglo Saxon Mining & Milling Company to drive the Gold King Tunnel from the mill at Gladstone (later renamed the American Tunnel). The American company then built a tramway down to the mill. Meanwhile, the Gold King company was entangled in a legal battle with the owners of the nearby Sampson Mine, who claimed that they owned the rights to the entire vein system. Both camps were unwilling to see their profits go to lawyers and came to terms in 1900. The Gold King directors suggested that the two parties merge and share profits, with the majority going to Kinney, Davis, and Soule. The Sampson owners accepted, and the directors reorganized the entire outfit, including the subsidiaries and several coal mines in Durango as the Gold King Consolidated Mines Company.[305]

It appears that the American Tunnel intersected the vein system during 1901, because production increased to the point where Kinney enlarged the mill a second time. The facility reduced around 200 tons of ore per day into forty of concentrates, which were enough to justify daily railroad service. Kinney continued his improvement campaign the following year and attempted to lower production costs and increase the mill's efficiency. Up to 1902, steam powered nearly the entire mining and milling operation, hence company interest in Durango coal mines. To reduce the costs of hauling coal, Kinney installed a powerhouse at the mill and electrified as much machinery as possible. To increase the mill's efficiency, he installed a number of new appliances, including a battery of vibrating tables that recovered gold from what had been discharged as tailings. It remains unknown how much the improvements cost, but they resulted in immediate short-term profits. In 1905 alone, the company realized $656,000. The mining industry recognized the Gold King as one of the county's most advanced operations.[306]

Gold King Mine lent legitimacy to the Cement Creek drainage and inspired investor confidence in other operations. As early as 1896, eastern investors organized the Red & Bonita Mining Company to develop a group of claims north up Cement Creek from the Gold King, but progressed slowly due to post Silver Crash depression. As the economy showed signs of recovery in 1897, they began driving two tunnels easterly into Bonita Mountain in hopes of striking an extension of the Sampson Vein. Confident, the directors financed a small mill at the lower tunnel and erected a surface plant. In 1898, miners reached the vein, found that it offered ore, and began production. Repeating the well-worn trend, however, the shallow ore was simple

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[305] Kinney, 1932; *"Mines of Cement Creek."*

[306] *"Gold King and Gold Prince Properties of the San Juan,"* Mining Investor (7/25/04): 234; Mineral Resources, 1905: 209; *"Mining News,"* EMJ (9/21/01): 368; *"Mining News,"* EMJ (8/9/02): 195.

enough to be treated in the mill, but after two years of extraction gave way to complex material. As a result, the mill ran intermittently and ultimately suspended. The mill later played an important role in the Cement Creek drainage's second-largest mine, the Mogul.[307]

The Yukon Tunnel followed a trajectory that paralleled the Red & Bonita. The Yukon was among the first significant operations that the revival fostered in the Cement Creek drainage, and even though the tunnel was a financial failure, the associated mill became important to other mining outfits. A group of eastern investors looking for opportunities learned the Uncle Sam and Lamont mines, on the west flank of Storm Peak, featured a bold vein largely untapped. In 1897, Roswell F. Baker, Major M.W. Emery, and E.R. Perham organized Boston & Silverton Mining & Reduction Company, and purchased the Lamont and Uncle Sam. A.A. Lamont, former owner of the property, became manager. To provide immediate income, the company pulled ore from the two remote properties but planned to drive a haulage tunnel around 4,000 feet easterly from the floor of Cement Creek, undercut the main vein, and work it upward. Baker suggested that the tunnel would probably penetrate hidden veins on its way and could serve as a platform for mining interests on the east side of Storm Peak. Of the project, the *Silverton Standard* opined:

> It is destined one day to be one of the most important factors in the development of the mineral resources of San Juan County, being so situated that by a company-operative system the entire section lying between the Animas River and Cement Creek could be developed at great depth. It could be made to serve the same purposes for all of the producers and promising prospects in that great mineral belt. Already some fifteen veins have been intersected and every one of considerable value.[308]

Under Lamont, miners began driving the tunnel in 1897 but progressed slowly because they drilled largely by hand. To expedite the project, Lamont installed a compressor the following year so the miners could bore blast-holes with rock drills. The company directors understood that the tunnel would require several years to complete, but nevertheless grew impatient. They ordered a mill be built at the tunnel in 1899, which, upon completion the following year, stood idle. The mill was a typical concentration facility with a wide variety of appliances. Lamont finally had the opportunity to test the mill in 1901, when miners penetrated the first of several veins. Predictably, the ore at depth was too complex for the mill, which recovered only some of the metals during its first two years of irregular use. During the next four years, Lamont spurred his miners toward the principal vein, encountering several other ore bodies on the way. Lamont attempted production in 1906 and 1907, but found the mill to be ineffective. Without the mill, he was limited to producing only medium-grade ore, and the low-grade material, of which there was plenty, would have to wait.[309]

On the South Fork of Cement Creek, several miles south of Gladstone, Thomas J. Hurley followed a similar path with the Occidental and Natalie properties. He was convinced that the

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307 Henderson, 1926: 214; *"Mining News," EMJ* (12/26/96): 613; *"Mining News," EMJ* (10/23/97): 497.
308 *"Possibilities of the Yukon Tunnel," Silverton Standard* (11/28/03): 1.
309 *"Mining News," EMJ* (5/6/99): 539; *"Mining News," EMJ* (3/16/01): 345; Ransome, 1901: 258; *Silverton Standard* (2/23/07): 1.

Occidental and Silver Ledge veins, high on the valley's east side, offered ore at depth and planned to develop them through several tunnels. Hurley organized the Occidental Mining Company in 1895 but was unable to secure funding because of the depression. He drew on his reputation and interested enough investors to begin work and acquire the adjoining Natalie group of claims in 1897. The amount of money was insufficient to support several tunnels, an advanced surface plant, and a mill, so Hurley organized a second company and issued more stock. In 1899, he conveyed the Natalie group to the new Natalie Mining & Milling Company and began building one of the most advanced operations on Cement Creek. He commissioned the Hurley Tunnel on the Natalie property and erected a large powerhouse that enclosed a steam-driven generator and a massive air compressor. A crew of around twenty pushed the tunnel, operated the costly machinery, and even produced a little ore in the Occidental workings. By 1903, Hurley reorganized the two companies into the Natalie-Occidental Mining Company to delay investors from demanding returns. This tactic bought Hurley only one year. In 1904 investors withdrew. In response, Hurley organized yet a third company, the Mines Securities Corporation, to complete the project. He began producing ore in the Occidental workings in 1905 but quickly went back to work on the Hurley Tunnel. By 1906, Hurley permanently suspended operations.[310]

The Henrietta was developed around the same time, but was truly a success. Elmer King worked the mine on a small scale in 1897 and 1898, revealing very rich pyrite-rich silver ore. Because the mine lay on the south flank of Red Mountain No.3, the ore was similar in character to material from the Red Mountain district. This interested the Kendrick Promotion Company because the firm was securing sources of ore in the Red Mountain area for a new pyretic smelter planned for the mouth of Cement Creek. In 1899, the company drove exploration workings, confirmed the richness of the ore body, and leased the property. The following year, the Kendrick investors reorganized their firm as the San Juan Smelting & Refining Company, built the Kendrick-Gelder Smelter, and bought the Henrietta.[311] In contrast to most mines in the drainage, the Henrietta was successful for several reasons. First, it was not overcapitalized, and second, its owners already had a process in place proven to be effective on the ore. During 1901, the company aggressively developed the property and hired fifty miners to send large volumes of ore to the smelter. A tramway down Prospect Gulch to the floor of Cement Creek in 1903 was the only capital-intensive facility. In 1905, the San Juan company found the smelter to be unprofitable and sold the plant to J.B. Ross, who bought it to treat ore from his mines in the Red Mountain district. The San Juan company, however, was unwilling to part with the Henrietta because of its richness and continued to send the ore to the Kendrick-Gelder Smelter through 1906.

The Grand Mogul, known simply as the Mogul, was part of a wave of new ventures in the Cement Creek drainage during 1901. F.M. Snowden and Theodore Dick located the vein in Ross Basin in 1881, produced a little ore, and then did little more for decades. In 1901, eastern investor Howell Hinds organized the Sioux Mining Company and purchased the property. The

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[310] *"Mines of Cement Creek,"*; *"Mining New"* EMJ (3/16/01): 345; *"Natalie-Occidental,"* Mining Investor (7/25/04): 248; Silverton Standard (4/1/99): 1; Silverton Standard (12/23/99): 1; Silverton Standard (4/25/03); Silverton Standard (7/2/04): 1; Silverton Standard (4/1/05): 1.

[311] Henderson, 1926: 214; *"Mining News,"* EMJ (12/30/99): 797; *"Mining News,"* EMJ (5/15/09): 1019; *"Mining News,"* MSP (5/22/09): 708; Silverton Standard (1/8/10).

company hired C.E. Condit as manager, and he ordered miners to simultaneously extract ore from the old upper workings and drive a deep haulage tunnel from Cement Creek to undercut the vein, and Ross Basin, at depth. Condit sent the ore to the nearest mill, the Red & Bonita facility.[312]

Within the year, the Mogul Mining & Milling Company purchased the Mogul and continued the plan initiated by the Sioux company. The Mogul company, however, possessed greater financial resources because it installed machinery at the Mogul Tunnel and employed a crew of fifty. Those financial resources were judiciously meted out, as the *Silverton Standard* noted in 1902: "One entire working shift of 12 men quit at the Grand Mogul mine owing to the refusal of the company to furnish rubber goods for working in the wet drifts." In striking, the miners suspended operations for a considerable length of time.[313]

In 1902, the Mogul Tunnel reached the vein, and miners drove several raises to connect it with the upper workings. They still produced ore from those workings and sent the material to both the Red & Bonita and Fisher mills. Concurrently, Condit built his own concentration facility, heeding lessons imparted by the long history of mill failures. He extracted ore samples from depth, where it was most likely to be complex and tested them in the two mills, as well as others, to determine an effective treatment process. With this information, a metallurgist designed a massive facility specific to the Mogul Vein material. In 1905, the company allocated capital for a new mill, sited the plant on the north edge of Gladstone, and finished it the following year. After following what seemed like a sound policy, the company was disappointed when the costly mill was unable to recover enough of the ore's metal content to be profitable. The company immediately refitted the mill, met with the same result, and tried a last time in 1907. With the third failure, the directors gave the operation up as an expensive loss.[314]

The Big Colorado, just across the South Fork of Cement Creek from T.J. Hurley's Natalie, was among Cement Creek's 1901 ventures. John May began a deep tunnel during the early 1890s but stopped due to the post Silver Crash depression. Around 1900, C.W. Bloodgood and partners bought the property, organized the Big Colorado Mining & Milling Company, and resumed driving the tunnel. As at the Natalie and Yukon, Bloodgood realized that rock drills would expedite progress, but like Edward Stoiber, did not want the added expense of a compressed air system. Thus, he imitated Stoiber, introduced electric models, and contracted with the Natalie company for power. In 1903, miners struck the Paul B. Vein, which excited the investors who patiently waited for two years. The ore was not rich, but Bloodgood felt that it could be made to pay if concentrated on-site in a mill, so he built the mill and installed a generator for power. Like all the operations in Cement Creek to date except for the Gold King, however, the mill failed after several trial runs and eroded confidence among the investors. The Big Colorado went idle and was later dismantled.[315]

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[312] Colorado Mining Directory, 1901: 115; Henderson, 1926: 214; *"Mining News," EMJ* (9/14/01): 338; Silverton Standard (8/3/01): 1.
[313] Silverton Standard (2/8/02): 2.
[314] Mineral Resources, 1906: 232; Silverton Standard (6/17/05): 1; Silverton Standard (5/26/06): 1.
[315] *"Mining News," EMJ* (10/11/02): 494; *"Mining News," EMJ* (5/30/03): 833; *"Mining News," EMJ* (10/17/03): 597; Silverton Standard (11/23/01): 1.

In 1898, when the revival was just beginning, a few visionary entrepreneurs forecast that the Cement Creek drainage would boom because of the potential that its undeveloped mines offered. Kinney, King, and Soule were among these entrepreneurs, and they felt that the inevitable boom and steady stream of freight to and from their Gold King would almost certainly be able to support a short-line railroad. The first wave of mining ventures to spread through the drainage in 1899 confirmed the forecast for growth and spurred investors into action. During the year, they organized the Silverton, Gladstone & Northerly Railroad, immediately turning to Otto Mears because he already ran two of the county's three railroads. Still recovering from the mid-1890s depression, Mears declined, and so Kinney and partners obtained backing from eastern capitalists. With financing in place, Kinney hired construction crews, placed an order for rolling stock, and leased an engine from the Denver & Rio Grande. Workers tied one end of the line into the Silverton yards of Mears' railroads, established a terminal at the Gold King Mill, and crisscrossed Cement Creek numerous times. The railroad began service in 1900 and immediately captured most of the freight business in the drainage. Kinney and partners were pleasantly surprised as the railroad surpassed expectations. The railroad immediately began generating profits, and through reduced freight rates, offered Kinney cost savings for the Gold King and contributed to growth in the drainage.

The town of Gladstone was one of the principal beneficiaries because it was the contact point between the railroad and the upper portion of the drainage. In 1897, the Gold King Mine brought renewed life to the town in the form of the large workforce. The following year, J.C. Bowman opened a mercantile and secured a post office, and the wave of mining ventures that began in 1899 drew additional businesses. Joseph Landry opened a saloon and Fred C. Grebles established a busy lodging service. He operated an establishment that was a combination hotel and boardinghouse for the Gold King company, as well as two more boardinghouses for the Mogul and Natalie company workers. Around a dozen families moved to town, and the *Kibosh* newspaper began printing. Gladstone possessed an industrial ambiance, which increased over the years. In 1902, the Gold King company built three large bunkhouses at the east end of town, a school, and electric lighting. In 1905, the Mogul company erected its huge mill on the north edge of town. The town became bracketed with mills, in addition to the Gold King and Mogul facilities, Theodore Grabowski ran the Fisher Mill at the south end of town. Around 1905, the population was at 300. However, numerous mill failures and unforeseen economic troubles ultimately curtailed Gladstone's prosperity.[316]

In the Cement Creek drainage, the 1907 recession brought disaster and few of the well-capitalized, promising mines survived. Financial problems and ineffective mills ruined the Big Colorado, Mogul, Natalie, and Red & Bonita mines. The Gold King burned and went bankrupt because of its financial ties to the collapsed Gold Prince Mine (discussed below). In particular, the recession ruined Davis and Soule, and the collapse of their personal fortunes dragged down the Gold King and Gold Prince. The Gold King went idle and was placed in receivership. The court appointed D.M. Hayes as temporary manager over the Gold King; but he was ineffective at

[316] Bauer, et al., 1990: 62; Colorado Business Directory, 1905: 610; *"Mining News," EMJ* (10/11/02): 494; Silverton Standard (10/19/01): 12.

maintaining production in the absence of the mill. Finally, the New Gold King Consolidated Mines Company bought the property, rebuilt the burned facilities, and tried running the operation. Another fire forced the company to suspend, and the directors leased it to the Mears and Slattery syndicate in 1910. They apparently employed the same progressive strategy at the Gold King as at the Iowa and their other highly successful leases, and restored the Gold King to its former status as one of the county's best producers.

When Hayes resumed activity at the Gold King in 1909, some life returned to Gladstone. The town was center to a population of Gold King workers who lived in boardinghouses and did business there. However, the Postal Service revoked the post office in 1912 because the population was too small, although the handful of businesses continued as before.[317]

The Yukon Tunnel was the only other substantial mine in the drainage to operate through the 1907 recession. The Boston & Silverton Mining & Reduction Company continued to drive the tunnel toward the Uncle Sam and Lamont veins during 1906 and penetrated several other ore formations. The company began production of medium-grade ore, shipped to Silverton. The low-grade ore was unprofitable to produce because the new mill was ineffective, but the investors were unwilling to pay the cost of refitting the facility. Manager Lamont left the low-grade material in the ground, pushed the tunnel, and sampled the veins, perhaps to impart an impression of progress. By 1909, investors ceased funding and put the property up for sale. W.B. Lowe bought it to provide ore for the Kendrick-Gelder Smelter, which he acquired from the Ross bothers around the same time. Lowe mistakenly thought that the accessible veins could feed his smelter. He shipped some ore but found that it resisted treatment. The ore was complex, and the smelter failed in 1910. Lowe closed both the smelter and the Yukon in 1910.[318]

Eureka Mining District

In the Eureka district, mining interests responded slowly to the great mining revival of the late 1890s. As elsewhere in the county, the revival started with a few substantial outfits that were already in production and grew into a major movement during the early 1900s. Well-financed companies, wealthy investors, and a few large corporations purchased the mines known for production and poured capital into development projects. The Sunnyside was among the major operations already in production when the revival began, and it helped to foster confidence in the central portion of the Eureka district. During 1898, John Terry used the $100,000 earnest money that investors left him when they forfeited the Sunnyside to finish his grand vision. He developed the Sunnyside Vein through several tunnels, provided the entries with surface plants, added surrounding claims, and was completing the last of a stairstep series of three concentration mills linked by an aerial tramway. Even though Terry was highly successful, he endured a procession of problems such as losing the vein several times and facing bankruptcy.

Unlike other mining companies, mill failures were not among his troubles. When Terry finally started the new Terry Mill at Eureka in 1899, it was a technical success, although a new

[317] Bauer, et al., 1990: 62; Colorado Business Directory, 1910: 742.
[318] *"Mining News,"* EMJ (10/20/09): 1043; Silverton Standard (1/2/09): 1; Silverton Standard (1/1/10): 1.

set of problems prevented the facility from reaching its potential. Because the smelter strike of 1899 closed the Durango Smelter, Terry had nowhere to send the concentrates for refining, while a dry autumn reduced the water supply. Miners lost the vein again, which interrupted the flow of ore to the new mill. By 1901, Terry resolved these issues, refitted the mill at Lake Emma for custom business, and electrified the mine. From this point onward, he enjoyed continuous production and notoriety in the industry for building a model operation.

With emergencies abated, Terry directed his energy to address one of the fundamental reasons behind thirty years of mill failures in the county. Specifically, most ore throughout the county featured a high zinc content. The metal interfered with conventional concentration processes, rendered otherwise profitable ore worthless, and therefore ruined sound mining ventures. Had mining companies been able to remove the material, they would have ejected it with the mill tailings because little demand existed for the metal. During the early 1900s, industrial manufacturers finally began to consume zinc, however, and it became a commodity worth exploiting. With zinc now of some value, Terry and metallurgists sought a process to separate the metal and recover it for shipment as a special form of concentrate. In 1905, a year behind similar efforts at the Silver Ledge Mine, he devised the most efficient method in the county to date and received enough income from the concentrates to justify a large-scale application. In so doing, Terry made an important step in placing zinc among the county's portfolio of profitable metals.[319]

The Silver Queen Mine was another operation that helped to anchor the revival in the Eureka district. The Silver Queen Mining & Milling Company developed the property during the early 1890s and enjoyed sound production into 1896, when the post Silver Crash depression forced the company to suspend. In 1898, manager B.D. Smith reopened the mine, and like his colleagues, realized that the ore was too impoverished to ship to Silverton without concentration. In 1899, he convinced the company directors to lease the Mastodon Mill and refit it with a process specific to the Silver Queen ore. In contrast to the trend of mill failures, Smith initially realized success with the facility and ran it through 1901. Smith lost the lease on the mill the following year, and because investors were unwilling to finance a new facility, Smith reduced work to minor production and development. He tied to sell the property, grew tired of waiting for a buyer, and resumed production in 1905. Without a mill, the ore barely paid the operating costs, but he persevered into 1909 and joined forces with John Terry, who owned the nearby Sound Democrat. Terry offered the Sound Democrat Mill, Smith provided ore from the Silver Queen, and the partners divided the proceeds. The underground development that Smith completed in the preceding years paid off, because the Silver Queen was well-prepared to sustain the partnership through 1911, when miners exhausted the last of the profitable grades of ore.[320]

The Tom Moore Mine was another early participant in the revival, and while it seemed significant at first, the property was actually the foundation for a prolonged financial scheme. Samuel G. Martin, more promoter than experienced manager, became involved with the property in 1897, after a previous company enjoyed very brief success several years earlier. Martin

[319] *Silverton Standard* (1/13/06): 1.
[320] *Silverton Standard* (7/7/1900): 1; *Silverton Standard* (10/28/05): 1; *Silverton Standard* (4/23/10): 1.

convinced St. Louis investors to purchase the mine and appoint him as manager. He hired a crew that produced ore from the old upper workings through 1897. Martin reasoned that if upper workings offered ore, the depths of the vein would be even better, and recommended driving a haulage tunnel to undercut the vein system. The investors stalled, during which time Martin produced small batches of ore and sent them to local mills for testing. The results indicated that the ore was too complex to be profitable, but Martin loudly promoted the operation and pursued the tunnel idea anyway.

In 1901, investors provided Martin with enough capital to build a surface plant and start driving the Tom Moore Tunnel. By 1903, the tunnel was 2,000 feet long, but without profit. Martin continued heavy promotion and created press that production was imminent. Investors believed in tangible financial returns, and withdrew their support. Martin had siphoned off capital, incurred significant debt, fended off lawsuits, and scrambled to find more investors. He reorganized in 1903 as the Tom Moore Consolidated Mining Company, lost the property to bankruptcy in 1904, reclaimed it the following year under the Pittsburg San Juan Mining Company, and repeated this cycle annually through 1907.[321]

Legalities and furious investors finally caught up with Martin. While in Denver Martin was arrested and jailed, but not for fraud. In 1892, Martin's wife divorced him and was awarded spousal and child support payments. Instead of paying, Martin had her committed to an asylum. Upon her release, she filed a complaint. Martin used mining money to pay his way out of jail, but the story created a minor sensation in the press. Matters worsened for Martin in 1908. He had underestimated investors who backed the Tom Moore Gold Mining Company. Dennis Ryan, vice-president of the company, had ample experience with fraud and lawsuits. The Bassick Mine near Rosita was among his many lucrative ventures, and he kept that property locked in litigation with recalcitrant investors for two decades. Ryan had no patience for Martin and brought his power to bear. He leveled a lawsuit, revealed fraud, froze Martin's assets, and sought restitution.[322]

In 1900, the revival gained momentum in the Eureka district, and both local experts and outside investors initiated a wave of significant mining ventures around proven properties. Local experts developed the Hamlet Mine into one of the most important operations at Middleton, before passing the property on to outside investors. Samuel Dresback, an independent miner in Silverton, leased the Hamlet in 1900 and generated enough ore to prove the mine. James H. Robin examined the property and purchased it in 1901. During the year, Robin developed the vein with several tunnels and built a mechanized surface plant. He enjoyed regular income for three years and sold the mine to Colorado Springs investors in 1904 while the vein still offered ore. The new owners organized the Hamlet Mining & Milling Company and commissioned the Hamlet Mill at the mouth of Maggie Gulch. Charles Dale erected the facility in 1905, and it proved effective from the beginning. Manager William Lloyd increased the workforce to twenty-five, divided between producing ore in the existing workings, running the mill, and driving a

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[321] *"Mining News," EMJ* (4/25/03): 646; *Silverton Standard* (2/16/01): 1; *Silverton Standard* (3/21/08): 1.
[322] *Silverton Standard* (10/21/07): 1; *Silverton Standard* (3/21/08): 1.

deep haulage tunnel known as Level No.6, or the Mill Level, to undercut the vein. For the next several years, the Hamlet remained in this highly profitable but incomplete state.

The Mountain Queen, west of the Sunnyside Extension, followed a path similar to the Hamlet. A party of Ouray miners leased the mine for several years beginning in 1900 and produced ore from the upper workings. Rasmus Hanson, now in semi-retirement, purchased the property in 1904 for $25,000 and completed needed development. Now ready for production, Hanson convinced Cripple Creek interests to buy it for $100,000 in 1905. They organized the Mountain Queen Mining Company, invested heavily in a new surface plant, and commissioned a lower tunnel to undercut the shaft and develop the Mountain Queen Vein system at depth. Some local experts claimed that the vein was an extension of the Gold King's famed ore system, which the character of the ore suggested.[323]

During 1901, the companies involved in the revival grew in size, financial resources, and ambition. Edmond C. Van Diest organized one of the most important, the Eureka Exploration Company. Van Diest was a trained mining engineer and consultant, born into a mining family in 1865 in the Dutch East Indies. His father, P.H. Van Diest, brought the family to Boulder County in 1872 to manage the Caribou Mine before moving to Rosita in 1874, where he ran the Pennsylvania Reduction Works. When the smelter failed after around five years, the elder Van Diest accepted the position of chief of the land department for the surveyor general's office in Denver. The younger Van Diest studied engineering and metallurgy at the Colorado School of Mines, graduated in 1886, and entered the industry as manager of the mining business of the Trinchera and Costilla estates in Costilla County. He also accepted consulting jobs in southern Colorado and New Mexico, settling in Denver by the late 1890s. When the revival began in the Eureka district, Van Diest organized the Eureka Exploration Company as an umbrella organization to speculate with both proven and new properties.

Van Diest had the opportunity to buy three particularly promising mines for which he secured backing from railroad operators in the east. In 1900, he purchased the Ridgeway Mine in Maggie Gulch, on the eastern side of Galena Mountain opposite from the Green Mountain and Pride of the West mines. The following year, he purchased the Silver Wing and adjacent Fredericka at auction. The Ridgeway was a sound acquisition because like the Hamlet, it lay on a bold vein not yet developed. The Silver Wing had a record of production and was fully equipped with a mill that, with refitting, could treat ore from the two mines.[324]

Immediately after the purchase, Van Diest put twenty-five miners to work producing ore in the Ridgeway and Silver Wing and rehabilitating the mill. The facility provided the company with some income during the year, but because it was inefficient, Van Diest installed new concentration machinery. The ore in the Silver Wing resisted concentration, and so Van Diest focused on the easily treated payrock in the Ridgeway and Fredericka. When this was exhausted, Van Diest refitted the mill again in 1905 in an attempt to succeed with the complex ore that remained in all three properties. His third try failed, but the Ross Mining & Milling Company provided the solution. The company actively sought mines with ore compatible with the process

[323] Marshall and Zanoni, 1998: 145; *Mineral Resources*, 1907: 272; *Silverton Standard* (12/30/05): 2.
[324] *Colorado Mining Directory*, 1901: 114; *"Mining News," EMJ* (8/3/01): 147; *Silverton Standard* (6/15/01): 1; *Silverton Standard* (8/3/01): 1.

it employed at the Kendrick-Gelder Smelter. Much to the relief of Van Diest, the Ross company leased the Silver Wing in 1907, it at last generated income.

Despite completion of the Terry Mill and activity in the northern half of the district, the town of Eureka remained small in the first decade of the twentieth century, despite the energy of the revival. The town was fairly static with population of around one hundred residents and the handful of businesses that survived the mid-1890s depression. Most workers lived either at the mines or in Silverton. Alexander Anderson, manager of the Silverton Northern Railroad, in 1902 instituted regular commuter service between Eureka and Silverton. Not until 1910, however, after the mining revival tapered, did Eureka see measurable growth. The population doubled and two boardinghouses provided for workers. Guests stayed in the Eureka Hotel, liveries kept horses, entrepreneurs opened two saloons, and existing mercantiles did a sound business. Increased activity at the Sunnyside, regular rail service, and the decline of Animas Forks all increased Eureka's local importance.

Prominent mines in Cunningham Gulch drew attention to the southern portion of the Eureka district during the revival. New ventures funneled capital into the Pride of the West, Green Mountain, Old Hundred, and Buffalo Boy. The Pride of the West was the first in a sequence. After developing the property and working it for twenty years, Christian Schoellkopf was ready to sell. In 1897, Joseph Gibbons, Charles W. Denison, and A.B. Sullivan organized the Joe Gibbons Mining & Milling Company and bought the Pride for $65,000. They understood that the ore required concentration to make it profitable to ship and also bought the old King Solomon Mill at Howardsville. In 1898, the company pursued a costly improvement campaign in which workers erected a new surface plant, tramway and terminal on the floor of Cunningham Gulch, and new appliances in the mill. During 1899, a crew of around thirty-five produced a respectable fifty tons of ore per day and sent the material by wagon to the Howardsville mill. As at the Silver Wing, the mill was not as successful as expected, which limited the company to the highest grades of ore.[325]

In 1903, a squabble between the three principals turned into full-blown litigation, which caused work on the Pride to stall. Eben Smith, David Moffat, and their Denver syndicate took an interest and could purchase the mine outright, if they liked what they saw. The potential sale enticed the principals to cooperate again. Denison and Gibbons invested in additional underground development to highlight the vein, installed new surface machinery, and developed plans for a new mill at the lower tramway terminal. When Smith examined the property later in the year, he was impressed, but not enough to buy it. The principals regressed into litigation through 1907, when Gibbons bought out his partners. Gibbons then promptly reopened the mine and resumed production.

In 1904, John Slattery reopened the Buffalo Boy after years of inactivity. Slattery would later draw on his experience there when joining Otto Mears and associates in a lucrative lease at the Iowa Mine. Meanwhile, Howard Hines and investors from Ohio bought the Old Hundred. Hines and partners organized the Old Hundred Mining Company with the intent of developing

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[325] *"Mining News," EMJ* (2/19/98): 231; *Silverton Standard* (5/14/98): 1; *Silverton Standard* (2/18/99): 1.

the property into a complete mining and milling operation. Manager Robert Davis hired a crew of fifty to develop the workings, install machinery, erect a tramway to link tunnels, and build a power plant and tram terminal on the valley floor. In 1905, the company financed a mill at the terminal and had it running the following year. Miners began driving a haulage tunnel to undercut the vein system in 1907. The company assumed that the tunnel would open vast ore reserves, but in the interim the directors were content with the substantial amount of ore from the upper workings. As with the majority of the mines in Cunningham Gulch, the ore proved difficult to treat, the usual harbinger of difficulty.[326]

One of the most infamous ventures in the Eureka district was the Gold Prince Mine. Originally known as the Sunnyside Extension, the Sunnyside Extension Mining & Milling Company bought the Gold Prince from Rasmus Hanson in 1892. Hanson reaped the best ore during his tenure, and the Sunnyside Extension company struggled with the complex, low-grade material that remained. In 1897, the outfit went bankrupt, company official F.W. Popple was appointed receiver, and he attempted to repay the debts through income realized from ore production. In 1900, Popple sold the property to the Smuggler-Union Mining Company, whose principals also purchased the North Star. Smuggler-Union tinkered with the mine for several years, decided it was not worth further effort, and planned to sell.[327] Willis Kinney examined the operation, and thought that if it could be worked in a manner similar to his Gold King, the Sunnyside Extension would be at least as profitable. Flush with profits from the Gold King and Silverton, Gladstone & Northerly Railroad, Kinney, Davis, and Soule purchased the property in 1903 under the Gold Prince Mines Company. Kinney began planning facilities larger than those at the Gold King and made initial preparations for a substantial mill at Animas Forks, a two-segment tramway to the mill, and other new facilities. In anticipation of hauling construction materials and carrying out a stream of concentrates, the Silverton Northern Railroad finished a line from Eureka to Animas Forks in 1904, as had been proposed years before. The only viable route was up the Animas River, and the grade proved to be one of the most difficult in Mears' railroad system. It was so steep that an engine could haul only two full or three empty cars up at a time, and they were pushed to prevent breakaways.

In 1905, Kinney contracted for the mill and tramway. Meanwhile, the miners blocked six million tons of low-grade material, enough to supply the mill for fifty years. As the mill took form, and a number of innovations drew accolades from the greater mining industry. At a cost of $500,000, the mill was steel frame with reinforced concrete floors and foundations, forced-air heat, and electric power wired from the Animas Power & Water Company. The use of steel and concrete with individual motors to run specific appliances were departures from conventional mill design. The mill was capable of treating 500 tons of ore per day, and some experts claimed that the facility was the largest comparable in the state. Stoiber's Silver Lake Mill may have had a higher capacity but was smaller in size.[328]

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[326] Henderson, 1926: 215; _Mineral Resources_, 1905: 209; _Silverton Standard_ (9/17/04): 1; _Silverton Standard_ (12/31/04): 1.
[327] Horn, 2010b; *"Mining News,"* _EMJ_ (7/24/97): 105.
[328] Horn, 2010b.

The tramway was an equally complex engineered Bleichert system. The route was not direct due to the obstacle of Treasure Mountain, so the tramway featured an angle station similar to the Silver Lake system. However, the Gold Prince tramway was further divided into three sections, which isolated potential damage from avalanche or fire. The tramway descended down Placer Gulch to a tension station; continued to an angle station on the northwest flank of Treasure Mountain and from there reached the mill at Animas Forks. The angle station and upper terminal featured concrete bases, steel frames, steam heat, and electric power.[329] At the end of 1906, the modern operation was complete. Miners began sending ore down the tramway to the mill, which processed the material and operated at around one-third capacity through most of 1907. The operation was a success, so Kinney and the local press claimed.

The Mineral Point Tunnel, a short distance west of Animas Forks, came to life in 1903 after remaining idle for nearly twenty years. N.R. Bagley, with support from the Rockefellers, revived the idea of driving the tunnel to undercut the Vermillion and Red Cloud veins. He organized the Frisco Mines & Tunnel Company, renamed the tunnel the Frisco-Bagley, and began work. Meanwhile, the company planned a mill and tested ore samples from the Red Cloud Vein to determine an effective treatment process. The investors patiently waited as Bagley slowly made progress through 1907. The following year, the tunnel struck the vein, where the ore proved to be uneconomical at depth. The operation stalled.[330]

The poor economic climate of the 1907 recession largely ceased development and production in the Eureka district. While some properties remained intermittently profitable, none were free of problems, and many failed within the next decade. For instance, the Gold Prince was nothing less than a monumental disaster, which deeply affected the mood in the entire county. At the end of 1907, low metals prices forced the company to stop the titanic mill. Without the mill, the company was unable to generate the income necessary to meet its debt obligations. At the same time, Davis and Soule, who provided most of the financing for the Gold King and Gold Prince, faced their own crises when the recession ruined other investments they held. These conditions precipitated a domino effect that brought down first the Gold Prince and then the Gold King. Davis, Soule, and the Gold Prince company all were overextended, and creditors clamored for payments on their loans. To help fund the Gold Prince, the partners diverted most of the Gold King's available resources, leaving that mine unable to meet its own debt obligations, as well. Angry creditors threatened to foreclose on both mines, and Davis and Soule negotiated a year to reconfigure their finances. A fire subsequently consumed the Gold King plant in 1908. By the end of the year, it was obvious that Davis and Soule could not extricate themselves and were bankrupted. The Gold King and Gold Prince were placed in receivership.

J.O. Campbell assumed Gold Prince receiver in 1909 and prepared to resume where the company left off. Campbell was qualified by his extensive experience with ASARCo, but even he was unable to mitigate the ensuing series of problems. Campbell hired Paul Hanson to restart

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[329] Horn, 2010b.
[330] *"Mining News," EMJ* (9/26/08): 638; *Silverton Standard* (12/26/03): 1; *Silverton Standard* (8/27/04): 1.

the mill, based on his experience with the Gold King. When Campbell and Hanson brought the mill into action, they discovered that the process lost a considerable percentage of the ore's metal content, despite its careful engineering. The Sunnyside Extension Mill was a testing plant to hone treatment methods known to be effective on Sunnyside Extension ore. Hanson refitted the Gold Prince Mill at great cost, tried again, produced a considerable amount of concentrates, but was still unsatisfied with the efficiency. Meanwhile, the Silverton Northern Railroad tracks washed out, stranding Animas Forks and preventing Campbell from shipping his concentrates. In 1910, Hanson ran the mill one last time with discouraging results, and shut it down. The court tried to find a buyer for the operation, but was unsuccessful.[331]

The Hamlet Mine was among the Eureka district's successes and remained highly productive through the 1907 recession. Unlike most other mining and milling combined operations, the Hamlet Mill generated concentrates as intended. In 1910, miners also drove the Level No. 6 Tunnel into the depths of the vein and found the high-grade ore. Just as the company prepared to develop the lower portion of the vein, William Lloyd, manager and driving force behind the entire operation, suddenly died. Activity stalled, while investors sought a capable replacement.[332] The Mountain Queen was another operation that remained profitable through the 1907 recession. The Cripple Creek owners completed significant improvements and sold to the Guggenheims in 1907. The Guggenheims installed new machinery and enjoyed ample production. Later that year, an avalanche wrecked the surface plant. The company rebuilt at great cost and kept the mine in production through 1910.

The Eureka district side of Cunningham Gulch was still a center of activity following the 1907 recession, but the mines were far from seamlessly productive. Once Joseph Gibbons assumed control over Pride of the West in 1907, he enjoyed sound production for several years and then leased the entire operation out. In 1910, I.C. Rosenfelt of Chicago, John Benson, and M. Pearson leased both the Pride and Green Mountain with the idea of working them together. Miners would produce ore from both and treat the material in the Green Mountain Mill. However, the new operators did not adequately consider that the high zinc content confounded milling. During the year, they had the properties in production and even went so far as to install a new compressor at the mill. As in the past, the mill did not recover enough of the metals, though, and the operation collapsed in 1912.

The Old Hundred Mining Company was already teetering when the recession pushed it over the edge. Howell Hines overextended the company in 1905 by gambling on the assumption that a tramway, mill, and power plant would facilitate production in economies of scale. Complex ore, faulted veins easily lost, and mill troubles prevented Hines from realizing the necessary income, and he defaulted on debts. An Ohio bank assumed control in 1908, and Hines personally visited Silverton to assess the situation, found additional financing, and tried a last

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[331] Horn, 2010b.
[332] *"Mining News," EMJ* (9/3/10): 476; Silverton Standard (8/20/10): 1; Silverton Standard (9/10/10): 5.

time in 1909 to salvage the operation. For two years, it generated significant amounts of ore, milled at an unknown location. At the end of 1910, Hines closed the mine as unprofitable.[333]

Mineral Point and Poughkeepsie Mining Districts

The mining revival of the late 1890s had only minor impacts on the Mineral Point and Poughkeepsie districts, due to the ventures of prospectors, rather than capitalists or large mining companies. The Ben Butler and San Juan Chief were the two principal operations in the Mineral Point district when the revival began. James L. Hill, New York investor, backed the Ben Butler Mining Company, which reopened the mine in 1898 and began production. Hill installed a new hoisting system the following year to work the vein at depth but then lost interest. In 1900, he sold to L.B. Jackson, who had purchased the San Juan Chief several years prior. Edward Brown maintained his lease on the San Juan Chief through the ownership change and produced small amounts of ore from the mine's shallow workings.[334] After purchasing the Ben Butler, Jackson planned to link the two properties with a haulage tunnel driven from the San Juan Chief. The project was risky as the tunnel would have to be around one mile long and hence extremely costly. Meanwhile, Jackson developed the Ben Butler and treated the ore in the San Juan Chief Mill. Neither of the properties was well-developed due to the inexperience of the past owners. The Ben Butler ore proved impractical to treat, and Jackson's operation collapsed in 1901.

The Mineral Point district otherwise had few mines of significance. The Bonanza King, Early Bird, Lion Tunnel, London, and Polar Star produced small tonnages between 1900 and 1903, but none were consistent. As a result, the mercantile in Mineral Point closed and M.M. Trickey moved his assay shop. The Poughkeepsie district was equally quiet. In 1899, Standard Oil reopened the Maid of the Mist and conducted development for a short time. In 1900, an unidentified interest tried working the Alaska, but it was sold the following year for back taxes owed by Horace Tabor. These two operations and a number of prospects provided just enough business to support the Poughkeepsie camp at the mouth of Poughkeepsie Gulch. During the late 1890s, it featured a mercantile, combination restaurant-saloon, several cabins, and mail. By the early 1900s, the camp disappeared.[335]

Mineral Creek Mining District

The Mineral Creek district was among the earliest areas in the county to boom with massive capital investment, mine development, and heavy production. All, however, met with the problems typical of operating in the San Juans. The Silver Ledge Mine, above the mostly vacant town of Chattanooga in the district's northern portion, was the first to draw investors of note. In 1897, a group of Denver elite including John L. Routt, Robert W. Speer, and Charles

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333 Marshall and Zanoni, 1998: 86; *Mineral Resources*, 1910: 432; *Silverton Standard* (11/14/08): 1; *Silverton Standard* (7/31/09): 3; *Silverton Standard* (11/27/09): 1.
334 *Silverton Standard* (9/9/99): 1; *Silverton Standard* (6/9/1900): 1; *Silverton Standard* (9/22/1900): 1; *Silverton Standard* (10/13/1900): 1.
335 Henn, 1999: 58; Ransome, 1901: 195; *Silverton Standard* (7/22/99): 1.

Hartzell bought the mine. Despite this, they organized the Silver Ledge Mining Company and contracted for a mill. A mill for an unproven property was predictably unwise. During the year, miners found plenty of ore, struck a gold vein, and began production. Workers completed the mill at the mine. By year's end, the Silver Ledge was in full production, and through 1898, miners ran the ore through the mill. But, at year's end, the company announced suspension for the winter, despite Silverton Railroad's all-season service. The company had overspent, while the mill was unable to recover adequate metal content. Debt forced the company into bankruptcy, and the creditors sued.

In 1899, the directors reorganized to reconfigure the debt and lease the property out. The strategy would provide regular income to repay creditors. The company appointed J.B. Warner as manager, who installed new surface facilities to make the mine attractive. Under the Elmira Mining & Milling Company's first lease, Warner oversaw a crew of ten who generated as many tons of ore per day. The operation proved successful enough to justify expansion, and the following year Warner hired more workers to run the mill. Although inefficient, the facility allowed Elmira to increase its production income. Warner convinced investors in the east to provide capital for more improvements and new mill appliances. A 1901 fire burned the entire surface plant, including the shaft house and mill, freeing Warner to erect a new mill. He replaced the mine plant, sited the new mill at Chattanooga, and had it running by the end of 1902. The Elmira company nevertheless suffered the same fate as its predecessor. Warner incurred more debt than he could repay, and the Bank of Silverton seized the property. Warner, however, came to an agreement to produce as much as possible and use the proceeds to repay the creditors. The effort lasted only through 1903, as the new mill proved only slightly better than the old, and Warner lost his position.[336]

The San Juan Mining & Leasing Company was the next outfit to lease the Silver Ledge, where it pioneered a significant trend in the regional industry. The company metallurgist recognized new demand for zinc and how to recover it with new concentration apparatuses. He innovated an electric separator that relied on a magnetic field to force zinc and iron particles from pulverized ore. The company refitted the mill in 1904 to both recover the zinc and condition the ore so that the rest of the metals could be captured. Although the separators were not perfect, they yielded the county's first meaningful production of zinc and reconsideration of the ore. At the Silver Ledge Mill, this translated into around thirty tons of concentrates per day.[337] For unknown reasons, the San Juan company did not continue its operation into 1905. Instead, D.E. Carmichael and Jesse Kramer assumed the lease and maintained heavy production with zinc separators. In the fall, litigation over unpaid debts restricted Carmichael and Kramer from extracting ore out of the workings. The partners retained only enough workers to recover low-grade material from the waste rock dump and treat it in the mill. After a year, the outfit exhausted the profitable material and moved on.

[336] *"Mining News," EMJ* (6/20/03): 945; *"Mining News," EMJ* (6/27/03): 982; *Silverton Standard* (1/24/03): 2; *Silverton Standard* (6/6/03): 1.
[337] Henderson, 1926: 50; *"Mining News," EMJ* (4/28/04): 699; *"Mining News," EMJ* (9/8/04): 406; *Silverton Standard* (5/14/04): 1; *Silverton Standard* (8/6/04): 1.

The qualified success of the zinc process followed by closure of the mine to litigation had the effect of creating and then destroying a community almost overnight. Although Chattanooga had never fully recovered from the late 1880s recession, it was not completely abandoned, either. The small collection of buildings continued to serve as both a stop on the Silverton Railroad and southern gateway into the Red Mountain district, and a few prospectors and miners occupied cabins at times. Construction of the Silver Ledge Mill restored activity and population to the defunct settlement, and by 1904 a post office opened under the name of Silver Ledge. Excitement over the experimental zinc process drew attention to the hamlet. The Silver Ledge Mine closure, however, reversed two years of growth, and when the workers left, the post office closed.[338]

Sultan Mountain, with its row of well-developed mines, was another natural magnet for capital and large engineering projects during the mining revival. The trend began with the Victoria Mine, idle like the North Star property. In 1898, Victoria company manager Thomas Kane organized the Little Dora Gold & Silver Mining Company to lease the Little Dora workings. In 1899, Kane organized the Empire Consolidated Mining & Milling Company, secured financing, and purchased the Empire Tunnel and Victoria Mill. The Empire Tunnel, drove into the base of Sultan Mountain, tapped the Little Dora Vein, and with more work, could reach the parallel Hercules Vein as well. At the same time, Kane established the Hercules Consolidated Mining Company and purchased the Ajax and Boston tunnels and a second mill. He refitted the Victoria Mill, instituted production in the Empire Tunnel, and did very well. The Hercules company moved slower because it required more development than the Empire. In 1900, Kane refitted the mill, renamed one of the main tunnels the Hercules, and pushed it beyond the Little Dora to other parallel veins. Later in the year, Kane had the Hercules mining and milling combination in full production.[339]

To improve the economies of scale, Kane brought everything together under the Hercules Consolidating Mining Company in 1901. He maintained production from the Empire and Hercules tunnels, closed the Hercules Mill, designated the Victoria Mill as the Little Dora, and improved the plant in 1902. The company may have been the single largest employer in Silverton and retained a workforce of around fifty-five, producing 75 tons of ore per day. The figure was among the highest in the county at the time. The operation was not trouble-free, however, and complex ore forced Kane to install new milling machinery in 1905, junk the plant, and erect a completely new mill. Heavy production continued for several more years.[340]

A short distance to the south of the Hercules, wealthy investors included the King group of claims in an unusual mining and power scheme. In 1900, G.A. Brouillet of Boston organized the Sultan Mining, Smelting & Power Company, bought the King group, and announced plans to build a power plant on Animas River at Rockwood to provide the Sultan Mountain area with electricity. The relationship between the King group and the proposed power plant is uncertain,

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[338] Bauer, 1990: 132.

[339] *"Mining News," EMJ* (3/11/99): 301; *"Mining News," EMJ* (6/10/99): 688; *"Mining News," EMJ* (8/18/1900): 198; *Silverton Standard* (12/31/99): 1; *Silverton Standard* (11/4/99): 1.

[340] *Colorado Mining Directory*, 1901: 112; *"Mining News," MSP* (8/19/05): 130; *"Mining News," EMJ* (8/16/02): 227; *"Mining News," EMJ* (3/30/01): 411; *Silverton Standard* (12/6/02): 1; *Silverton Standard* (6/14/02): 1.

but Brouillet probably entertained the idea of a generator-consumer relationship similar to Stoiber's Silver Lake. The King group was supposed to be the principal electric consumer with the surplus power sold to other mines. The company made little progress, however, beyond starting a haulage tunnel and building a flume to the operation. In 1901, Edward M. Brown leased the group but did little better with it than he did at the San Juan Chief. The following year, the Royal Mining Company signed a lease, installed machinery, completed the tunnel to the King Vein, and began production.

The North Star Mine was the last major property on Sultan Mountain to benefit from the revival. The operation stalled in 1896 because the Silverton Mining Company directors were unwilling to reinvest into a mill that kept failing. In 1901, they sold the operation, with its 10,000 feet of workings on several veins, ineffective mill, and multiple tunnels, including the Sultan. John C. O'Neill, Chicago capitalist who already possessed interests elsewhere in the west, researched mines in the San Juans for potential investment. He reviewed the North Star and bought the company. During the summer, he hired a crew of fifty to rehabilitate the property and secured Robert McCartney, who helped Stoiber design the Silver Lake Mill, as manager. O'Neill's experts claimed that the North Star Vein probably held value at depth and advised sinking a shaft on the formation from within the mine. O'Neill commissioned the shaft that year.[341]

Preparing the operation for production consumed more than a year. McCartney rebuilt the mill, installed a power plant, continued rehabilitation, and oversaw the exploratory shaft. By the end of 1903, McCartney reported that the mine and mill were ready to produce, but died early in 1904 while at the Silver Lake Mill. McCartney's replacement had mixed reports. The mine and mill were in full production, but the shaft confirmed that the North Star Vein was too impoverished at depth to justify further attention. The manager assured O'Neill that the upper workings still offered plenty of ore, and began driving the Sultan and North Star tunnels farther to intersect the Belcher Vein. The company then repeated the pattern that stymied profitability in the past. The mill began losing some of the metals because the ore changed character, the company focused on the highest grades and delayed refitting the mill, and when the rich ore was exhausted in 1908, the company suspended.[342]

The 1907 recession impacted the Mineral Creek district in a manner similar to the county's other centers of mining. Most small operations ceased, while large mines survived for a few years before succumbing to the poor economic climate and exhaustion of ore. The Silver Ledge Mine was idle during the recession, because still locked in litigation. The owners came to terms in 1909 and offered a lease to the Ross brothers, who no longer operated the Kendrick-Gelder Smelter but retained their collection of zinc mines. They organized the Ledge Consolidated Mining Company, unwatered the shaft, and struck rich zinc ore. Through 1912, the mine enjoyed peak production. The *Silverton Standard* regularly reported accounts such as: "At

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[341] *"Mining News," EMJ* (12/28/01): 863; *"Mining News," EMJ* (7/19/02): 93; *"Mining News," EMJ* (8/16/02): 227; *Silverton Standard* (11/30/01): 1; *Silverton Standard* (8/2/02): 1.
[342] *Silverton Standard* (4/23/04): 1; *Silverton Standard* (6/25/04): 1; *Silverton Standard* (2/18/05): 1; *Silverton Standard* (1/2/09): 2.

the Silver Ledge overflowing bins are reported and more ore in the mine everywhere."[343] Willis Kinney, no longer at the Gold King, assumed the position of manager in 1911.

After production declined abruptly in 1913, Joseph Warner and William Feigel leased the mill alone in an attempt to run it as a custom plant equipped for zinc. The press stated: "The Warner Mill, formerly known as the Silver Ledge, appears in the list as the first recipient of custom ores in the camp for many years and will henceforth be an active factor in the industrial activity of the county."[344] The venture was sound in theory, but the complexity of ore in the western portion of the county caused it to fail after a year.

The Hercules Consolidated Mining & Milling Company easily weathered the 1907 recession and remained Silverton's flagship operation. Under Thomas Kane, the mining and milling combination produced heavily through 1910, despite complex ore and several adjustments to the mill. The Empire Tunnel developed the lower workings, and the Hercules (Boston) Tunnel was the principal point of access for the upper workings. The operation attained the status of largest county producer during 1910 before beginning a gradual decline. Around 1912, after nearly fifteen years of a constant yield, miners exhausted the profitable grades of ore. In 1913, Kane suspended operations, and the following year the property was auctioned to repay creditors.[345]

The Silverton Mining Company tried one last time to remodel the North Star Mill when the economy began to recover after the recession. In 1909, the company hired Paul Hanson from the Gold Prince Mill, to install a zinc recovery process. Toward the end of the year, he had the mill in operation, and the company optimistically prepared several ore bodies in the upper workings. The mill functioned well enough to sustain production through 1910 and then stopped. Supposedly, the company planned to install new motors, but when the mine failed to reopen, it became obvious that the same old troubles reappeared. The North Star remained quiet through foreclosure hearings in 1913.

<u>Ice Lake Mining District</u>

The Ice Lake district and its principal mine, the Bandora, followed inverse trends during the mining revival. The Bandora Mining & Milling Company played a key role in preparing the district for the revival by investing in development, building a mill, and grading a road. Even though development focused on the Bandora, it inspired confidence. The road also opened the area to other companies as early as 1897. The Golden Horn Consolidated Mining Company, backed by London investors, bought the Golden Horn property in 1897 and refitted a mill there. A group of Ouray miners leased the Lady Ellen and brought it into production. While these and other small mines opened during the late 1890s, activity at the Bandora wound down. The partnership of Patterson & Johnson signed a lease in 1897, produced well, but ran out of profitable ore the next year. The partnership did not renew the lease, and the Bandora company

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[343] *Silverton Standard* (5/13/11): 1.
[344] *Silverton Standard* (8/9/13): 1.
[345] *Mineral Resources*, 1910: 432; "*Mining News*," *EMJ* (13/21/14): 637; *Silverton Standard* (3/12/10): 1.

conducted some development to restore the mine to a ready state. An unknown entity leased the mine again for a short time before the property went quiet for the rest of the revival.

The 1907 recession snuffed out most district activity except for the Bandora. The Ross Mining & Milling Company leased the mine in 1907 because its ore was suitable material for the Kendrick-Gelder Smelter, which the firm had purchased in 1905. The Ross company assembled a collection of mines, including the Bandora, either through acquisition or lease to provide a continuous flow of ore to the smelter. When the company sold the plant in 1908, it no longer needed the ore and relinquished the lease. Around this time, William Sullivan bought the mine back, developed another section of the vein, and resumed production. He was rewarded in 1911 with a rich strike, which sustained limited production for several years. When the ore was gone, Sullivan suspended the last major operation in the Ice Lake district.[346]

The World War I Revival, 1915 – 1921

The revival of the late 1890s and first half of the 1900s created an energy and atmosphere that San Juan County would never see again. Capital and mechanization lowered operating costs, allowing companies to extract higher tonnages of ore from greater depths and thoroughly explore the principal vein systems for more payrock. The improved milling technology also rendered previously uneconomical grades of ore profitable to process. The 1907 recession culled those mining operations based on speculation, poor science, faulty economic equations, and inadequate ore reserves. And yet, enough companies were able to weather the recession to maintain substantial production through 1910. That year the mining industry entered another watershed period. Most mines ran out of medium-grade ore and faced an end to the profitable low-grade material, which resulted in an overall decline of the industry. During the early 1910s, a handful of large mines carried the county, and the future of the industry did not appear bright. Despite this, the county improvements in concentration processes rendered zinc a metal worth recovering. Zinc was now in demand and smelters such as Pueblo and Salida competed for ore and concentrates. To encourage zinc production, in 1910, the Denver & Rio Grande Railroad offered rate reductions for ore shipped to smelters at Pueblo and Salida, and on concentrates to Canyon City. These conditions fostered a strong interest in the county's zinc resources, and some mines like the Silver Ledge came to rely on its production. In 1911, the American Zinc Ore Separating Company installed a trial recovery process in the Sunnyside Mill at Eureka. At the Sunnyside, American Zinc installed the first Huff Electrostatic machines in Colorado, which immediately proved successful. The Sunnyside company enlarged the plant for commercial use in response. It remains uncertain whether other companies in the county adopted the technology or if the Sunnyside Mill started accepting custom ores from other mines. In either case, the county's zinc production ascended in the early 1910s.[347]

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346 "*Mining News*," *EMJ* (7/8/11): 85; *Silverton Standard* (2/23/07): 1; *Silverton Standard* (7/1/11): 1.
347 Henderson, 1926: 50; *Mineral Resources*, 1911: 558; "*Mining News*," *EMJ* (7/23/10): 185; "*Mining News*," *EMJ* (1/27/12): 236; *Silverton Standard* (6/1/12): 1.

A few other major mines were scattered throughout the county, and they produced whatever type of ore they possessed. The Gold King, leased in 1910 by the Mears and Slattery syndicate, ranked second in terms of output. The Iowa, also syndicate-owned, was the county's third largest producer. The Eureka district saw a number of transitory ventures in the early 1910s. W.J. Rattle organized the Vermillion Mining Company in 1905 to work the Red Cloud Vein between Animas Forks and Mineral Point. He developed the vein through the Bonanza and Rattle tunnels, and built a mill in 1909. The company enjoyed production through 1911, when the directors sued each other over debt. When the Frisco Mines & Tunnel Company intersected the Red Cloud Vein in the Frisco-Bagley Tunnel, manager Charles Gagner reported the ore was unprofitable at depth. In 1910, Gagner dispatched a party of prospectors to examine the vein through the old Red Cloud workings near Mineral Point and confirm that the vein's upper reaches held value. They affirmed this, and in response, Gagner had miners drive a raise upward on the vein from within the Frisco-Bagley Tunnel. When miners found plenty of ore, Gagner commissioned the Frisco Mill in 1912 to treat the material. The mill did fine with ore from the upper zone but was unable to process the material from depth. When the upper zone was exhausted, the company struggled and suspended in 1914. When active, the Vermillion, Frisco-Bagley, and other small mines were the economic foundation for Animas Forks in the wake of the Gold Prince failure. The handful of mines, however, was insufficient to sustain the community, which hung on in a marginal state until 1913, when the business district burned. Instead of rebuilding, most people left, and, without a population of note, the post office closed in 1915. Animas Forks embodied the county's mining decline.

The southern portion of the Eureka district was a hotspot of activity during the early 1910s. The Hamlet Mining & Milling Company sought a new manager after William Lloyd died in 1910 and hired the highly experienced Etienne A. Ritter. Ritter decided to develop the mine for long-term production and convinced the investors to fund extensive work underground. The campaign took two years and was highly successful. The Intersection Mine, at the head of Minnie Gulch, proved to be a bonanza. In 1910, the Intersection Development Company discovered an untapped gold vein. The company installed a simple hoisting system and small mill, and enjoyed regular production for the next seven years. By limiting debt and the scale of the operation, the investors maximized their profits. Samuel Martin resurfaced after his stint in jail and moved on from the troubled Tom Moore operation to manipulating the Kittimac Mines Company to support his lavish lifestyle. The company developed what was originally known as the Minnie Gulch group. As he did with the Tom Moore, Martin promoted the Kittimac and its high potential for ore but made little progress in actual production. The Hamlet, Intersection, and Kittimac all contributed to the prosperity of Middleton and Eureka.[348]

The Buffalo Boy, west of the Intersection, showed great promise because it had not yet been systematically developed. In 1909, Joseph Bordeleau organized the Continental Mining Company to lease the property. Over the next three years, miners would encounter rich gold ore in the vein, lose the trace, develop the ore formation further, reestablish contact, and repeat the

[348] Colorado Mine Inspectors' Reports: Intersection; ***Silverton Standard*** (5/13/05): 6; ***Silverton Standard*** (1/1/10): 1; ***Silverton Standard*** (5/3/13): 1; ***Silverton Standard*** (9/27/13): 1.

cycle. Overall, the operation was moderately successful until a lawsuit among the owners froze the operation.[349]

Political unrest in Europe set the stage for another mining revival. When World War I began in 1914, manufacturing industries first in Europe and then in the United States mobilized to meet heavy wartime demand, and as the war progressed and devastated Europe's economy, governments sought monetary stability in silver. To the delight of the greater mining industry, the value of industrial metals and silver slowly rose again and then shot upward as the war dragged on. Silver ascended from an abysmal $.54 per ounce to $.73 and continued upward to $.84 in 1916, a price not seen since the Silver Crash of 1893. Lead and zinc almost doubled. Around 1910, zinc was valued at $.05 per pound and leaped to $.08 by 1917, while lead doubled from $.04 to $.08 per pound. Ores that were moderately remunerative by 1910 standards became almost the stuff of bonanza, and abundant low-grade ores were at last profitable.[350]

World War I ushered in a surge of activity across Colorado and restored a sense of optimism, purpose, and prosperity to San Juan County. Conditions were now different, however, when virgin ground still offered untapped resources. By World War I, the era of high-grade discoveries, overnight millionaires, and investment schemes was replaced by new generations of speculators, investors, and laborers reexamining areas that already witnessed decades of mining. Hard work, experience, training, capital, and some intuition were all necessary to find untapped deposits of profitable ore. The successful operators applied science, economics, and careful scrutiny to identify mines that still offered potential, and most of these were the properties with proven records of production.

One man who possessed the above qualities was Mears and Slattery syndicate member Louis O. Bastian, who introduced a technological development that revolutionized the definition of profitable ore. In 1914, Bastian installed the county's first flotation machines in the syndicate's Gold King Mill. Specific to complex ore, flotation was a new treatment process that exploited the behaviors of weight and gravity in separating metalliferous material from waste. Flotation relied on oil or detergent to float metalliferous material away from finely pulverized ore in rectangular cells or tanks. Mechanical sweeps or paddles shoved the metal-rich froth out of the cells and into troughs that carried the material onward to other processes. The Atlas Mill in the Sneffels district saw one of the first trials of flotation in the San Juans in 1914, and progressive Bastian brought it to San Juan County shortly after.[351]

Bastian concluded that flotation resolved the ore problems that had defied mill men for decades. Mining companies scrambled to find the capital for flotation in their mills, and 1915 saw a wave of installations. Bastian refitted the North Star and Iowa mills for the syndicate. James O'Kelly did likewise at the Hamlet Mill. The American Oil Flotation Company planned a massive plant at the Silver Lake Mill, and flotation expert James H. Hyde installed the process at

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349 *Silverton Standard* (1/2/09): 1; *Silverton Standard* (12/27/13): 1.
350 Henderson, 1926: 216; King, 1977: 183; Saxon, 1959: 7-17.
351 Colorado Mine Inspectors' Reports: Gold King; Henderson, 1926: 50; *Mineral Resources*, 1914: 299.

the Sunnyside. Widespread utilization increased through 1916, with Bastian busy at the Highland Mary and Contention mills, and flotation installed in the Green Mountain and Kittimac plants. Because the process was new, its application was not yet universally successful. Bastian clearly understood the process and his projects functioned correctly, but most of the others experienced initial problems.[352] By 1917, flotation began to deliver on its promise of improved ore concentration. Not only did flotation separate the metal constituents from previously untreatable ore, but also it rendered even lower grades of payrock profitable to produce. The result was that mining companies revisited previously ignored veins, reopened old workings, and recovered huge volumes of low-grade material cast off as waste.

World War I lasted longer than anticipated, prolonging inadvertent stimulus of the mining industry. The prices and demand for industrial metals remained high, specifically interest in silver because of its political and economic value abroad. As silver approached $.98 per ounce in early 1918, Congress fixed the price and levied foreign interest to support a subsidy for silver mining and increase profits. In April, the federal government approved the Pittman Act, which fixed the value of trade silver at $1.00 per ounce internationally.[353]

Silver mining interests in the county reveled in a price not seen since the Sherman Silver Purchase Act of 1890. In contrast to market trends following previous silver subsidies, the value of the metal continued to climb instead of erode. The affect on mining came with caveats, however, that presented challenges to profitability. Because of the war, inflation for mining supplies, equipment, transportation, and smelting fees was equally keen. Skilled labor was increasingly difficult to find as fewer young men replaced older miners leaving the workforce. To complicate matters, the ore that the workers did discover continued to decline in quality, which forced mining companies to generate higher tonnages.[354]

Two other trends conspired against the profitability promised by the Pittman Act. The first interfered with the transportation of ore, concentrates, and supplies. Specifically, the federal Railroad Administration assumed control of all railroads as a wartime mobilization asset for two years. The administration proved inefficient at managing freight traffic, which reduced service, delayed the movement of materials, and increased freight rates by 25 percent. Congress authorized payment to railroad companies for maintenance and operating costs, but the values were usually underrepresented, leaving some railroad companies in such poor financial condition that they closed.[355]

In October 1918, a Spanish influenza pandemic struck the nation with force. The flu spread quickly through Silverton and some of the boardinghouses at the large mines. Hundreds of individuals fell ill, and doctors and volunteer nursing committees quarantined and attended to them. Most of those who were ill languished for weeks before recovering, but a significant number died, which instilled fear throughout the county. The environment and working

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[352] Colorado Mine Inspectors' Reports: Sunnyside; "Mining News," *EMJ* (5/15/15): 879; "Mining News," *EMJ* (9/4/15): 412; "Mining News," *EMJ* (11/4/16): 845; *Silverton Standard* (4/17/15): 1; *Silverton Standard* (12/25/15): 1; *Silverton Standard* (7/22/16): 1.
[353] "Events and Economics of the War," *EMJ* (5/18/18): 926; "Industrial News from Washington," *EMJ* (4/27/18): 804; Saxon, 1959: 8.
[354] George E. Collins, "Mining in Colorado in 1918," *EMJ* (1/18/19): 152.
[355] "Editorial Correspondence," *EMJ* (6/29/18): 1191; Sloan and Skowonski, 1975: 319.

conditions at the mines contributed to who contracted the illness, how fast it spread, and the number of deaths. Altitude, extreme cold in poorly heated buildings, and air pollution augmented risk to miners. From the moment a miner entered the workplace, he was exposed to a challenging respiratory conditions. In addition, the underground environment was cold and damp, the work hard, and the commute from the tunnel portal to the boardinghouse frigid, especially when the miner was already saturated with moisture and sweat. Physically taxed by these conditions, the miner was predisposed to pathogenic illnesses easily transmitted in crowded boardinghouses with poor sanitation.

A second wave of flu swept the county in November, and it was worse than the first. A significant proportion of the population fell ill, several hundred died, and panic set in. Mining companies closed due to both sanitary reasons and attrition of workforces. The situation grew so severe that the conservative *Engineering & Mining Journal* reported: "Spanish influenza caused more than 130 deaths in Silverton district in the last three weeks. Mines shut down will have difficulty in resuming normal operations owing to labor shortage, many miners having left camp. Epidemic appears under control."[356] The epidemic, however, was nothing close to being under control. Most public halls and buildings became infirmaries and morgues, and as the dead accumulated, flu committees buried the bodies in wooden boxes or blankets. In January and March of 1919, two more waves of contagion swept through the region. Silverton suffered, and the mining industry had a difficult time recovering.[357]

Despite these challenges and hardships, the combination of an effective zinc separation process, improvements in other milling methods, and the increase in metals prices revived the county's mining industry. Statistics for the latter half of the 1910s quantify the revival. During this time, the county featured nine prospects, thirty-five small mines, twenty-six medium-sized operations, and seven large producers, a significant increase over the turn of the century. Ore production gradually increased from $273,000 in silver, $508,000 worth of gold, and $203,000 in lead, and $50,000 for zinc in 1914 to $477,000 in silver, $257,000 worth of gold, $673,000 in lead, and $310,000 in zinc by 1918. As during the late 1890s revival, the fact that most of the ore was low in grade is significant because a greater tonnage of material had to be mined and treated per dollar realized.[358]

The declaration of Armistice in 1918 brought a long-awaited end to the World War I, but also it set in motion an irreversible decline of mining in much of Colorado. The economic and political trends of the next two years belied the impending doom. As soon as the war was over, European nations began the costly and protracted process of reconstruction, which maintained the high demand and value of silver and industrial metals. The price of silver crept from $1.04 per ounce in 1918 to as high as $1.11 by the beginning of 1920. With metals values increasing for almost two years after the war's end and production in the county during 1920 a record

[356] "Mining News," *EMJ* (11/23/18): 932.
[357] *Denver Times* (10/23/18): 4; *Denver Times* (12/6/18): 17; Smith, 1992: 103; Louis Wyman, *Snowflakes and Quartz: Stories of Early Days in the San Juan Mountains* (Silverton: Simpler Way Books, 1993) 54.
[358] Henderson, 1926: 216 for production figures. The number of mines was derived from a survey of Colorado Mine Inspectors' Reports.

$3,617,000, the impending industry-wide collapse across the west came as an even greater shock.[359]

For a brief time during the late 1910s, prior to the collapse of mining, tungsten joined the county's portfolio of exploitable resources. Early prospectors and assayers were aware that some veins in the Cement Creek drainage possessed high percentages of tungsten but took little interest because almost no demand existed for the metal. During the late 1890s, European steel manufacturers, primarily Krupps in Germany, developed a means of using it to make hardened steel alloys. Within several years, American and British steel companies followed. At the time, tungsten was exceedingly rare and few profitable deposits had been identified, which agents from the steel makers aggressively pursued. When the agents learned of the rich deposits in Boulder County around 1900, they stimulated a tungsten rush there. Individuals elsewhere in Colorado began to pursue tungsten deposits in earnest.

Prospectors familiar with Cement Creek remembered that some veins featured tungsten. Individuals communicated this to speculators that were interested in the metal. Charles Poulot and Charles Voilleque, French metallurgists that specialized in rare metals, were the first experts to respond. They were already in western Colorado developing the first uranium mines in North America and made the short trip to Cement Creek to examine the tungsten reports. In 1900, they examined the Leslie claims in Dry Gulch, one mile west of Gladstone, and leased the Fisher Mill to run tests on the ore. William Schultz, a Denver speculator, arrived around the same time, leased the Evaline claims and operated the mill. Refitting the facility successfully yielded concentrate tungsten ore which stimulated further interest.[360]

In 1903, Lucus Abbie and Joe Kattenbocker produced tungsten ore at the Ohio Mine in Dry Gulch and treated the material in the Fisher Mill. They produced concentrates and shipped them to Germany. Shortly afterward, Chicago investors organized the Venetian Mining Company, bought the Evaline Mine and Fisher Mill, and planned on consistent production. The operation failed, stifling the local tungsten market for years.[361]

The county's tungsten resources drew serious attention again during World War I. Weapons manufacturers found that hardened steel made with tungsten was well-suited for battle, and demand the metal reached unprecedented levels. This stimulated a wave of prospecting and mine examination throughout the northwestern portion of the county in 1915, with several operations in production the following year. Cement Creek was the center of interest. The Colorado Metals Company assembled a small tungsten monopoly in 1915. The company leased the Galty Boy and Congress mines, purchased the Sterling, and leased and refitted the idle Yukon Mill to concentrate the ore. Colorado Metals then accepted custom ore in the mill and fostered development of other operations during 1916. Frank C. Grimes and George Haskell organized the Cascade Tungsten Mining Company to develop claims in Cascade Gulch, and James Clifford worked the Conyers-Clifford, both on Cement Creek. Small outfits also

[359] Henderson, 1926: 216; Saxon, 1959: 8.
[360] "Mining News," ***EMJ*** (7/7/1900); *Silverton Standard* (4/14/1900): 1; *Silverton Standard* (5/12/1900): 1.
[361] "Mining News," ***EMJ*** (5/16/03): 762; *Silverton Standard* (5/2/03): 1; *Silverton Standard* (3/12/04): 1.

developed other properties in the area. The San Juan Tungsten Company organized in 1918 to lease the North Star Mine and refit the mill for tungsten ore. Although tungsten continued to draw interest through the 1950s, World War I was the only concerted period of production. When the war ended in 1918, demand for the metal stalled.

Las Animas Mining District

After approximately twenty-five years of continuous, heavy production, Silver Lake Basin remained one of the most important centers in the county. This was due largely to the Mears and Slattery leasing syndicate, which continued its lease at the Iowa Mine and sent the ore down to the Iowa Mill via tramway. The Melville and Iowa-Tiger Leasing companies ran most of the operation, while the syndicate leased additional ground in 1914 in the form of Delsante & Company. In 1913, Mears, Slattery & Pitcher leased the idle Silver Lake Mine from ASARCo and rehabilitated the Stoiber Tunnel. The combined Iowa and Silver Lake workforce was large enough to justify reopening the Arastra post office. Mears and Slattery renewed the lease in 1916 under the firm Slattery, Delsante & Gillette, also known as S.D. & G. Company. The syndicate maintained a constant but limited production into 1917, when experienced miners noticed an eight-foot-wide vein in the walls of the Stoiber Tunnel. The vein's copper, silver, and gold content were a boon to Mears and partners.[362]

The Mears syndicate was not the only entity to work the Silver Lake and Iowa mines during the first years of World War I. Small parties of lessees, mostly Italians previously employed by the Stoibers, enjoyed ample production. The Unity Tunnel was also abuzz with lessees who worked ground above and below the tunnel level. Various partnerships pooled their capital and modified the idle Bleichert tramway at the Unity so that it terminated near the Iowa Mill, where the lessees sent their ore. The Iowa Mill was the center for production in and around Silver Lake Basin. To improve the recovery of metals, Louis Bastian installed flotation equipment in 1915. Even with flotation, the mill workers had a difficult time keeping up with the ore flowing in from all directions. In 1916 alone, the mill processed a weighty 700 tons of concentrates from Iowa ore, as well as around fifty tons from the nearby Mayflower Mine.[363]

The Mayflower, located amid the cliffs forming the east wall of Arrastra Gulch, was a relatively late development. As early as 1913, G.H. Malchus scraped together enough capital to develop the property, begin production, and build a Bleichert tramway from the lower tunnel down to a terminal adjacent to the Iowa Mill. While the distance to the mill was very short, the steep, loose scree slopes made a reliable road impossible, and hence a tramway was necessary for meaningful production. Malchus hired a crew to lengthen the development workings. As the Mayflower proved itself, ASARCo examined it as a replacement for the idle Silver Lake Mine and took an option in 1914, but let the deal fall through. In 1915, the American Oil Flotation Company leased the Silver Lake Mill from ASARCo with the intent of converting the plant for

[362] Bauer, et al, 1990: 13; Colorado Mine Inspectors' Reports: Silver Lake; *Mineral Resources*, 1916: 374; "Mining News," *MSP* (10/18/13): 628; Prosser, 1914.
[363] "Editorial Correspondence," *EMJ* (10/17/14): 718; "Mining News," *EMJ* (9/4/15): 412; "Mining News," *EMJ* (5/27/16): 962; "Mining News," *EMJ* (8/19/16): 365; "Mining News," *EMJ* (12/16/16): 1078.

custom flotation. The custom business, however, was slow, and American Oil sought its own mine to provide a steady stream of ore. The Mayflower was the logical choice because it lay almost directly on the Silver Lake tram system. American Oil took an option on the property and paid Malchus $3,000 in earnest money, before workers accidentally set fire to the surface plant. The sale failed to go through because American Oil ceased to function. The Mears and Slattery syndicate moved in quickly as Malchus, ASARCo, and American Oil had collectively demonstrated that the Mayflower had the potential to become a significant producer. In 1916, the syndicate organized the Mayflower Leasing Company and developed enough ore for an excellent production run.

Although the Iowa, Silver Lake, and Mayflower mines produced well, they did not satisfy the Mears syndicate. One of the syndicate members probably was aware that Edward Innis ignored a number of silver veins in the Highland Mary Mine in his search for the lake of gold. Around the turn of the century, lessees and the Gold Tunnel & Railway Company attempted to find and mine the veins with limited success. The Mears syndicate was convinced that they could make the Highland Mary pay well with proper management, ore concentration, and expert miners. In 1916, J.H. Slattery & Company leased the property from owner Highland Mary Mining & Milling Company.[364] Initially, Slattery's lease included the mine's upper workings and the surface plant. In the past, the mine's various operators completed eight levels with the Mountaineer, also known as Level No.1, as the highest, and the Innis Tunnel, also known as Level No.8, the lowest. The main surface plant and the mill erected by the Gold Tunnel & Railway outfit stood adjacent to the Innis Tunnel. As originally equipped, the mill failed to recover enough of the ore's metal content, so Louis Bastian put a crew to work remodeling the facility. While the crew refitted the mill with flotation, Slattery sent ore down to the Contention Mill, which Bastian remodeled earlier. By December the workers were finished, and the Highland Mary Mill turned out around two tons of concentrates per day.

In 1917, Slattery remediated the inefficiencies posed by the haphazard organization of the underground workings. According to conventional mining engineering, underground levels should be linked by vertical passages that allowed ore mined in the highest levels to be easily transferred down to the lowest with little handling. Miners could then haul the ore out to a mill or holding bins. The Highland Mary, by contrast, had little such organization. Instead of expending enormous sums on the necessary underground connections, Slattery diverted the ore completely via two aerial tramways. One leg descended from Level No.2 Tunnel down to a station at the Level No.7 Tunnel, and the second leg followed west Cunningham Gulch to the mill. While the cost of a segmented system was high, it allowed large crews in both tunnels to produce as much ore as the tram buckets could carry. The efficiency, success, and tonnage realized by the Slattery lease confirmed the syndicate's expertise.[365]

During 1917 and 1918, the syndicate operated the Iowa, Silver Lake, Mayflower, and Highland Mary mines, among the best producers in the Las Animas district. This began to

[364] Colorado Mine Inspectors' Reports: Highland Mary.
[365] Colorado Mine Inspectors' Reports: Highland Mary; "Mining News," ***EMJ*** (9/29/17): 579; "Mining News," ***MSP*** (3/17/17): 389.

change the following year. At the Iowa and Silver Lake, three shifts of miners worked around the clock until the influenza epidemic suspended operations. The October pandemic swept the crew and Slattery personally nursed the sick in the boardinghouse. When the second wave further decimated the crew in November, he closed the mines and had the boardinghouse fumigated. Like most of the region's other mine operators, Slattery had a difficult time finding replacement workers and only reopened the Iowa in 1919. At that time, Slattery renewed the lease for Iowa alone under the Southwestern Mining Company and the Melville Leasing Company, but cut the workforce. The syndicate did not renew the Silver Lake lease, heralding an end to its run. These issues indicated that the Iowa and Silver Lake workings were running out of ore. The Iowa Mine then remained one of the Las Animas district's best producers through 1920, when operations collapsed.

The Mayflower and Highland Mary operations regressed in a similar manner. At the Mayflower, a crew of thirteen miners sent ore down to the Iowa Mill through 1918 and 1919 but were discharged the following year. The mine remained quiet until 1922, when Slattery, John F. Barnett, and Leonard L. Aiken organized the Mayflower Mining & Milling Company to work the property with a crew of only six. This operation only lasted a year. The Highland Mary Leasing Company kept the mine and mill producing through 1918 and developed several veins. Slattery suspended operations during the flu epidemic, and when he resumed, hired only ten workers in part because production declined. In 1920, Slattery found that the mill was not worth operating, shut the facility down, and did not renew the lease when it expired. Between 1918 and 1920, the county lost four of its most important producers.[366]

In Dives Basin, west of and above the Highland Mary, Daniel McLean continued to work the Shenandoah Mine through his Dives Leasing Company. McLean suspected that the mountain shared by the Highland Mary, Trilby, and Shenandoah mines concealed a hidden vein system. While this notion was not unlike Innis' lake of gold, McLean's hypothesis was founded on geological knowledge. His miners extracted as much as four tons of ore per day from the Shenandoah and conducted exploration for the elusive vein system as finances allowed. In 1917, McLean formed the O.S. Leasing Company and included the Trilby in his operation. He hoped to find the system from within the Trilby workings and with the Shenandoah to create a single entity. The underground connection was not realized, but he did make several substantial discoveries and operated both mines as a single unit with great success. As one operation after another closed in the Las Animas district, the Dives Leasing Company assumed the role as the most important producer by 1920. However, in 1921, after only nine months of operations, McLean suddenly laid off the workforce of thirty and shut this mine down, as well.[367]

On the opposite side of Dives Basin, the North Star Mine saw activity after remaining long idle. In 1916, a group of lessees reopened the original workings and produced a small

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[366] Colorado Mine Inspectors' Reports: Highland Mary, Mayflower; *Mineral Resources*, 1918: 861; "Mining News," *EMJ* (7/27/18): 195; *Silverton Standard* (8/16/19); Weed, 1925: 724.
[367] Colorado Mine Inspectors' Reports: Shenandoah-Dives , Trilby; "Mining News," *EMJ* (1/20/17): 167; "Mining News," *EMJ* (9/15/17): 499; *Silverton Standard* (3/31/17).

amount of ore, before accidentally set alight the tunnel house. The miners moved into the old base camp in Dives Basin, found the mine difficult to work, and ended production in 1917. The mine, a cornerstone of the Las Animas district for years, saw no further activity of note.[368]

The Big Giant Mine, in Little Giant Basin below North Star Peak, also saw renewed activity during the World War I revival. William Keith drove a tunnel to the Big Giant Vein and built a mill in 1895, but the ore was too complex and Keith abandoned the operation within several years. Peter Orella, who operated the Standard Bottling Works in Silverton as early as 1907, came to the conclusion that the vein had high potential Keith left undeveloped. When metal values began to increase in 1914, Peter Orella & Company leased the Big Giant, Contention Mill, and Contention tramway. He rehabilitated the surface plant and underground workings and connected the Big Giant with the Contention tramway. Originally, the Contention Mining Company built the tramway to connect the Contention Mill on the Animas River with the North Star Mine outlet at the head of Little Giant Basin. In 1902, the Black Prince Gold Mining Company bought the tramway and adapted it to their operation around one-half mile below the Big Giant. In so doing, the Black Prince company shortened the tramway, leaving a gap between the Black Prince terminal and the Big Giant. To span this distance, Orella built a double-rope reversible segment and reused the old Keith Mill structure as his upper terminal.[369] Orella wisely realized that the Contention Mill would probably not treat the complex Big Giant ore and sent batches to the Silver Lake and Highland Mary mills for testing. In 1916, Orella finally settled on the best treatment process and hired Louis Bastian to install a flotation flow path almost identical to that at the Highland Mary Mill. Once finished, the facility treated ore not only from the Big Giant, but also from independent customers. Although Orella continued to lease the mine, he bought the mill to retain his investment in the facility.[370]

During the fall of 1916, someone, probably Orella, collected up the tailings left in Little Giant Basin by the 1889 North Star Mill and sent them to the Contention Mill to be processed. The terminal at the Big Giant was the nearest place to load the tailings, but a deep chasm blocked easy access. To overcome this, Orella built another double-rope system that ascended from the terminal up to a loading station on the basin floor, where workers transferred the material. Orella's complicated tramway system now included the tailings segment from the upper basin down to the Big Giant terminal, the double-rope segment from the Big Giant terminal to the Black Prince, and the Bleichert tramway to the Contention Mill.[371]

Ore in every mine in the county was slightly different in character even when from the same geological formation, and so it was with the Big Giant. By 1917, Orella realized that despite the flotation installed by Bastian, the Big Giant ore was still too complex to be easily

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[368] *Mineral Resources*, 1916: 374; "Mining News," *EMJ* (8/19/16): 365; "Mining News," *EMJ* (10/27/17): 777.
[369] Colorado Mine Inspectors' Reports: Big Giant; "Mining News," *EMJ* (11/28/14): 980; "Mining News," *MSP* (4/3/15): 534; *Silverton Standard* (10/17/04); *Silverton Standard* (11/13/15).
[370] Colorado Mine Inspectors' Reports: Big Giant; "Mining News," *EMJ* (11/4/16): 845; "Mining News," *EMJ* (4/7/17): 647.
[371] "Mining News," *EMJ* (10/21/16): 769; Eric Twitty, *Basins of Silver: The Story of Silverton, Colorado's Las Animas Mining District* (Montrose, CO: Western Reflections, 2006): 16.

treated. Because shipping the ore as crude material was not feasible, he closed the Big Giant by 1918 while continuing to run the mill as a custom facility.[372]

The Black Prince Mine, on the west floor of Little Giant Basin, was among the operations that responded to the high value of silver. J. Robert Crouse and H.A. Tremaine of Chicago recognized the property's potential because, like its Big Giant neighbor, the vein had never been developed to depth. Further, the property required little capital because it already featured a 500-foot tunnel and an excellent surface plant. In 1920, the investors organized the Crouse-Tremaine Mines Company, purchased some claims and leased others, and leased the Contention tramway and mill.[373] A crew completed necessary repairs and began driving a haulage tunnel. By the end of 1920, the Black Prince had all the makings of a great operation, which is what the Las Animas district needed to counter the decline of its other mines. The staff of the *Silverton Standard* was impressed with the progress: "One of the largest undertakings of 1920 will be ready for production during 1921. The Black Prince Group, under development by the Crouse-Tremaine Mines Company, has been improved with sufficient buildings etc. to enable the management to carry out with the greatest speed the development of the Black Prince and other veins of the group."[374]

By the spring of 1921, miners made the long-awaited breakthrough into the main vein. In driving the haulage tunnel, the engineer followed the proper practice of undercutting the formation at depth so miners could work the ore body from the bottom up. There was one problem, however, there was no ore. The vein was highly mineralized, but lacked payrock of economic worth. The company was forced to suspend operations.[375]

During the World War I boom, the Lackawanna Mine became the focus of an important project. In 1917, John M. Wagner, who owned a number of mines in San Juan and San Miguel counties, confidently purchased the group of claims. During the winter, he made a deal with William A. Way, R.E.L. Townsend, and Melvin Smith to lease the main complex as the Lackawanna Mining & Reduction Company. Although relatively inexperienced, Way was a respected Silvertonian. Born in Hancock County, Illinois in 1874 to a family of some means, Way attended Western Illinois Normal School and studied law at the Northern Indiana Law School. He came to Silverton around 1904 and practiced law under Judge Searcy until 1913, when he established a partnership with H.E. Curran. In 1917, Way married Hazel Fletcher of Salt Lake City and went into practice on his own. Townsend had slightly more direct experience with Animas River mines than Way and had previously leased several properties. The Lackawanna failed to meet expectations, and the partners dumped the lease during the year and moved on to other mines around Eureka.

[372] *Mineral Resources*, 1917: 840; "Mining News," *EMJ* (10/13/17): 663; "Mining News," *EMJ* (10/27/17): 777.
[373] Colorado Mine Inspectors' Reports: Black Prince.
[374] *Silverton Standard* (1/1/21).
[375] Colorado Mine Inspectors' Reports: Black Prince.

In late 1917, a group of investors from the east assumed the Lackawanna Mine lease as the D.L. & W. Mining & Reduction Company. Under manager C.B. Sheehan, a crew of twenty attempted to ready the operation for work through the winter. One team accompanied master tramway builder O.F. Sackett to the Titusville Mine, dismantled the idle Huson tramway, and rebuilt it at the Lackawanna. The upper terminal stood near the main tunnel, and the lower terminal was on the Silverton Northern Railroad. A second group erected a concentration mill at the lower terminal. A third workforce developed ore and engaged in minor production. While the mill was under construction, the company leased the Silver Lake Mill to process high-grade ore that miners discovered in 1918. After sending the ore to the Silver Lake Mill, little more was forthcoming, however. The compressor house and mill subsequently burned, and after the company collected insurance money, it rebuilt the structures and dissolved.

Before Silver Lake Basin ran out of ore at the end of the 1910s, its mines were a centerpiece of Otto Mears' financial structure. Not only did they yield significant profits, but Mears commissioned an unusual project involving the mill tailings dump that formed an artificial beach on the shore of Silver Lake. Ironically, Edward Stoiber was concerned enough with the water quality of the lake to install a sewer system for his boardinghouses, but flumed at least 500,000 tons of mill tailings from the original mill into the lake's north end. Supposedly, Stoiber did so to store the tailings for future reprocessing. Samuel Hallett planned on treating the tailings in the second Silver Lake Mill after ASARCo acquired the property, but the logistics proved to be too complicated. The tailings were in essence a ready form of extremely low-grade ore and, although they had been treated once in Stoiber's original mill, the tailings retained enough metal content to be profitable. The costly steps of crushing and grinding had already been done and the tailings only required advanced concentration.

Advanced concentration was the specialty of Arthur Redman Wilfley, renowned engineer and metallurgist who split his time between Summit County and Denver. Born in Missouri in 1860, in 1878 Wilfley accompanied his father to join the Leadville rush, set up a sawmill, and profited from the lucrative demand for lumber. The family ultimately went to Kokomo, just over Fremont Pass from Leadville, where young Wilfley became a prospector and miner. In 1882, Victor G. Hills, an engineer and surveyor, offered him a job as assistant surveyor. Wilfley learned quickly, became a partner with Hills, and in 1885 leased the White Quail Mine under the firm of Wilfley, Clark & Company. Investors provided Wilfley with capital to build a mill, which he designed to concentrate low-grade ore. Thus began a protracted career focused on the efficiency of milling and concentration.[376]

Wilfley continuously tinkered with various apparatuses to improve their performance. In 1895, he developed a particularly effective appliance that he patented as the Wilfley vibrating table and began selling as a practical model in 1896. The Wilfley table featured a stationary chassis and an irregular, four-sided tabletop that vibrated rapidly. The tabletop was coated with linoleum and numerous fine riffles, and, as it oscillated, metal-rich particles settled against the

[376] Jay E. Niebur, *Arthur Redman Wilfley: Miner, Inventor, and Entrepreneur* (Denver: Western Business History Research Center, Colorado Historical Society, 1982): 12-23, 30.

riffles while a water spray washed the waste away. Sales were slow at first, but the Silver Crash only energized Wilfley because his device addressed making low-grade ore pay. Eben Smith, principal of the Mine & Smelter Supply Company, contracted with Wilfley for the rights to make and sell the table, and the device netted a fortune in the Rocky Mountain West. Wilfley continued inventing and tinkering and in 1903 developed a multi-deck vibrating table specifically to treat finely ground slurry usually piped out of mills as waste.[377]

Mears, aware of Wilfley's ingenuity and skill, approached him regarding a technical solution to make tailings remunerative. In 1913, Mears explained the project to Wilfley, and obtained money from his leasing syndicate. Mears and Wilfley selected a mill site on the north side of the Animas River opposite the mouth of Arrastra Gulch, which seemed illogical, as it necessitated moving the tailings from Silver Lake Basin down and across the river. The adverse climate, propensity to freeze, and difficulty of access made Silver Lake Basin a poor choice, and why Mears and Wilfley did not adjoin the new plant to the Iowa Mill in Arrastra Gulch is not known. The system that Mears and Wilfley devised for moving the tailings was also unconventional. Special sand pumps mounted on a barge vacuumed up the tailings and piped them over to the outlet of Silver Lake, whose fall was increased by a low dam. The torrent carried the suspended particles over Arrastra Gulch's cliff headwall and down to the base, where another dam diverted the current into a large wooden drain box. Excess water flowed out of the box and the tailings reverted to a slurry, which flowed into a wooden flume that descended steeply along the gulch's west side. A trestle carried the flume out beyond the mouth of the gulch and over the river to the mill.[378]

As a concentration facility, the Mears-Wilfley Mill was completely novel. The interior was relatively level and featured only a handful of apparatuses that were radically different. However, the most imposing were grossly enlarged versions of Wilfley tables 12'-wide and 48'-long with two decks, in addition to several twenty-four-deck shaking tables. Wilfley designed the contraptions to treat the tailings in economies of scale. The giant tables were for coarse particles, and the twenty-four-deck machines treated slurry of extremely fine material. The Mears-Wilfley Mill featured additional processing machinery, although Arrastra Creek naturally completed some of the classification and separation stages that mills usually executed. According to design, the custom facility could treat 600 tons of Silver Lake tailings per day.[379]

Mears' workers consumed nine months building the mill and flume system, while Wilfley perfected his machinery. One device was a sand pump capable of withstanding the high-impact tailings project. The deck shaking table, also known as a slime table after the material it treated, occupied Wilfley such that he installed a unit in the Iowa Mill for testing. By late summer, Mears and Wilfley opened the mill after a $22,000 investment, around $407,000 today.[380]

[377] Niebur, 1982: 73-5, 82, 84-8, 132-4; Spence, 1993: 369.
[378] "Editorial Correspondence," *EMJ* (4/4/14): 729; Niebur, 1982: 162; Prosser, 1914; *Silverton Standard* (8/28/15); Tucker, 2003: 117.
[379] "Mining News," *EMJ* (5/16/14): 1027; Niebur, 1982: 159; Prosser, 1914; *Silverton Standard* (8/22/14).
[380] Niebur, 1982: 164; Prosser, 1914.

The novel enterprise ran into trouble early in 1915. The flume developed a number of leaks because the tailings slurry acted like liquid sandpaper and wore the wood rapidly. Instead of lining the existing plank trough with sheet iron, Mears opted for concrete, another innovation that drew the attention of engineers who became interested in the project. More problematically, Wilfley's new machinery failed to perform as expected, despite the results of tests that suggested otherwise. Mears ultimately replaced the machinery with flotation.

Following troubleshooting, Mears operated the mill around the clock during in the short working season. During the rest of the year, however, the mill recovered around $5,000 per month, and so well worth the trouble. Mears and Wilfley must have enjoyed high profits since the mill was relatively inexpensive and the basic work of mining and crushing the tailings was already complete. From 1915 through 1918, Mears' railroad hauled off dozens of rail cars of concentrates that fetched, in total over $100,000. The facility functioned smoothly into 1919 when Wilfley, in ill health, sold his interest to Mears. During the year, Mears closed the operation, having exhausted the richest and most debris-free tailings.[381]

Eureka Mining District

The Eureka Mining District followed the general trends of its southern neighbor, the Las Animas district, during World War I. Mining companies responded readily to the improved climate and suspended just as quickly when that climate soured in 1921. The principal difference was that some of the mining operations had greater staying power than those in the Las Animas district. The Sunnyside was one, as the county's greatest producer with a size and complexity similar to the waning Silver Lake. Before John Terry died in 1910, he groomed his two sons to replace him. Joseph focused on managing the mine and William the mills. William built the zinc recovery plant in 1911 and Joseph the aerial tramway and other buildings after they burned two years later. The zinc plant and tramway functioned well, which confirmed confidence in the abilities of the two sons.[382] William led the Sunnyside's response to the improved conditions of World War I. He improved the efficiency of the Eureka mill, increasing income and rendering even lower grades of ore profitable to produce. In particular, he enlarged the Huff Electrostatic plant and consulted with James H. Hyde to install flotation in 1915. Over the course of a year, the Terrys were so impressed with flotation that they moved the machinery up to the Midway Mill and installed a larger set in the Eureka plant, increasing metals recovery even further. The mill at Lake Emma performed general concentration. By this time, Joseph managed a workforce of ninety employees producing 180 tons of ore per day, double the usual average per worker.[383]

For years, the local ASARCo directors eyed the Sunnyside but were distracted by constant trouble with the Silver Lake. It may be that as the Silver Lake wound down during the mid-1910s, they had enough energy and capital to consider other producers and targeted the

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381 *Mineral Resources*, 1917: 840; "Mining News," *EMJ* (10/7/16): 688; "Mining News," *EMJ* (10/6/17): 622; "Mining News," *EMJ* (7/27/18): 195; Niebur, 1982: 166.
382 Colorado Mine Inspectors' Reports: Sunnyside; "Mining News," *EMJ* (1/27/12): 236; "Mining News," *EMJ* (12/20/13): 1192.
383 Colorado Mine Inspectors' Reports: Sunnyside; "Mining News," *EMJ* (8/28/15): 372; *Silverton Standard* (7/29/16): 1.

Sunnyside. It remains uncertain whether ASARCo approached the brothers first or the reverse, but by 1917, the two parties began discussions. The Terrys, nearing retirement, were open to selling, and ASARCo made them a generous offer.

Repeating the pattern established with its Silver Lake properties, ASARCo bought the Sunnyside, as well as the other principal mines on the ore system to ensure long-term reserves. The mining giant also enlarged the operation. In 1917, ASARCo organized the Sunnyside Mining & Milling Company and consolidated the Sunnyside, Washington, and Gold Prince groups. W.G. Sharpe was president, F.W. Batchelder secretary, and E.L. Young manager. Young planned a new mill at Eureka capable of treating 500 tons per day and to finish driving the Terry Tunnel from the mill site to undercut the vein system at great depth. Overall, ASARCo's plan was the largest undertaking in the county since the Gold Prince operation. Young sent a crew of forty to dismantle the Gold Prince plant and incorporate the materials and equipment into the design. At the same time, Andrew Coyle gained the contract to drive a raise up into the old workings from the Terry Tunnel.[384]

The town of Eureka was already bustling because of the existing Terry Mill and nearby operations. New construction filled the available housing and provided business for local merchants. With the Sunnyside Mill finished in 1918, the town's permanent population reverted to around 250 people, an increase from prior years. Workers lived in several boardinghouses, received shaves and haircuts from Robert White, purchased candy and other treats from J.C. Hopper, saw physician William Carter when ill, and patronized C.F. Worden's billiard hall. Local residents purchased goods in J.F. Warnock's mercantile and feed and fuel at the McJunkin station. Visiting dignitaries lodged and dined at the Eureka Hotel and had the A.L. Lashbaugh livery tend their animals. Eureka was also home to several mining companies and assayers.[385]

At first, ASARCo had equally poor luck with the Sunnyside as at Silver Lake. A portion of the surface plant caught fire in 1917, and the following year burned to the ground. The new Sunnyside Mill was ready, but the destruction at the mine shut the operation down. The company hired a workforce of eighty to rebuild, and they made progress until the influenza epidemic, avalanches, and power blackouts stalled the effort. After more than a year, the new surface plant was ready and larger than ever. ASARCo continued Terry's practice of providing superior housing for the miners. The boardinghouse and bunkhouse each had three stories, dozens of rooms, and hot water, steam heat, and showers. Off shift, the miners visited the commissary equipped with billiards and a theater for films, while a doctor provided services. In total, the complex housed 220 workers, as many as Stoiber employed at the Silver Lake twenty years earlier.[386]

The ASARCo directors exhaled a sigh of relief during the summer of 1919 when the host of problems seemed to have passed. The new surface plant was finished, the mill ready, and the influenza epidemic over. A crew of 270 brought the mine into full production and doubled the

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[384] George E. Collins, "Mining in Colorado in 1917," ***Engineering & Mining Journal*** (1/19/18): 143; Colorado Mine Inspectors' Reports: Sunnyside; Henn, 1999: 34; "Mining News," *EMJ* (4/14/17): 689; "Mining News," *EMJ* (4/28/17): 689; "Mining News," *EMJ* (6/15/18): 1109.
[385] *Colorado Business Directory*, 1918: 587; *Colorado Business Directory*, 1919: 480.
[386] Colorado Mine Inspectors' Reports: Sunnyside; *Mineral Resources*, 1919: 783; "*Mining News*" *EMJ* (6/9/17): 1043.

county's total output. However, in 1920, the national recession, an abrupt drop in the prices of industrial metals, and a decrease in demand forced ASARCo to suspend operations yet again. The company laid off hundreds of workers who left. Despite its massive investment, ASARCo responded to what appeared to be another countywide collapse of mining.[387]

The headwaters around Animas Forks and the Mineral Point district were nearly forgotten during the World War I revival. ASARCo's removal of the Gold Prince Mill was the largest project in either area, although several small ventures tried to get going during the revival. One was the idle Frisco-Bagley Tunnel, which eastern investors attempted to reopen in 1917. The other was the Columbus Mine on the north edge of Animas Forks. W.M. Johnson & Company produced from the Norton Vein until the early 1910s. In 1915, Arthur Johnson lengthened the Columbus Tunnel, the lowest of three entries, in an attempt to reach the Columbus Vein, and extracted ore from the upper workings to pay for the work. In 1917, A.S. Sturgeon, the subsequent operator, intermittently tried developing the ore formations. In 1918, Johnson returned as manager for the Gnome Mining Company, which resumed driving the lowest tunnel to the Columbus Vein. A crew of eight miners labored into 1919, but the vein did not offer profitable ore at depth, and Johnson closed the mine.

The central portion of the Eureka district was a complete contrast to the Animas Forks area. Perhaps the Sunnyside stimulated confidence among investors, but at any rate Minnie and Maggie gulches in particular saw three substantial operations gain momentum during the revival. However, just as they were on the brink of prosperity, these succumbed to the typical problems. The Intersection Mine at the head of Minnie Gulch yielded gold ore regularly since the Intersection company initially developed the property in 1910. After producing $177,000, the miners simply ran out of ore in 1917 and were unable to find more. With no ore, the company closed the mine, which had already lasted longer and generated more profits than expected.[388]

Farther down the gulch, D.W. Fleming was at work on the Caledonia, originally known as the Beaton Group where James Beaton developed a gold and silver vein during the 1880s. In 1905, Fleming organized the Peerless San Juan Mining Company to develop the vein at depth, built a mill in 1909, and on the eve of production, suspended due to the effects of the 1907 recession. In 1918, he reorganized the outfit as the Caledonian Mining Company and resumed where he left off. Little work was required to bring the Caledonia into production, and he ran the mill on low-grade ore and sent the higher grades of material to the Durango Smelter. This lasted into 1920, when the ore changed character at depth and miners exhausted the shipping-grade material. Unfortunately, the mill was unable to treat the remaining low-grade ore, but Fleming lacked the capital to refit the facility. In response, he scaled back operations, conducted development, and sought more money. In 1921, economic woes and a collapse in metals prices discouraged his investors, and he suspended work.

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[387] Colorado Mine Inspectors' Reports: Sunnyside; Henn, 1999: 34; Marshall and Zanoni, 1998: 127; "*Mining News*" <u>*EMJ*</u> (9/6/19): 421.
[388] Colorado Mine Inspectors' Reports: Intersection.

During the late 1900s and early 1910s, the Kittimac Mines Company struggled with the Kittimac Mine, around one-half mile east of the Caledonia. The Kittimac paralleled the Caledonia, in part because it tapped the same ore system. The Kittimac had extensive underground workings, a mechanized surface plant, and a mill unable to treat the complex payrock. Unlike Fleming, however, the Kittimac company had enough capital to refit its mill under the guidance of an expert. In 1915, James Hyde installed Huff Electrostatic separators to recover zinc and flotation machines to provide the final separation of other metals. In 1916, after nearly four years puzzling out problems with the ore, the company successfully ran the mill for several months to demonstrate its effectiveness, then leased the entire operation out.[389]

The lessee was George A. Beaton, son of James Beaton, who had made a considerable fortune from the Caledonia Mine during the 1880s. George Beaton organized the Kittimac Mining & Milling Company to work the property. To avoid the pitfalls of earlier operators, Beaton hired his own experts to manage the mine and the mill. P.M. Collins of the American Oil Flotation Company ran the mill and improved the flotation process, and Augustus Malchus oversaw operations. Malchus was also involved with the Mayflower in Arrastra Gulch. Almost from the beginning, the mill did not recover adequate metals content and had to be refitted again. Later in 1916, the mill finally functioned as expected, and as an added benefit, miners discovered a rich pay chute underground during 1917. The operation became profitable, but short-lived as the ore declined in quality. Mired in debt, the Kittimac Mining & Milling Company was unable to meet its payments, causing the owner, Kittimac Mines Company, to default on its debts and declare bankruptcy. The Kittimac Mines Company, however, remained in possession of the mine and spent 1918 operating it to realize some income. Probably to evade creditors, principal Daniel Carey dissolved the company in 1919, found new investors, and moved the assets to the Sullivan Mines Company of Wyoming in hopes of resuming production. Carey was unable to work the mine, however, and the property remained quiet for several years. Finally, in 1921, Carey interested Pennsylvania investors who organized the San Juan Consolidated Mining & Milling Company to lease and bond the property. They hired a crew of five miners who rehabilitated the surface plant and began driving exploratory workings underground. As the nation’s economic climate worsened, the new firm gave up.[390]

Above Middleton, experienced engineer Etienne Ritter continued preparing the property for long-term production for the Hamlet Mining & Milling Company. Workers refit the mill, pushed Level No.6 Tunnel to undercut the old workings, and developed the vein. In 1914, a portion of the mill burned, granting Ritter the opportunity to rebuild with flotation. In 1915, Ritter finally brought the operation into production, only to discover that the mill was still not effective enough. Before he was able to determine why, it burned to the ground. Insurance paid for a new, properly designed plant. By the end of 1916, Ritter started the operation for a second time and found that the new mill functioned perfectly. To keep the company from defaulting on

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389 Colorado Mine Inspectors' Reports: Kittimac; "Mining News," ***EMJ*** (9/19/14): 549; "Mining News," ***EMJ*** (10/19/15): 619.

390 Colorado Mine Inspectors' Reports: Kittimac; "Mining News," ***EMJ*** (7/22/16): 201; "Mining News," ***EMJ*** (10/7/16): 688; "Mining News," ***EMJ*** (12/2/16): 999; Weed, 1922: 622; Weed, 1926: 648.

its debt payments, Ritter expedited production and had three shifts working around the clock. In 1917, the same two problems that plagued other companies in the region changed this. Miners reached an end of the easily treated ore, and the mill had difficulty with the remaining material. For the next two years, Ritter was caught in an endless cycle of intermittent production due to inconsistent payrock, searching for treatable material, and adjusting the mill. In 1919, investors were unwilling to spend any more money on the operation and suspended work. They leased the operation to Al Koltz in 1920. Koltz encountered the same problems, hired Louis Bastian to install the latest flotation equipment, and had no better luck. The Hamlet saw no further activity of note.

The east side of Cunningham Gulch, in the southern portion of the Eureka district, was another center of activity during the World War I revival. After remaining idle, the Green Mountain and Pride of the West mines became the focus of a well-engineered and coordinated effort, and the Gary Owen, quiet for at least a decade, also joined the county's roster of producers. These three mines, the Highland Mary, and several small operations sent so much ore out of Cunningham Gulch that the *Silverton Standard* offered special recognition: "Cunningham Gulch is the most active section of the county. Nearly all the old mines are going, and several new ones have started up."[391]

The Garry Owen, on the east side of Stony Gulch, was among the few mines to operate relatively free of problems through the revival. How the property escaped extensive development in the past is unclear. Experts suggested that it lay on the northeast end of the same ore system as the Green Mountain and Pride of the West, the two principal producers in the southern portion of the Eureka district. And yet, the Garry Owen attracted little interest. Philip Flynn, one expert, was convinced that the mine would yield if properly developed. During the early 1910s, he spent his available capital buying the associated claims but had little money left for necessary work. In 1917, Flynn organized the Wide West Mining Company, obtained investors, and leased the property to keep the operators separate from ownership. He employed William Pantalone as superintendent over a crew of twelve that built a surface plant and drove development workings. By 1918, Flynn's suspicions proved correct, and the miners struck ore rich enough to ship to the Durango Smelter without first being concentrated. Because Flynn was the first to tap the vein system, he found enough payrock to sustain sound production into 1922.[392]

The Green Mountain and Pride of the West, in contrast, were among the county's oldest producers and lay on the same vein system. Despite extensive development, the mines still offered plenty of ore for two principal reasons. The vein system possessed vast reserves, but past operators gave up because the payrock resisted every attempt at concentration. No one had yet tried flotation. In 1916, two separate companies cooperated to profit from the Green Mountain and Pride of the West. J.H. Bird & Company leased the Green Mountain, which featured three tunnels and a mill on the floor of Cunningham Gulch, all connected by tramway. The Pride of

[391] *Silverton Standard* (7/28/17): 1.
[392] Colorado Mine Inspectors' Reports: Gary Owen; *Silverton Standard* (3/10/17): 1.

the West Mining Company, managed by A.W. Harrison, leased the Pride of the West, which featured several tunnels, a power plant, and no mill. Both outfits prepared their mines for production, and the Pride company offered to refit the Green Mountain Mill with flotation. As part of the agreement, the Pride company realigned the Green Mountain tramway to serve its own needs, which was no loss for Bird because ore could be hauled out the lowest Green Mountain tunnel and directly into the mill. In 1917, the Pride company hired Bastian to install flotation, and it was successful from the beginning.

During the spring, both operations began production with great promise. Under Harrison, the Pride company generated around fifty tons of ore per day and ran it through the mill, while the Bird lease slowly sputtered to a stop. Bird turned his lease over to ASARCo during the summer, and the mineral giant brought the Green Mountain into regular production. ASARCo's interest in the mine was twofold. One was to profit from the ore, and the second to provide a stream for the Silver Lake Mill and offset the dwindling custom business. Thus, instead of treating ore in the Green Mountain Mill, located at the mine portal, ASARCo shipped the material to the Silver Lake plant instead. The mill was busy, however, on payrock from the Pride. The split arrangement continued through 1918, when dwindling ore reserves caused ASARCo to end its lease. The Pride company more than made up for the loss and was so productive, the mine assumed the status of fifth most important producer in the county. Around this time, Joseph Terry, flush from the sale of the Sunnyside, replaced Harrison. Terry's experience was immediately put to a test in 1919 when the company temporarily ran out of ore. The investors considered what to do, acceded to recommendations of an exploration campaign, and then stalled in 1921 due to the poor economic climate.[393]

Cement Creek Subdistrict

Other than the tungsten rush, the Cement Creek subdistrict was relatively quiet during the World War I except for two principal operations. The most important was the Gold King Mine, lifeblood of Gladstone and the Silverton, Gladstone & Northerly Railroad. The Mears and Slattery syndicate therein leased one of the county's top producers. The mine achieved this status during the early 1910s, and Bastian's groundbreaking 1914 application of flotation in the Gold King Mill only increased the yield. In 1917, the syndicate failed to renew its lease, and Willis Kinney seized the opportunity to regain the mine. Kinney must have understood that the syndicate rarely quit a lease unless the ore was gone, but he established the Gold King Extension Mines Company and put a workforce of eighty in search of ore and rehabilitating the mill for greater efficiency. Although fifty of the workers lived in Gladstone, the town's population was insufficient to support any business other than the Gold King boardinghouse. In 1919, Kinney located enough payrock to support intensive operations. With rehabilitation finished, he divided the workers into three shifts and kept them busy around the clock producing ore and running the mill. Kinney enjoyed this pattern until the economic climate of 1921 forced him to suspend.[394]

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[393] Colorado Mine Inspectors' Reports: Pride of the West; *Mineral Resources*, 1918: 861; "*Mining News*" *EMJ* (7/28/17): 189.
[394] Colorado Mine Inspectors' Reports: Gold King; *Mineral Resources*, 1918: 862; "*Mining News*" *EMJ* (8/17/18): 325.

The Silverton, Gladstone & Northerly Railroad stopped running in conjunction with the Gold King, which adversely impacted the other principle operation in the Cement Creek drainage. In 1917, the Henrietta Copper Mining Company purchased the Henrietta in Prospect Gulch as justified by the increase in metals prices. The Henrietta was ready to produce because its surface plant and tramway were intact, and the Mears and Slattery syndicate provided rail service at the bottom terminal. The company hired experienced engineer E.W. Walter to reopen the property. Once the mine was in sound condition, Walter leased it to the Adam & Eve Mining Company, which enjoyed production until the profitable ore was gone in 1918. Walter employed a small crew to find more ore through 1921, when the economy soured and the railroad stopped running.[395]

Mineral Creek Mining District

The Mineral Creek Mining District remained depressed during the World War I revival, even though it featured what had been some of the county's most important mines. Unlike Silver Lake Basin or the Sunnyside Mine, the district's large operations were depleted at the turn of the century and had little profitable payrock left to offer. In contrast to the central portion of the Eureka district, the small and medium-sized mines did not attract interest either. The Coming Wonder was one exception, located on Anvil Mountain north of Silverton. The property overlay the Crown Jewell Vein which, like the Garry Owen in Cunningham Gulch, saw almost no development since the mid-1890s. Thus, three seasoned miners felt that Coming Wonder was an appropriate name for their new venture, sure to be highly productive, and formalized in 1916 as Andrean, Jackson & Gustafson. After only one year, however, Nels Anderson & Company replaced the trio, conducted additional development, and enjoyed sound production through 1917. The firm generated so much ore that the directors built a double-rope reversible tramway to lower it down to a shipping point. In 1918 Ed Johnson assumed the lease. Johnson specialized in leasing small mines and had just finished with the Aspen when he organized the Anvil Leasing Company. Under Johnson, a small crew kept the Coming Wonder in production for three years. In 1921, the declining economy shut the operation down.[396]

In Silverton, business owners and residents eagerly anticipated the impending reopening of the Hercules and North Star mines. Although owned by separate parties, both ceased work in 1911 or 1912 due to problematic ore, were foreclosed upon, and put up for auction in 1915. The North Star sold first. The size, condition, and history of property met the criteria favored by the Mears and Slattery syndicate. They formally purchased through the S.D. & G. Leasing Company, one of their many subsidiary organizations. Louis Bastian immediately refitted the mill with flotation, and Matt Delsante employed a small crew rehabilitating critical underground

[395] Colorado Mine Inspectors' Reports: Henrietta; "Mining News," *EMJ* (4/7/17): 647; "Mining News," *EMJ* (10/6/17): 622; *Silverton Standard* (6/9/17): 1.
[396] Colorado Mine Inspectors' Reports: Coming Wonder; "Mining News," *EMJ* (9/29/17): 579.

workings. In 1916, they began production, some miners sending low-grade ore from old stopes, others prospecting underground for fresh material. The North Star, however, lived up to its reputation for difficult ore and was among the few operations that truly challenged Bastian's expertise. His flotation process did not recover enough of the ore's metals content, so he refit the mill in 1916 with flotation machines of his own design. Miners generated ore from the North Star workings through 1917, when they began to run out of profitable grades of material. As production decreased, Delsante kept the mill busy with ore hauled from the syndicate's other leases, such as the Detroit-Colorado and Silver Lake. By the end of 1918, the syndicate was satisfied that they had exhausted the last vestiges of ore out of the North Star and let the lease lapse.[397]

Even though the value of metals remained high, the North Star gradually declined until it too succumbed to the economic troubles of 1921. The San Juan Tungsten Company leased the mine, refitted the mill, tried producing tungsten, and failed. Phillip Sartori subsequently leased the mill and used it to treat ore from the Silver Ledge Mine, hoping that it was more efficient than the Silver Ledge Mill. Matt Delsante returned in 1920, when his North Star Leasing Company leased the nearby Gladstone Mine and needed the mill to treat ore. Delsante built a tramway up to the Gladstone and enjoyed sound production through 1921. Except for a few limited partnerships, no one took an interest in the North Star workings for more than a decade afterward.[398]

The Hercules revived more slowly initially than the North Star. B.S. Robinson, Joseph M. Boyce, and other investors organized the Dora Consolidated Mining Company and purchased the operation in early 1916. The company split management of the mine and mill for efficiency. W.R. Chase oversaw teams of miners who began an exploration campaign and generated some ore, while John Hughes prepared the mill for its first run in almost ten years. When the entire property was ready for production, the company increased the workforce to sixty-five, employed at an efficient strategy tiered on the different grades of ore. Specifically, Hughes processed simple material on-site in the Little Dora Mill and sent complex payrock, usually with a high zinc content, to the Silver Lake Mill's custom flotation plant. This lasted into 1919 when, like other principal mines, miners exhausted the profitable grades of ore. The company conducted some development work, resumed production in 1920, but closed the next year.[399]

The Silver Ledge, at the head of Mineral Creek, was the district's third and last major operation during the World War I revival. In 1914, after Joseph Warner and William Feigel failed at their custom milling venture, Louis Bonavida and Baptiste Matties leased the mine, unwatered the shaft to the 400-foot level, and conducted development in new ground. They struck fresh ore, enticed Feigel to prepare the mill for operations, and had both in production by the end of the year. The operation did well into 1916, when Bonavida died, although his wife

[397] Colorado Mine Inspectors' Reports: Colorado Metals Co., North Star; "Mining News," *EMJ* (7/29/16): 242; "Mining News," *EMJ* (11/4/16): 845; *Silverton Standard* (1/22/16): 1; *Silverton Standard* (7/29/16): 1; *Silverton Standard* (10/14/16): 1; *Silverton Standard* (6/16/17).

[398] Colorado Mine Inspectors' Reports: North Star; "Mining News," *EMJ* (12/7/18): 1013; *Silverton Standard* (9/13/19): 2; *Silverton Standard* (10/4/19): 1; *Silverton Standard* (1/1/21): 1; *Silverton Standard* (8/13/21): 1.

[399] Colorado Mine Inspectors' Reports: Dora, Hercules; *Mineral Resources*, 1916: 374; *Mineral Resources*, 1918: 862; *Mineral Resources*, 1920: 588; "Mining News," *EMJ* (3/25/16): 581; "Mining News," *EMJ* (8/26/16): 404.

Jennie assumed his duties so the operation could continue. She held the lease, managed business affairs, and worked with Fiegel to refit the mill. Further adjustments became unnecessary because in 1917, the facility burned. Sartori now had to haul his ore to the North Star Mill, which impacted profitability. In response, Sartori leased the mill in 1919 and ran it until miners exhausted the Silver Ledge, which he closed later in the year.

Ice Lake Mining District

The Ice Lake Mining District's quiet state during the late 1910s gave no hint that a revival was under way in the rest of San Juan County. The only significant operation was the Bandora, which saw intermittent activity at best. William Sullivan, the mine's longtime operator, produced silver ore on a limited basis until around 1912, when he suspended operations because the best payrock was gone. When metals values began to creep upward, Sullivan waited until 1916 and reopened the Bandora, ostensibly under the Sullivan Mines Company. He employed a small crew that altered between occasional production and vein development on a seasonal basis into 1920, when metals prices reached their peak. Sullivan exploited the positive market to sell to Henry Wycoff and other Denver mine speculators, before metals prices fell within a year. Wycoff prepared for production and even contemplated moving the Yukon Mill onto the property, before the 1921 depression struck.[400]

Major Decline, 1921 - 1932

The spike of industry prosperity fostered by World War I ended by 1921 throughout Colorado. The impending collapse struck with full force as almost the entire mining industry failed, including the long-term producers. Conditions conspired against meaningful recovery. Within the county, nearly all the known profitable ore bodies had been discovered, developed, and worked to exhaustion after forty-five years of continuous activity. With the exception of a few late-comers such as the Little Nation, Coming Wonder, and Garry Owen, the county offered little potential for new discovery. In addition, the disappearance of custom concentration mills ensured that the small operations had nowhere to process their low-grade ore. Outside the county, as peace returned to the United States and Europe demand for and value of industrial metals returned to lower pre-war prices. Furthermore, a deep, postwar depression crept over the entire United States.

Those outside the county had only to consider statistics to recognize collapse. In 1921, the mining industry generated a lowly $5,000 worth of gold, $64,000 in silver, $25,000 in lead, and no zinc, tiny fractions of the previous years. Whereas miners produced $3,617,000 in 1920, this diminished to $100,000 in 1921 and slightly double that for the following year, the least amounts since 1882. The number of active mines fell proportionally. After 1921, the county had around twenty small outfits, six medium-sized mines, and two large producers. Compared with wartime, the small outfits fell by almost one-half and the rest by 75 percent. Only the late 1880s

[400] Colorado Mine Inspectors' Reports: Bandora; "Mining News," ***EMJ*** (8/21/20): 382; "Mining News," ***EMJ*** (11/13/20): 968.

recession compared. The loss of jobs and ruined economy forced nearly half the population to leave. In 1910, the county was home to around 3,000 individuals, and fewer than 1,700 remained to make a living as they could.[401]

With a decrease in business came a reduction in railroad traffic. James Pitcher closed the Silverton Railroad. Otto Mears, who had purchased the Silverton, Gladstone & Northerly Railroad, ended service to Gladstone. Only the Sunnyside Mine reopened in 1922 along with a handful of other companies hoping to profit from silver.[402] As early as 1920, however, the Federal Reserve targeted the Pittman Act, creating insecurity in the silver market. Western legislators and capitalists rallied in response, contested the anti-Pittman sentiments, and safeguarded the Act in 1922. This kept the county's mining industry alive, as federal statisticians noted the situation from a broad perspective:

> The situation in the Colorado metal-mining industry during the first half of 1922 was disappointing, but there was a marked improvement as the year drew to an end, particularly in November, when the prices for lead and zinc warranted hopes of a stable market. There was also an increased interest in investigation of the industry by capitalists. The price of $1 an ounce for silver derived from domestic ores under the Pittman Act was all that kept many Colorado mines in operation in 1922.[403]

Just as the region seemed to be on the verge of low-level stability, however, the comptroller general forced the Pittman Act to expire at the end of 1922. Silver reverted to its former value of around $.65 per ounce, and the state mining industry fell apart. Coupled with a broad economic shift toward finance and business, the expiration sealed the fate of silver mining in Colorado.[404]

Between 1923 and 1929, county residents left or found alternative sources of income. Silverton miner Zeke Zanoni and Ouray resident Roger Henn recounted the distillation of liquor to meet an enormous demand fostered by the Volstead Act, also known as Prohibition. Ethnic Slavs and Italians produced wine. Henn noted that Ouray was a natural center for these activities because of its remoteness and limited access. If Ouray was a sound location, Silverton was even better and conducted as much business. Zanoni claimed that in Silverton, small saloons and distilleries paid $25 per month to operate, large businesses provided $125, and the fees guaranteed protection against federal raids.[405]

Those workers who knew nothing other than mining faced a difficult struggle because their skills were specialized and narrow. With no better means of income, many individuals continued to mine with the lowered expectations of mere subsistence rather than finding bonanzas. They sporadically leased blocks of ground in what had been the richest properties,

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[401] Henderson, 1926: 216 for production figures; Schulze, 1977: 1920. The number of active mines was derived from a survey of Colorado Mine Inspectors' Reports.
[402] Sloan & Skowronski, 1975: 321.
[403] *Mineral Resources*, 1922, V.1: 527.
[404] "End of Pittman Silver Purchases Cut Profits Sharply," *EMJ* (12/1/23): 960; "News from Washington," *EMJ* (7/28/23): 165.
[405] Henn, 1999: 50-2; Marshall and Zanoni, 1998: 12.

secreting out small ore shoots and scraping together low-grade payrock left by previous outfits. The leases tended to be short-lived as the subsistence miners moved from claim to claim frequently. Production was limited to several tons per day. The lessees possessed resources opposite to the strategy of economies of scale. Specifically, they had plenty of time, very little capital, and expected little income, favoring hand-labor over mechanization. In an era of relatively inexpensive and readily available machinery, the prevalence of such methods effectively reversed fifty years of technological advancement, but also facilitated subsistence survival.

Another subsistence strategy was gathering low-grade ore already brought to the surface and abandoned by previous companies. While few companies willingly discarded profitable ore outright, improved milling technologies, especially flotation, rendered this material profitable. all The lessee sorted through waste rock dumps to recover formerly discarded payrock. Sorting was well-suite to these impoverished lessees because it was ready at hand and required virtually no capital or equipment except for shovels and screens. The work was not easy, though, and lessees withstood alternately wind, storms, brilliant sun, frigid temperatures, or snow. During the latter half of the 1920s, enough lessees braved the elements to constitute a small ore sorting industry focused on the formerly richest mines.

In addition to the subsistence miners, a handful of capitalized companies maintained some semblance of heavy industry in the county. They were few at the beginning of the 1920s and increased in number as general economic conditions improved during the decade. All shared similar characteristics that included proximity to transportation corridors, mines with histories of production, profitable grades of ore, and an increasing reliance on machinery. Only a few of the old mines in the county met these criteria, with the exception of the Eureka and Las Animas districts. None of the operations were trouble-free except for the Sunnyside and Mayflower, popularly known as the Shenandoah-Dives.

In 1922, ASARCo revived its subsidiary, Sunnyside Mining & Milling Company, and reopened the Sunnyside. The Sunnyside company had no intention of permanently closing after investing heavily in the property and resumed where it left off. A fortunate 162 miners were offered jobs underground and an additional fifty-four positioned at the surface plant and two mills. They produced and milled an impressive 500 tons of ore per day, double the normal average per worker. The Sunnyside was already the largest employer and accounted for nearly all the county’s output, and yet the company enlarged the operation.[406]

Management understood that the high rate of production would eventually exhaust the known ore reserves and began a major development campaign in response. Most of the extant workings were on the original Sunnyside property, so the company had wisely purchased all adjoining claims in 1917 to support long-term operations. In 1922, the directors moved towards development, beginning with Ruben McNutt’s old Washington. Miners started sinking the Washington Shaft with three compartments instead of the usual two to maximize anticipated production. By 1923, they reached the vein, drove development workings, and made available an

[406] Colorado Mine Inspectors' Reports: Sunnyside.

entirely new ore reserve. In response, the company increased the workforce to 360 and hired an additional 40 miners in 1926. An astounding 800 tons of ore poured out of the mine around the clock and passed down the tramway to the mill at Eureka. The amount of concentrates supported the Silverton Northern Railroad and constituted a huge percentage of the Durango Smelter's business. During 1926, the company reached production capacity and ensured its future by expanding the underground workings into most of the adjoining ground including the Gold Prince claims to the northeast and the old Mogul property to the northwest. Most of the ore was low in grade, but the company sustained operations for the rest of the decade.[407]

Although the Sunnyside was the county's most important operation, Charles Chase developed the Mayflower into a close second. Chase was convinced that in the Las Animas district, past mining operations gutted most of the high-grade ore in the upper reaches of the veins but left vast deposits of low-grade material at depth. Chase, an exacting engineer, based his educated opinion on twenty-five years of experience with deep mining in the San Juans. Born in Hartford, Wisconsin, in 1876, Chase's mining engineer father who brought the family to Georgetown during the 1880s. Charles went east to Minneapolis for schooling, graduating in 1893. He returned to Colorado, studied metallurgy at the University of Colorado, and sought work in the mining industry after graduating in 1898. Arthur Winslow hired him as surveyor and assayer at the Liberty Bell Mine at Telluride, from whence Chase became general manager. While at the Liberty Bell, Chase played various roles in the violent strikes that swept Telluride at the turn of the century. Overall, he proved responsive to reasonable union demands such as better living conditions, but he sided with the company and mine owners' association in the face of violence. When the industry slowed after the 1907 recession, Chase broadened his experience elsewhere. By the 1910s, he managed the Mogul Mining Company of South Dakota and the Primos Exploration Company's molybdenum operations at Empire, Colorado. Chase subsequently became chair of the Colorado chapter of the American Institute of Mining Engineers.[408]

As a consulting engineer in the 1920s, Chase secured a group of investors in Kansas City interested in starting a mining venture and suggested they focus on the San Juans. Surveying the areas with the greatest cumulative records of production, Chase visited the Las Animas district in 1925 and concluded that miners never reached the bottom of the low-grade veins around North Star Peak and Silver Lake Basin. Further, he found that the veins were part of a larger disseminated system. If they could be mined in economies of scale from a deep haulageway, the veins could provide returns for years.[409]

Chase contacted his Kansas City investors and found them keenly interested. Fortunately for Chase, the investors already had considerable experience with large-scale mining ventures and, in particular, James W. Oldham had organized the Wellington Mines Company, which operated one of Breckenridge's largest properties since 1906. Chase recommended that Oldham

[407] Colorado Mine Inspectors' Reports: Sunnyside; Marshall and Zanoni, 1998: 127; *Mineral Resources*, 1923: 636.
[408] Stone, 1918, V.2: 91; Reuben O. Norman, *Who's Who of Denver 1931-1932* (Denver: The Blue Book Company, 1932): 47.
[409] Charles A. Chase, *Shenandoah-Dives and North Star Mines 1925*.

and associates fund exploratory work at the North Star to confirm the continuation of the veins, and, if the hypothesis held true, that they acquire the mines around North Star Peak.[410]

Meanwhile, Chase planned a mining operation on the same scale as the Sunnyside. He consulted with engineer O.R. Whitaker to confirm his supposition that the North Star claims could only be accessed from underneath via a long haulage tunnel. The Mayflower was an ideal candidate because it already had a tunnel at low elevation, a location suitable for a tramway down to a mill on the Animas River. The tunnel would have to be lengthened to 5,000 feet to undercut North Star Peak, which presented the drawback of a high cost. Whitaker estimated that driving the Mayflower Tunnel would require eighteen months and $400,000, close to $4 million today. The investors did not flinch, however, and moved forward at once. In 1926, they organized the Shenandoah-Dives Leasing Syndicate and authorized Chase to buy the North Star, Shenandoah, Dives, and Mayflower mines.[411] Besides the location, Chase recognized that the Mayflower possessed several qualities that would save the organization capital. First, the tunnel already offered a small surface plant that could support underground work from the outset. Second, the tunnel accessed several veins capable of providing immediate income. Third, the tramway was serviceable and would carry ore down to the Iowa Mill, which Chase leased in 1928. Oldham and associates were pleased with Chase's careful planning. For the next several years, two crews of miners drove the Mayflower Tunnel toward North Star Peak and extracted 100 tons of ore per day from the existing veins. They sent the material down to the Iowa Mill, which also received ore from the Colorado-Mexico Mining Company, which had leased the Iowa workings since 1926.[412]

In 1929, the financial crash destabilized the economy again, and the situation in San Juan County worsened. Financial experts at first thought that market sectors were merely undergoing short-term adjustments, but as bank security and stock values continued to slide downward, they forecast a recession similar in scale to 1907. Between September and November, however, a financial panic pushed the nation into the Great Depression. All aspects of business and commerce imploded, thousands became unemployed, capital evaporated, and goods and services were curtailed or became no longer available. Under President Herbert Hoover, the nation's economic climate worsened through the early 1930s. Industry came to a standstill, and the prices for silver and industrial metals dropped to new lows. Silver fetched a mere $.29 by 1931. At the same time, copper decreased to $.11 per pound and lead to $.05 per pound.[413]

The Great Depression was unlike any economic bust that San Juan County or the nation had experienced. Few if any mining companies could pay their operating costs, let alone realize a profit. The Sunnyside suspended work in 1930. The county was devastated. Not only did the region lose most of its income, but now at least 30 percent of its residents were unemployed. Other principal mines closed. The abrupt halt to mining caused a ripple effect that worsened

[410] Chase, 1925; "Mining News," *EMJ* (10/30/20): 885; Weed, 1918: 711.
[411] Chase, 1925; Colorado Mine Inspectors' Reports: Mayflower; O.R. Whitaker, *Report on Shenandoah-North Star-Terrible-Mayflower Group* 1926.
[412] Colorado Mine Inspectors' Reports: Iowa, Mayflower; *Mineral Resources*, 1928: 855.
[413] *Minerals Yearbook*, 1937: 115; Saxon, 1959: 7-9, 14-7.

already poor conditions. With almost no freight traffic, the Denver & Rio Grande Extension reduced service between Silverton and Durango, and James Pitcher mothballed the Silverton Northern in 1930. ASARCo declared that it would close the Durango Smelter because the volume of business was insufficient to pay for the operating costs. By 1931, without a smelter, the little mining that survived ceased.[414]

The Shenandoah-Dives Mining Company, in the Las Animas district, was the only outfit to continue as the depression deepened. Prior to the crash, Chase contracted with Stearns-Roger to build a mill that rivaled the Sunnyside facility in size across the river from the Silver Lake facility. He also hired engineer Frederick C. Carstarphen to build a tramway between the mine and mill.[415]

The unique Carstarphen tramway drew industry attention. In broad form, the system operated like the Bleichert tramways that proliferated throughout the San Juans, but the set of towers and means of powering the traction cable differed. To save construction costs, minimize maintenance, and increase longevity, Carstarphen erected eleven steel towers instead of more numerous timber structures. In the upper terminal, the traction cable did not wrap around a giant sheave wheel, but instead made several ninety-degree bends around small pulleys powered by two motors. Approximately two miles in length, the Carstarphen Tramway was the longest operating system in the San Juans and transported buckets around the circuit in only forty-five minutes.[416]

When the Great Depression struck, the mill and tramway were almost finished, leaving Oldham and associates in a difficult position. Chase required more capital before he could produce ore in the economies of scale necessary to offset the declining value of silver. If Oldham and associates balked, they stood to lose the investment up to that point. Oldham and associates gritted their teeth, provided the funds, and waited for Chase to bring his vision to completion. In 1930, Chase finally began operating the mine and mill as a single ore production entity. A crew of fifty miners generated hundreds of tons of ore per day and another thirty-five workers provided support services and ran the mill. Profitability, however, remained elusive because the value of silver was half of the price that Chase used for his economic calculations in 1925.[417]

The difficult conditions required Chase to scrutinize all operating costs and efficiency measures. He personally inspected the mine and mill and constantly improved operations. During one visit to the machine shop, Chase discovered workers leaving broken domestic items for the repair when the opportunity arose. Over time, this practice had snowballed such that it was unclear how Chase might react. However, Chase congratulated a worker on an efficient use of time and the importance of the service. Chase understood that the Mayflower Mine was also a major community institution.[418]

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414 Sloan and Skowonski, 1975: 335; Smith, 1992: 114.

415 Dawn Bunyak, *Frothers Bubbles and Flotation: A Survey of Flotation Milling in the Twentieth Century Metals Industry* (Denver: 1998): 59, 63; Colorado Mine Inspectors' Reports: Mayflower; *Mineral Resources*, 1929: 954; *Mineral Resources*, 1930: 1072.

416 Bunyak, 1998: 60-2; Colorado Mine Inspectors' Reports: Mayflower.

417 Colorado Mine Inspectors' Reports: Mayflower; *Mineral Resources*, 1929: 954; *Mineral Resources*, 1930: 1072.

418 Wyman, 1993:71.

Las Animas Mining District

To the residents of Silverton and Howardsville, every mining operation in the Las Animas district was essential and three revived ventures were welcomed during the 1920s. Joseph E. Dresback organized to take over the Highland Mary Mine when the Mears and Slattery syndicate ended its lease. While relatively young, Dresback was a trusted local businessman. Born in Bellevue, Ohio in 1891, Dresback came with his family to Silverton as a boy. In 1909, he took a job as clerk in the First National Bank of Silverton, then worked as an agent for Mears' Silverton Northern Railroad beginning in 1914. Dresback joined the army and went to Europe during World War I, returning in 1919 to marry. Dresback revived his railroad career and replaced C.W. Montgomery as auditor of Mears' railroads. Four years later, he was appointed manager of the Silverton Northern.[419] Because the Highland Mary Mine was vast, Dresback assumed that he could still find fresh ore in the underground workings. In 1923, he organized the Highland Leasing Company, put a small crew to work bringing low-grade ore out of old stopes, and began an examination for new veins. The company kept ten miners busy through 1927.[420]

C.H. Smith, J.E. Storey, and F.P. Despain held the same optimistic outlook about the Lackawanna Mine. In 1926, the three Utah investors organized the Lackawanna Mining Company and hired a crew of ten to rehabilitate the surface plant and underground workings for production. Instead of immediately extracting ore, however, they waited to build a concentration mill. Upon completion in 1928, the mill was equipped with flotation to treat the Lackawanna's complex ore. Initially, the mill generated enough concentrates to justify a shipment to the Durango Smelter.[421]

The Little Nation Mine was one of the few operations that not only weathered the previous collapse, but thrived. In 1923, the Little Nation Mining Company pursued plans to make the mine a sound producer. Within a year, the company built a new mill on the north edge of Howardsville, completed an aerial tramway, and developed the Royal Charter Vein, the principal ore body. The mill featured a modest conventional flow path and flotation, a combination known to work on the area's complex ore. The mill, however, did not recover the ore's metal content as expected, and manager A.G. Marsh concluded that it would have to be refitted. The investors would part with no more capital, however, forcing Marsh to suspend operations in 1924, which contributed to growing pessimism in the Animas River drainage.[422]

In 1927, William Way, a Silverton lawyer who had leased the Lackawanna in 1917, eyed the idle Little Nation. He felt that with proper management and close attention to the

[419] Sloan and Skowonski, 1975: 320; *Who's Who in Colorado: A Biographical Record of Colorado's Leaders in Business, Professional, and Public Life* (Boulder: Colorado Press Association, University of Colorado, 1938) 1032.
[420] Colorado Mine Inspectors' Reports: Highland Mary; *Mineral Resources*, 1923: 637; *Mineral Resources*, 1926: 761; *Mines Register*, 1937: 409.
[421] Colorado Mine Inspectors' Reports: Lackawanna; Horn, 2004; *Mineral Resources*, 1928: 856.
[422] Colorado Mine Inspectors' Reports: Mermac; *Mineral Resources*, 1923: 637; *Mineral Resources*, 1924: 566.

concentration process, the mine would pay. Way interested F.J. Bruening and Dan Harroun in a lease and they hired a crew of eighteen. The operation started well, but shut down after a year.[423]

In the Las Animas district, most mining companies and lessees active during the Great Depression tried their best to maintain operations and wait for a recovery. In 1928, E.A. Hiett, president of the Highland Mary Mining & Milling Company, had decided that the company would work the Highland Mary and no longer lease the property out. Immediately after Hiett brought the mine into production, the economy forced him to curtail operations. He maintained a small crew through 1930, when he reluctantly suspended operations.[424] In 1929, William Way and partners tried again with the Little Nation Mine, on the assumption that the economy would improve. However, not only did economic conditions worsen during 1930, metals values continued to fall. Way suspended operations in 1931.[425]

Eureka Mining District

In the Eureka Mining District, all the principal companies, except for the Sunnyside, suspended operations pending better times. The wait was too long for many, who dissolved by the mid-1920s. A few companies with patient investors retained one or two workers, employed largely to provide security and prevent equipment theft. When the economy recovered later, a few companies reopened several of the Eureka district's most important producers, particularly in Cunningham Gulch. When the Great Depression descended, mining companies and lessees tried their best to maintain operations. As the situation worsened, those outfits with debt were unable to meet their obligations and disappeared.

The northern portion of the Eureka district was quiet except for the Mountain Queen, among the mines brought back into meaningful production after the early 1920s collapse. In 1924, Mike Babich, Pete Dunk, and A.R. Walker leased the property, brought in their own equipment, and unwatered the shaft in preparation for production. By secreting out small ore chutes and extracting fill from old stopes, they generated around five tons of ore per day. Even though the mine was largely exhausted after forty years of intermittent activity, they found enough payrock to sustain the lease for three years before moving.[426]

The Buffalo Boy reopened concurrently with the Mountain Queen. In 1925, the Vertex Mining Company signed a lease, hired a crew of twenty-five, and invested capital to modernize infrastructure. The company installed an air compressor underground and provided workers with a boardinghouse equipped with a rare hot-air furnace. For three years, Vertex enjoyed sound production of medium-grade ore with significant profits going to shipping and smelting. Thus, in

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423 Colorado Mine Inspectors' Reports: Mermac; ***Mines Register***, 1937: 810; ***Mineral Resources***, 1927: 559.
424 Colorado Mine Inspectors' Reports: Highland Mary; ***Mineral Resources***, 1929: 954.
425 Colorado Mine Inspectors' Reports: Iowa, Mermac; ***Mineral Resources***, 1929: 855; ***Mineral Resources***, 1930: 1072
426 Colorado Mine Inspectors' Reports: Mountain Queen.

1929, the company built a mill at the mouth of Stony Gulch, the seed for a major improvement campaign. The mill featured flotation to ensure the efficient recovery of gold, silver, lead, and zinc. Vertex commissioned a tramway to lower the payrock to the new mill, a boardinghouse, and new surface facilities. Like Chase and the Mayflower, these plans were under way when the economy collapsed in 1929, and Vertex finished the costly improvements probably under the presumption that the economy would correct itself within a short time. Vertex brought the mining and milling combination into full production in 1930 only to suspend as metals prices tumbled.[427]

The Pride of the West Mining Company leased the Pride of the West in 1916, enjoyed heavy production until 1921, and then scaled back and waited for conditions to improve for the mining industry. By 1926, the company directors lost interest and failed to renew the lease. C.M. Lane saw value in the Pride, Garry Owen, and Old Hundred, and assembled the properties. In 1928, Lane organized the Pride Mining Company and prepared each property for heavy production. At the Pride, he financed a new mill at the lowest tunnel and linked the upper tunnels via tramway. At the Old Hundred, Lane directed a crew of ten to refit the mill with flotation and develop the vein. At the Garry Owen, a larger workforce repaired the surface plant and built a new tramway to Old Hundred Mill. Lane now controlled the three mines, as many tramways, two mills, and a powerhouse.[428] When the Great Depression began, Lane's empire crumbled under debt. He relinquished the lease on the Garry Owen and Old Hundred and turned the Pride over to the Altamont Mining Company. Both outfits attempted to produce through 1930 and then suspended.[429]

In 1928, Samuel Martin reappeared and perpetrated another investment scheme. Under the Treasure Mountain Gold Mines & Power Company, he acquired the so-called Martin Group near Middleton and promoted a tunnel project that he claimed would open up vast ore reserves. Martin forecast that the mine would yield enough ore to justify an electric trolley to haul the material to Middleton. Martin hired a workforce of fifty to build a substantial surface plant at the mouth of the Martin Tunnel. Martin intended for the surface plant to inspire confidence among investors and not to support work underground, which was the actual purpose of a surface plant. As proof, there was no work underground to support because the Martin Tunnel never progressed more than around 20 feet in length. The workers labored seasonally until 1929, when the economic collapse preceding the Great Depression exposed Martin's fraud.[430]

<u>Great Depression Era Revival, 1933 – 1939</u>

In 1932, Franklin Delano Roosevelt was elected president and the next year launched a variety of programs to revive the nation's economy. A year later, Roosevelt and advisors devised

[427] Colorado Mine Inspectors' Reports: Buffalo Boy; ***Mineral Resources***, 1929: 953; ***Mineral Resources***, 1930: 1073.
[428] Colorado Mine Inspectors' Reports: Garry Owen, Old Hundred, Pride of the West; ***Mineral Resources***, 1929: 953.
[429] Colorado Mine Inspectors' Reports: Garry Owen, Old Hundred, Pride of the West; ***Mineral Resources***, 1930: 1073.
[430] Colorado Mine Inspectors' Reports: Martin Group.

a plan intended to simultaneously devalue the dollar while reviving metals mining on a broad scale. The dollar was taken off the gold standard and the Federal Reserve bought gold at inflated prices. The plan stimulated gold mining as expected. In 1934, Roosevelt signed into law the Gold Reserve and Silver Purchase acts in hopes that they would resuscitate mining. The Gold Reserve Act raised the price of gold from around $20.67 to $35.00 per ounce and the Silver Purchase Act raised the value of silver from around $.48 to $.70 per ounce.[431]

Roosevelt's plan, combined with widespread destitution, unemployment, and New Deal programs, stimulated a revival of mining across the west. Experienced miners reopened properties known to still possess ore, and inexperienced laborers formed an operational workforce. Adding to the growing interest, advances in milling technologies rendered previously uneconomical ores profitable. Thus, mining companies began producing low-grade ore, but not with the expectation of high profits. Instead, they were satisfied with subsistence. Overall, the revival was minor compared to decades past, but the west, including Colorado, witnessed a return to the old mining districts on a scale not seen since World War I.

San Juan County responded slowly to improved conditions and incentives instituted by the Roosevelt administration. Few individuals with the resources for meaningful development took interest in abandoned properties. As the decade progressed, conditions improved just enough to resuscitate the industry and allow the county to join the rest of Colorado in its Depression-era mining revival. The demand for industrial metals increased slightly as some manufacturing resumed. Investors more freely funded mining ventures, seeking security in gold, which some of the county's mines were known to have produced in high volumes.

Statistics reflect how the county responded to the Depression-era revival. In 1933, the county generated $742,000 worth of ore, which increased to a substantial $2,323,000 by 1938 before declining. These figures indicate the county's overall production trends, but are slightly skewed because the Shenandoah-Dives alone contributed disproportionately more than the rest of the county's mines combined. The number of mines active during the 1930s better reflects the trend that the industry followed. Between 1930 and 1933, before Roosevelt's programs, there were five substantial prospects, ten small mines, two medium-sized operations, and the Sunnyside and Shenandoah-Dives mines as the large producers. When the Sunnyside closed in 1930, the Shenandoah-Dives was the only significant operation remaining. Between 1934 and 1939, numbers tripled to eight prospects, twenty-eight small mines, eight medium-sized operations, six large producers, and several placer mines. Despite the increase, county population declined significantly. The county had 1,900 residents in 1930 and only 1,400 in 1940.[432]

The strong interest in gold inspired ventures that varied widely in scale and sophistication. Some of the older miners searched their memories to recall likely sources of gold. Those without capital considered the idle mills that specialized in separating the gold content from ore whose leftover concentrates might be an easy source of the metal. In 1932, Forest Goody used a placer machine to recover gold from tailings at the Gold King Mill. Two years

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[431] Robert S. McElvaine, *The Great Depression: America, 1929-1941* (New York: 1993): 164; Saxon, 1959: 7-8, 12, 14, 16.
[432] Schulze, 1977: 1930; Schulze, 1977: 1940. The number of mines was derived from a survey of Colorado Mine Inspectors' Reports.

later, unemployed individuals prospected the Silver Lake Mill site with some success. Other miners returned to the impoverished gold placers around Eureka and in Cunningham and Arrastra gulches and gleaned gold. Organized companies joined the return to placer mining and in 1934, rehabilitated the Buffalo Placer near Eureka with hydraulics.[433]

In terms of established hardrock mines, the Shenandoah-Dives continued to be the foundation of the county's economy and its largest employer. Chase's miners consistently proved that the veins under North Star Peak featured more low-grade ore at greater depths than previously suspected. Chase believed the Silver Lake Basin offered similar deposits, and that they would significantly increase the available reserves of payrock and hence extend the life of the mine. In 1937 or 1938, he commissioned the Silver Lake Cross Cut, intended to encounter the Silver Lake Vein first, followed by other mineralized formations. Miners bored the crosscut around the clock for several months before trouble swept the Shenandoah-Dives company.[434]

Chase had tried to reduce operating costs by demanding concessions from the workforce, but the miners and mill workers were unwilling to concede. The parties came to a stalemate in 1939, and the workers, who were thoroughly unionized, threatened to strike, which would have been disastrous to both sides. Chase figured that the threats were idle, and if not, such an action would be short-lived because the miners had no other hope of employment. He miscalculated, and the entire workforce struck in June and shut down the mine. Although unintentional, this caused independent companies that relied on the Mayflower Mill for custom concentration to falter. Residents in the county became polarized, but because Shenandoah-Dives miners and their sympathizers made up a majority of the population, the strike continued through the summer. Backed by investors with deep pockets, Chase waited out the workers fearful of losing their jobs. By the end of summer, the workers grew tired of their reduced union compensation and voted to return to work with no concessions. The union flexed its muscle, but Chase was now free to resume production on a greater scale then ever.[435]

By 1940, Chase's miners finally reached the Silver Lake Vein after thousands of feet, and the vein not only featured ore, but some of the material was higher in grade than expected. Chase originally had a lease agreement with ASARCo, and when ASARCo realized just how much ore Chase found, the company became keenly interested in mining its own property. Adept at business as well as mining, Chase secured a reverse lease arrangement where ASARCo paid him to use the Mayflower Tunnel as a point of access for the Silver Lake ground. The deal was a good one for Shenandoah-Dives. ASARCo provided royalties, maintained the crosscut, drove additional development workings, and assumed the financial risks should the Silver Lake and adjacent veins not pan out as hoped. The contract provided the Shenandoah-Dives company with income for eight years.[436]

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433 Colorado Mine Inspectors' Reports: Gold King; *Minerals Yearbook*, 1935: 229, 231; *Minerals Yearbook*, 1936: 268.
434 Colorado Mine Inspectors' Reports: Mayflower.
435 *Durango Herald Democrat* (6/29/39); *Minerals Yearbook*, 1940: 277; *Silverton Standard* (7/14/39).
436 Colorado Mine Inspectors' Reports: Silver Lake; *Minerals Yearbook*, 1942: 340.

The Silver Lake Crosscut was important for several reasons in addition to improving the profitability of the Shenandoah-Dives company. The passage increased ore production contributing to the local economy at a critical time. As the Great Depression dragged on, the meager revival in the county began to wane as miners cleaned out the last vestiges of ore from the handful of properties in production. For a brief time, it appeared that the Sunnyside Mine would fill the void left as independent mines began to close.

In 1937, the Sunnyside company announced that it was reopening its enormous mine, which created a furor of excitement. The company hired a crew of 177 workers, to prepare the surface facilities and underground workings. By September, the mine generated so much ore that it attained the status of Colorado's largest gold producer for 1937. The company did not convey, however, that the accessible ore reserves were almost gone and extensive work required to develop more. Imitating Chase, the company commissioned a deep tunnel from Eureka to undercut the entire property from the lowest elevation possible, but such a project required years. The existing ore bodies would not last that long at the current rate of production, and were in fact gutted within two years. The Sunnyside company was unwilling to pour money into the tunnel without returns from the rest of the mine. In 1939, as soon as the ore was gone, the company laid off the workforce, suspended the deep tunnel, and permanently closed the mine.[437]

The trend that the mining industry followed during the early 1940s originated in the Depression-era revival. Beginning in 1939, the county saw a wave of mines close because there was no longer enough low-grade ore even to sustain subsistence. And yet, from a broad perspective, the county's production figures remained deceivingly high because of the outstanding efficiency of the Shenandoah-Dives company. Depending on sources, by 1941, the county featured between ten and twenty-four active mines that produced less than $100,000 in metals, not including the Shenandoah-Dives. These figures did not fill ASARCo with confidence that it would be able to reopen the idle Durango Smelter. ASARCo mothballed the smelter at the beginning of the Great Depression due to a lack of ore and patiently waited for mining to resume. When the volume of ore and concentrates did not increase, the company dismantled the smelter in 1941. Although the smelter had been idle for years, its loss assured that the possibility of another meaningful revival was remote.[438]

Las Animas Mining District

For much of the county's history, the Las Animas Mining District seemed to offer endless ore reserves. In reality, however, the most extensive ore reserves lasted around fifty years, already an impressive span of time. But when the Great Depression began, nearly all veins had been exhausted of even their low-grade payrock, leaving little even for subsistence mining. Because of this, nearly all mines remained quiet and the Depression-era revival passed the

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[437] Burbank and Luedke, 1969: 56; Colorado Mine Inspectors' Reports: Sunnyside; *Minerals Yearbook*, 1938: 276; *Minerals Yearbook*, 1939: 303.

[438] A survey of Colorado Mine Inspectors' Reports suggests ten active mines, although the 1941 *Minerals Yearbook* (p. 298) claims the figure was twenty-four.

district by. And yet, several properties seemed to offer enough potential to interest several successful ventures.

One was the Mabel, whose gold ore had been forgotten since around 1890. The mine was small and isolated in Deer Park at the district's southwestern corner. F.R. Steelsmith and others examined the property and found that the free-gold ore was largely gone, but the complex material would be profitable if a mill could be erected at the site. Building a mill was a challenge, however, because the mine was accessible only via pack trail. In 1933, Steelsmith organized the San Juan Mining Company and bought the property. In 1934, the mining crew used mules to drag in the components for a compact but highly functional surface plant and a small mill powered by a gasoline engine. The following year, manager J.B. Tusant began operations, and the mill recovered some gold bullion and generated concentrates. The workers returned on a seasonal basis until the mine finally closed in 1940.[439]

Concurrently, C. Lorimer Colburn examined the Trilby Mine at the mouth of Dives Basin. Dan McLean was the last to work the property around 1917. Colburn understood that some deep veins offered enough gold to support a limited operation, and he was careful not to stray into the adjoining claims purchased by Charles Chase. Colburn was a trained engineer who spent much of the 1910s working for the Bureau of Mines. In 1934, he returned to private industry as president of the Highland Mary Mining & Milling Company. Colburn entertained the idea of reopening the Highland Mary as well, but remained unable to convince his backers. In 1936, Joseph M. Bradley replaced Colburn as president and had better luck convincing investors. Either Bradley or Colburn, who remained as engineer, offered them a plan to extract ore from the Trilby and apply the proceeds to the Highland Mary. Bradley hired a large crew who rehabilitated the surface plant, upper workings, and portions of the lengthy Innis Tunnel. By 1939, Bradley brought the Highland Mary back into production and trucked the ore to the Mayflower Mill for concentration.[440]

As the company's situation improved, Bradley instituted several improvements to lower operating costs. He insisted on a new mill to prevent profit loss by sending the ore to the Mayflower. Bradley also found that the best ore was located in the mine's midlevel workings, which had no direct connection with the surface. Instead, miners had to haul the payrock out through a maze of passages and then down to the proposed mill. This inefficiency could be remediated by a new tunnel bored directly into the midlevel workings. In 1940, Bradley refit the existing mill with modern equipment, and the metallurgist proved his expertise by designing a facility that successfully recovered metals from the start. Bradley bored the new Bradley Tunnel and built a tramway down to the mill. By year's end, the operation was in full production and assumed the role of one of the county's most important mines.[441]

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[439] Colorado Mine Inspectors' Reports: Maybell; ***Mines Register***, 1937: 830.
[440] Colburn, 1936; Colorado Mine Inspectors' Reports: Highland Mary; ***Mines Register***, 1937: 409.
[441] Colorado Mine Inspectors' Reports: Highland Mary; ***Minerals Yearbook***, 1941: 311.

Eureka Mining District

After more than fifty years of activity, the Eureka district mines were bankrupt of easily accessed payrock, and few outfits were willing to risk the capital required to extract the meager amounts of ore that lay deep in the underground workings. As a result, the Eureka district was relatively quiet during the Depression-era revival, except for the principal mines on the east wall of Cunningham Gulch. The Green Mountain had been quiet since the late 1910s, but the Pride of the West was never fully abandoned. When the Great Depression began, owner A.W. Harrison kept several miners employed maintaining the property and conducting minor work underground to maintain title to the claims. Thomas B. Stearns and Tyson S. Dines were aware that both mines still possessed gold ore, and because they were adjoining properties on the same general ore system, the two mines could be worked as one. Dines backed several companies during the World War I revival and acquired a number of mines in the district during the 1920s. Stearns lived in Denver, invested heavily in mining during the Great Depression, and had ample resources from his connections with the machinery manufacturer Stearns-Roger. When President Roosevelt signed the Gold Reserve Act into law in 1934, the partners quickly organized Pride of the West, Inc.

The new company hired sixteen miners who conducted the usual rehabilitation work and built a new tramway to a loading station on the road to Howardsville. Within the year, they started trucking ore to the Mayflower Mill while metallurgists attempted to refit the mill that a predecessor company erected in 1928. By 1936, the company finished the mill and pulled the Green Mountain into the operation. Crews divided among the two mines generated thirty tons of ore per day from the Green Mountain and fifty at the Pride. The company eagerly anticipated running the refitted mill at capacity, but the troublesome ore of Cunningham Gulch thwarted efficiency, even with flotation. Dines directed miners to ship the payrock to the Mayflower Mill while an engineer resolved the metallurgical issues. By 1938, miners exhausted the ore worth shipping, and Dines suspended further work until the mill was back on line.[442]

The answer to the ore problem was clear but costly. An entirely new set of machinery was required, and the metallurgist recommended building a dedicated mill anew instead of adapting the existing plant at the Pride. Dines and Stearns decided that if they were going to pay for a new mill, they would offset the cost by soliciting custom concentration in addition to processing payrock from their own operation. For this reason, they chose Howardsville as the site, and Dines reorganized the company in 1940 to allocate capital.[443] The Pride company pushed mill construction through 1940. When tested, it was so well-engineered and orderly, the local mine inspector came away impressed after an examination. To make up for lost time, the company resumed heavy production and ran the mill at capacity. The operation passed into World War II as one of the county's largest producers.[444]

[442] Colorado Mine Inspectors' Reports: Pride of the West.
[443] Colorado Mine Inspectors' Reports: Green Mountain, Pride of the West.
[444] Colorado Mine Inspectors' Reports: Pride of the West.

While Dines and Stearns prepared to work the Pride of the West in 1934, John Gilheany watched from above while he did likewise at the Philadelphia upslope. The Philadelphia lay dormant for decades, until Gilheany signed a lease in 1934, began limited operations, and shipped ore to the Mayflower Mill. He reinvested some profits in improvements, which allowed him to bring yet more payrock out of the workings. By 1936, Gilheany doubled his crew to eight and maintained sound production through 1940, when work suspended.[445]

In 1934, Charles H. Kimball of West Virginia, backed by investors from Pennsylvania, purchased the Old Hundred Mine with the expectation of high returns. They organized the Old Hundred Gold Mining Company, bringing the old, upper workings into production first and applying the income toward developing the lower reaches of the vein. In 1935, the company hired a workforce of ninety, rehabilitated the entire property, built new buildings at the lower tunnel, and engaged in exploration. When the company deemed the mine was ready, fifty miners generated payrock while thirty workers ran the mill and surface facilities. In 1937, the operation collapsed, due to insufficient ore.[446]

In addition to old mines, several organizations from the district's past resuscitated during the Depression-era revival. The increase in gold and silver values brought Edmond C. Van Diest to reconsider the Fredericka and Ridgeway mines, which he initially developed during the early 1900s under the Eureka Exploration Company. Van Diest reorganized the outfit as the Metals Exploration Company, and in 1936 worked first the Fredericka and then the Ridgeway. The Fredericka was a short-lived affair that lasted for one year. The Ridgeway was more intensive and represented the emerging trend for companies to sort waste rock without ever reopening a mine's underground workings. In 1937, W.C. Service established the Ridgeway Gold Mining Company and leased the Ridgeway exclusively to recover low-grade ore from the waste rock dump. Service found that there was enough material to justify a tramway, which extended one mile to the road in Maggie Gulch. By 1938, Service ran out of waste rock and reopened the underground workings after all. He shipped 10 tons of payrock to the Mayflower Mill per day through the rest of the year.[447]

C.R. Walker reopened the Mountain Queen according to a similar pattern. In 1938, he leased the property from owner Tyson Dines, bulldozed an access road, and hauled off waste rock as low-grade ore. When this was gone by 1940, Walker hired five miners who installed a hoisting system and reopened the shaft. In 1941, they conducted exploration and found stringers of ore missed during the mid-1920s. These small chutes sustained minor production into World War II.

Mineral Creek Mining District

Although Silverton was center to the county's mining industry, it was unable to legitimately claim the title of true mining town until the 1890s, when the large mines on Sultan

[445] Colorado Mine Inspectors' Reports: Little Fannie.
[446] Colorado Mine Inspectors' Reports: Old Hundred; *Minerals Yearbook*, 1937: 333.
[447] Colorado Mine Inspectors' Reports: Fredericka, Ridgeway.

Mountain employed armies of miners who established residence there. In 1920, the mines closed and workers moved on, but Silverton remained a mining town in spirit. In 1935, Silverton reclaimed its status when Warren C. Prosser reopened the Hercules and North Star properties.

Prosser was an experienced mining engineer who worked in Colorado, and especially the San Juans, over several decades. He was also a gifted writer and contributed articles regularly to mining periodicals. He understood the difficulties of mining in San Juan County, especially how problematic the ore was, and yet he bought one of the most troubled properties. In particular, Prosser purchased the North Star after it closed in 1921. At the end of the decade, he organized the North Star-Sultan Mining Company and gradually rehabilitated the Sultan Tunnel, surface plant, and mill. His goal was to make the mine attractive to lease, but the Great Depression delayed interest.[448]

In 1934, with the values of gold and silver high, Prosser organized the Mystery Gold Mining Company and bought the adjacent Hercules complex. The North Star had surface facilities and an operational mill, and the Hercules greater potential to offer ore. Prosser aggressively pursued the lease idea, hired a large workforce, and began developing both properties through the Sultan and Hercules tunnels. In 1936, Prosser added the Little Dora and expanded his project to include linking all three mines.[449] Prosser leased out blocks of ground as quickly as his miners could condition them. In 1936, Intermountain Shares, Inc., managed by Bill Rich, worked the Wheal Alfred Mine with great success. At the same time, the Culver Leasing Company, backed by Dale Culver, produced soundly from the Little Dora and Hercules veins. Small parties worked other sections, and Prosser's own miners also produced regularly. In 1939, Roy Blakely sorted through the waste rock dump at the Empire Tunnel for low-grade payrock. None of these outfits, however, including Prosser's, remained operational by 1940.[450]

A handful of other ventures scattered elsewhere in the Mineral Creek district provided employment and some ore during the Depression-era revival. Since 1927, J.E. Carney and Thomas H. Woods tinkered with the Brooklyn, on the west side of Anvil Mountain, and hoped to bring the property into production some day. In 1935, Carney and Woods established the Brooklyn Mining Company, improved the surface facilities, and began shipping payrock. By 1936, they were successful until miners brought out the last of the ore in 1941. The Bonner joined the Brooklyn in 1936, producing regularly until 1940. Otto Anesi was the first to work the Silver Ledge since it closed in 1920. With little capital, he was unable to unwater the shaft, however, and was limited to the mine's upper levels. He generated small amounts of ore in 1939 and 1940. The Bandora Mine was still owned by the Sullivan family, which leased the remote property to Wilbur Maxwell & Associates in 1936. Maxwell rehabilitated the mine, produced payrock, and then turned the property over to the Blanco Mining Company in 1938. Blanco realized minor profits until 1940.[451]

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[448] Colorado Mine Inspectors' Reports: North Star.
[449] Colorado Mine Inspectors' Reports: Little Dora, North Star.
[450] Colorado Mine Inspectors' Reports: Little Dora, North Star.
[451] Colorado Mine Inspectors' Reports: Bandora, Brooklyn, Silver Ledge; ***Minerals Yearbook***, 1937: 333; ***Minerals Yearbook***, 1941: 311.

World War II, 1941 - 1945

During the early 1940s, a combination of domestic and international events created a socio-economic environment that made mining perhaps even more difficult than during the Great Depression. The world slipped into war just as the United States showed signs of a long-awaited economic recovery. The improving economy coupled with mobilization for another sweeping conflict fostered a renewed demand for industrial metals and other minerals. On the surface, this seemed to offer the mining industry hope for a recovery. When the United States was drawn into World War II following the December 7, 1941 attack on Pearl Harbor, the federal government initiated programs to organize and control economic, material, and labor resources for the mobilization effort. With domestic resources of supreme importance, the government passed legislation addressing mining. War Production Board Ruling L-208, much to the dismay of mine owners across the west, mandated suspension of gold mining by October 1942 on grounds that it did not contribute to the war effort. Other 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 ascended to record levels, such that the War Production Board placed price caps to prevent profiteering. Finally, the Reconstruction Finance Corporation and Smaller War Plants Corporation, federal agencies, provided low-cost loans to mining companies willing to reopen idle mines and prospect for new metal deposits.[452]

The three rulings were not necessarily beneficial to San Juan County. Without being able to produce gold, many mining operations suspended work. Others skirted the issue by claiming their focus was industrial metals and any gold realized was a byproduct. Companies merely had to demonstrate that their ore possessed high percentages of industrial metals, which many did. The low-cost loan program had little impact locally, because few, if any, companies used the program to reopen mines, suggesting that the ore was impoverished. Price caps had the greatest impact, diminishing financial incentive to produce ore. As a result, World War II was not a time of recovery for the county as it was for other mining regions in Colorado, and in fact the industry regressed from the previous period. Between 1942 and 1945, the county possessed only two prospects, nine small outfits, four medium-sized mines, and two large producers, one-third the outfits operational during the Great Depression. Ore production, largely from the Shenandoah-Dives, increased slightly. Government statisticians noted that nationwide production of gold and silver fell to their lowest points since 1935.[453]

The Shenandoah-Dives, Highland Mary, and Pride of the West mines were the three largest producers in the county during the war. Not only did their operators contribute the bulk of the county's output, but they anchored the rest of the industry. In particular, each company ran a concentration mill and accepted ore from independent outfits on a custom basis. In so doing, they filled the void created when the Durango Smelter closed. Concentrates subsequently shipped by

[452] *Minerals Yearbook*, 1942: 80; Saxon, 1959: 17.
[453] *Minerals Yearbook*, 1942: 79. The number of active mines was derived from a survey of Colorado Mine Inspectors' Reports.

rail to the Golden Cycle Smelter in Colorado Springs or to the A.V. plant in Leadville. Without local ore treatment, the handful of independent companies may not have been able to remain in business.

The Shenandoah-Dives continued as the most important county employer, with the Highland Mary a distant second. Charles Chase ran the Shenandoah-Dives like the ore factory that it was. Joseph Bradley pursued a similar course at the Highland Mary on a smaller scale. The Pride of the West was among those mines that realized profit from gold but was able to continue production because its ore met War Production Board criteria for industrial metals content. Manager Fred A. Brinker maintained maximum production and in 1942 reopened the Green Mountain. To accommodate the higher volume of ore, Pride of the West, Inc., increased capacity at the mill at Howardsville. During the war, the company employed around sixty workers and processed 100 tons of ore per day.[454]

Previously quiet, the Cement Creek drainage attracted renewed interest. The Lark, a small mine on the west side of the drainage near the Henrietta, saw only minor development until World War II. In 1943, William H. Steel realized that the Lark Vein still offered ore and leased the property. Steel bulldozed a road to the Lark and began production with little preparatory work. He utilized the income and capital from the Lark Mining Company to buy the property, build surface facilities, and drive a lower tunnel. In 1944, the tunnel, linked with the rest of the underground workings and enjoyed a sound yield for the rest of the war.[455] The Lead Carbonate, amid the peaks east of Gladstone, also had escaped significant development during the previous sixty-five years of mining in the county. In 1940, owner Vaughn Jones reopened the tunnel and brought it into minor production, but suspended when the war began. He improved the surface plant in 1944 and began production on a meaningful scale. Jones continued through 1945, when he sold the property.[456]

Post-World War II Recovery, 1946 – 1954

The end of World War II marked a major turning point in the United States, a period of almost unrivaled prosperity. The economy soared as returning soldiers engaged in consumerism; coupled with post-war construction; and a nascent Cold War, which fostered demand for industrial metals on a huge scale. In theory, this climate should have stimulated mining. The increased value of metals was certainly an incentive. While the prices for gold and silver changed little, copper almost doubled to $.21 per pound, and lead and zinc more than doubled from $.06 to $.13 per pound. In tandem, improvements in mining and milling technology greatly reduced the cost of producing and treating ore.[457]

[454] Colorado Mine Inspectors' Reports: Green Mountain, Pride of the West.
[455] Colorado Mine Inspectors' Reports: Lark.
[456] Colorado Mine Inspectors' Reports: Lead Carbonate; ***Minerals Yearbook***, 1940: 306.
[457] Saxon, 1959: 9, 14, 16, 17, 37.

By contrast, the prices for silver and gold remained static, but their values relative to the dollar actually declined slightly because of inflation. In 1947, foreign nations successfully lobbied the federal government to reduce tariffs on imported industrial metals, which were completely repealed in 1950. Eight years later, the Paley Commission actively fostered mining overseas in hopes that countries with strong economic ties to the United States would not ally with the Soviet Union. Mining in the west had an increasingly difficult time competing.[458]

Another disincentive was the dwindling labor pool. Youth less frequently engaged in mining. As a result, the older miners did not find dedicated individuals interested in carrying on the tradition of hardrock mining. The greatest challenge, however, was the insurmountable argument that the veins in San Juan County were bereft of ore.

Cumulatively, these factors ended intensive mining in the county. Through the mid-1950s, the county enjoyed one last push of activity. During the latter half of the 1940s, the industry slightly recovered. Between 1946 and 1949, the county featured twelve prospects, twenty-five small mines, nine medium-sized operations, and three large producers. While the number of active mines paralleled the Great Depression, ore production doubled. During the depression, mining companies, anchored by the Shenandoah-Dives, generated between $900,000 and $1.6 million. By the late 1940s, the output ranged from $2.3 million to $2.7 million. In concert with increases in production and number of mines, the population of the county rose slightly. In 1940, 1,400 people resided in the county, rising by seventy by 1950.[459]

Statistics indicate that, during the early 1950s, the postwar revival began to wane. Between 1950 and 1954, the county had ten prospects, fifteen small mines, seven medium-sized operations, and one large producer. Ore production peaked in 1951 at $3.3 million and then dropped off as two important mines closed. In 1951, the Highland Mary suspended, and the county's yield decreased to $2.8 million. In 1953, the Shenandoah-Dives stopped producing ore, and county output plummeted to $816,000. When the mill stopped treating custom ore later in 1953, many of the county's mines closed, and total production dropped to $151,000. The Shenandoah-Dives, Highland Mary, and Pride of the West, flush with success from heavy wartime production, led the county's mining industry into the postwar recovery. These three operations changed little and joined new ventures organized in 1946 and 1947, primarily in the Eureka district.

<u>Las Animas Mining District</u>

The Osceola Mine was one of the first properties reopened in the Last Animas district after the war ended. The Osceola Vein, on the east side of Cunningham Gulch, had been prospected early in the county's history, but only the upper portion saw any work of substance. In 1946, O.L. Larson determined that the lower extent probably offered ore worth extracting and leased the mine under O.L. Larson & Associates. Larson then built a surface plant at the lower

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[458] Bunyak, 1998: 79; Saxon, 1959: 37, 39.

[459] Production figures from *<u>Minerals Yearbook</u>*, 1946-1950 and S.M. Del Rio, *Mineral Resources of Colorado: First Sequel* (Denver: State of Colorado Mineral Resources Board, 1960) 272. The number of mines was derived from a survey of Colorado Mine Inspectors' Reports. See Schulze, 1977: 1950 regarding population statistics.

tunnel, drove exploratory workings, and struck the vein. By 1947, he brought the mine into production and shipped ore to the Mayflower Mill. For unknown reasons, Larson did not return the next year. A.B. Crosby, who specialized in leasing proven mines, recognized enormous potential and assumed the lease. In 1948, he and J.H. Harvey organized the Osceola Mining & Milling Corporation to provide capital for more development and buy the Lackawanna Mill. A handful of miners generated around six tons of ore per day, processed the material in the mill. The operation changed hands in 1951 but remained a sound producer for several years.[460]

The Silverton Mining Company owned the Mighty Monarch at the base of Kendall Mountain, which it reopened in 1947 after it lay quiet for nearly fifty years. The ore was complex and high in zinc content. The company rehabilitated the lower tunnel, extracted ore, and shipped the material to the Mayflower Mill. The returns were poor, and in 1948 the company built a test mill of its own. Workers trucked in and assembled portable components and tried processing the ore with conventional methods. The ore proved too difficult, and the operation ceased. The mill removed elsewhere.[461]

The Little Nation ranked with the Osceola in importance. Beginning with Henry Frecker's work on the Royal Charter Vein during the 1900s, the mine saw a series of operators that invested more than they recovered. The principal reason was that the ore resisted concentration, including flotation, but was not rich enough to pay for long distance shipping to advanced mills. In 1942 and 1943, the Mermac Mining Company trucked ore to the Mayflower Mill, but this was not economical. When values increased following World War II, the Royal Charter ore became profitable to produce. In response, the Little Nation Leasing Company leased the mine in 1947 and became the first outfit to work it on a profitable basis for a sustained period. The company ignored the surface facilities, tramway, and mill at Howardsville, so carefully designed in the 1920s, and instead brought in portable equipment. Workers bulldozed roads and began trucking ore to the Mayflower Mill. The operation remained small, but profitable, until the Mayflower Mill stopped accepting custom ore in 1953.[462]

Eureka Mining District

The Eureka Mining District hosted the greatest number of mining ventures following the war. The northern portion, in particular, saw a number of old mines reopened. The region attracted little interest after the late 1890s revival and so still had low-grade ore to offer. The Burrows Mine initially developed by the McIntyres of Animas Forks during the mid-1870s, reached its potential in 1947. At that time, H.G. Knapp & Associates leased the claim, which featured only an open-cut and a tunnel. Knapp bulldozed a road, brought in portable equipment, and began extracting ore. Miners then drove a lower tunnel to develop deeper portions of the vein and enjoyed seasonal work until 1953, when the Mayflower Mill closed.[463]

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[460] Colorado Mine Inspectors' Reports: Osceola; *Minerals Yearbook*, 1947: 1371.
[461] Colorado Mine Inspectors' Reports: Mighty Monarch.
[462] Colorado Mine Inspectors' Reports: Mermac; *Minerals Yearbook*, 1948: 1465; *Minerals Yearbook*, 1953, V.3: 270.
[463] Colorado Mine Inspectors' Reports: Burrows.

The Columbus Mine near Animas Forks saw more activity in the few years after World War II than in the decades prior. William Erikson reopened the mine in 1943 to meet wartime demand for industrial metals and found the property a ready-made producer. The mine featured a haulage tunnel driven to the Columbus Vein at the turn of the century, but the vein lay fallow because the ore was low in grade. By the 1940s, trucking and the Mayflower Mill rendered the ore profitable, and Erikson brought the mine into production. He gradually increased the workforce during the war, and afterward hired more. In 1947, Erikson's crew generated fifty tons of ore per day, but trucking consumed so much money, Erikson considered building a concentration mill. In 1950, he finally erected a small plant at the mine, but was a little late to maximize the benefit that it provided. He ran the mill through 1951, when his miners exhausted the ore reserves underground. Exploration conducted in 1952 failed to find more payrock, which forced Erikson to close the mine and dismantle the mill.[464]

The Gold Prince Mine reopened, nearly fifty years after the monumental failure of the Gold Prince Mines Company. The Sunnyside Mining Company bought the property in 1917 for the Sunnyside Extension Vein, which the company worked at depth prior to closing in 1930. The vein's upper, northeastern section still offered low-grade ore, which attracted the Venture Leasing Company in 1951. Company principal William Gianetto understood the ore was complex and might not be profitable, so he distributed small batches to different mills for testing. William Gianetto grew satisfied that he had found a process that would concentrate the ore. He purchased the Slick Rock Mill at Ouray and rebuilt it on the old tramway terminal foundations at the mine. In 1953, Gianetto began operations, but shortly afterwards ceased. Perhaps the mill did not recover the metals content Gianetto hoped for, or the Mayflower no longer accepted his concentrates. For some reason, he did no further work at the property.[465]

W.L. Chase exemplified the practice of serial leasing common in the county. In 1947, his Great Eastern Mining Company leased the Great Eastern, Silver Wing, Sioux City, and Klondyke, all in and around Burns Gulch. Moving from one property to the next, a crew of nine miners conducted exploratory drilling, extracted shallow ore, and planned to develop the deeper reaches of the veins through the Silver Wing Tunnel. By 1950, the company aggressively developed the area's veins and leased the Pride of the West Mill at Howardsville to process ore. During the year, a crew of thirty-six generated 100 tons of ore per day, and although the volume fell during 1951, the operation was productive until it suspended in 1954.[466]

The Great Eastern Mining Company leased the Pride of the West Mill in 1951 after the owner, Pride of the West, Inc., ran out of ore in both the Pride and Green Mountain mines. As noted, the Pride company was among the three largest and most consistent producers in the county through the Great Depression and post-war recovery years. Emulating the familiar pattern, the Pride ore system had a limited amount of payrock, and company directors paused to consider their options. At the end of 1950, after fifteen years of heavy production, the company

[464] Colorado Mine Inspectors' Reports: Columbus; *Minerals Yearbook*, 1950: 1459.
[465] Colorado Mine Inspectors' Reports: San Juan County, Gold Prince.
[466] Colorado Mine Inspectors' Reports: Great Eastern.

discharged most workers and stopped the mill. To keep some income flowing in, the company leased the mill to Great Eastern and the mines to several small parties. In 1954, the company halfheartedly attempted to operate the Pride and hired a small crew of eight miners, who worked alongside almost as many lessees. By 1955, the company withdrew, leased the Pride mine and mill, and closed the Green Mountain Mine entirely.[467]

The Old Hundred Gold Mining Company was among the last outfits to operate an aerial tramway in the county. In 1948, the Old Hundred company bought its namesake mine and the Gary Owen with the intent of operating them together. The outfit rehabilitated the mill and tramways to both mines and enjoyed successful production for several years. Because the mill was able to process only some of the ore, miners trucked additional material to the Mayflower plant. When the Mayflower closed, the Old Hundred company lost a significant share of its revenue stream and suspended operations.[468]

Cement Creek Subdistrict

The Cement Creek drainage enjoyed its highest level of activity since the late 1890s immediately following World War II. The Lead Carbonate and Lark mines anchored the activity. Vaughn Jones operated the Lead Carbonate through the war and demonstrated its capacity as a sound and reliable source of ore. In 1946, he sold the property to H.P. Ehrlinger, Fred Archibald, and John Archibald, all experienced leasing other mines in the county. The new owners prepared the mine for production by erecting new facilities, including an ore concentration mill at Gladstone. Ehrlinger and partners produced and milled approximately fifty tons of ore per day through 1952 and then leased the entire operation to the Bonita Mining Company. The mill allowed the company to survive when the Mayflower plant closed. The mill earned additional income by treating some custom ore for local independent outfits. In 1955, Wyoming Tungsten Mines assumed the lease, ran the mill through the next year, and then shut down the mine.[469]

William H. Steel's Lark Mining Company converted the Lark from a shallow prospect into a sound producer, and Steel ran the mine into the post-war recovery period. In 1947, his other company, the U.S. Oil & Development Company, absorbed the Lark. U.S. Oil had much greater financial resources, which Steel directed toward the adjoining Henrietta and Ohio mines. In 1950, Steel acquired both complexes, shut the Lark down, and sent his miners to the Henrietta. At the same time, he leased the Ohio to Ed Walby and Milo Williams. Walby and Williams remained committed to the economy of tramways, which they repaired and used the double-rope system at the Ohio. Meanwhile, Steel's miners generated twelve tons of ore per day in the Henrietta until 1954, when he suspended the Henrietta, but leased the Lark to the Columbine Leasing Company and subsequently the Ruhter Mining Company.[470]

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[467] Colorado Mine Inspectors' Reports: Pride of the West; ***Minerals Yearbook***, 1949: 1439; ***Minerals Yearbook***, 1951: 1469.
[468] Colorado Mine Inspectors' Reports: Garry Owen; ***Minerals Yearbook***, 1950: 1459; ***Minerals Yearbook***, 1952, V.3: 238.
[469] Burbank and Luedke, 1969: 60; Colorado Mine Inspectors' Reports: Lead Carbonate; ***Minerals Yearbook***, 1946: 1408.
[470] Colorado Mine Inspectors' Reports: Henrietta, Lark, Ohio.

Mineral Creek Mining District

The post-war recovery did not impact the Mineral Creek Mining District to the same degree as the rest of the county. Most activity focused on modern prospecting and small leases, confirming that the mines had little profitable ore left to offer. Although the North Star and a few others remained active, they operated for brief periods by limited parties. The Silver Ledge was the only to yield briefly a significant amount of ore. During World War II, Joseph Bradley purchased the Silver Ledge, but because the Highland Mary consumed his attention, Bradley did little with the Silver Ledge except lease it to the San Juan Mining & Milling Company in 1947. The company used core drills to prospect the vein to the north of the shaft and located ore. Instead of encountering payrock within the vein, the company discovered a completely new formation on the vein's west side. The new formation was so close to the surface that the company could extract ore with heavy equipment instead of incurring the high cost of underground development. With bulldozers and power shovel, the company stripped away the overburden in 1949, exhumed high volumes of payrock, and trucked the material to the Mayflower Mill and the American Zinc Mill at Ouray. The operation lasted three years, when the Silver Ledge saw no further activity.[471]

Coda

Although the Shenandoah-Dives Mining Company closed the Mayflower Mill in 1953, the mining industry in the county slowly atrophied. From the mid-1950s onward, the industry was highly unstable and dissipated in importance. The statistics for the latter half of the 1950s reflect this decline. The county's output fluctuated wildly between a high of $537,000 in 1956 and a low of $36,000 in 1961. Because the Shenandoah-Dives and Mayflower were idle, these figures represent the volatility of independent outfits. Between 1955 and 1959, the county featured only seventeen prospects, nine small mines, two medium-sized operations, and one large producer, among the fewest in the county's history.

Finding ore became increasingly difficult after seventy-five years of prospecting and production, for the payrock truly was exhausted in most known mines. Those companies that stayed in business employed strategies of mobility and serial leasing rather than allegiance to specific properties. The companies specialized in secreting out small pockets of high-grade ore scattered throughout the county. To do so, companies used drilling programs, portable equipment, and experts to chase ore reserves as they could. Because most pockets lay within known veins, most activity remained in the historic centers.

The Argyle Mining & Milling Company and Technical Services Company were among the county's typical outfits during the 1950s. Barney Blackmore organized the Argyle company around a lease he obtained on the Pride of the West. In 1954, Blackmore trucked his ore to the Pride of the West Mill, which he also ran beginning in 1955. At the same time, the Osceola Mine came up for lease. Blackmore and partners realized they could operate both mines and lease the

[471] Colorado Mine Inspectors' Reports: Silver Ledge; *Minerals Yearbook*, 1947: 1465.

Pride of the West Mill to treat the ore. The Argyle company also accepted custom payrock for treatment from other outfits. The arrangement generated surplus capital, which the company applied to exploration of other properties, including the Black Hawk Mine in the Cement Creek drainage. Most went bust, but the Argyle produced small lots of ore for brief periods of time from disparate leases. In 1958, the Pride company left the mining business altogether and offered the Argyle company its property. Two years later, however, during a brief spike in interest in the region's mines, the Argyle company also left the mining business.[472]

While Blackmore's miners extracted ore from the Osceola Mine in 1955, the Technical Services Company did likewise from another section of the property, which it leased. J.C. Grant established the company, popularly known as Tec-Ser, early in the 1950s to conduct drilling and minor property development. The company moved toward speculation and eventually became interested in leasing mines. The Osceola was among the company's most successful operations and yielded ten to twenty tons of ore per day, which was also shipped to the Pride Mill. Argyle and Tec-Ser speculated with the same properties at different times, such as the Black Hawk leased by Argyle in 1955 and by Tec-Ser the following year. Tec-Ser also worked the Lucky Jack, Caledonia, and other properties for brief times. In 1957, the company left the region.[473]

In the late 1950s the Mayflower Mill announced reopening. The Shenandoah-Dives company had suspended operations in 1953 because it was out of ore and lacked capital to develop new formations that geologists discovered through sample drilling. To secure capital, the organization merged with the Marcy Exploration Company, a uranium company in Durango, forming the Marcy-Shenandoah Corporation in 1957. The company reopened the mill to custom business, which caused a surge of excitement among mining outfits still in existence. This proved short-lived, however. The company shut down the mill almost immediately because the mining industry could not provide enough ore to offset operating costs.[474]

Mining interests in the county interpreted the mill closure as a sign that Marcy-Shenandoah was canceling its plans. As a result, most outfits suspended operations. Marcy-Shenandoah, however, prepared to refit the mill, bring the Shenandoah-Dives Mine back into production, and complete deep development that the Sunnyside company had abandoned in 1938. The Shenandoah-Dives Mine would serve as a temporary source of ore, and the deep workings on the Sunnyside property meant to provide a long-term stream of payrock. In 1959, Marcy-Shenandoah leased the Sunnyside from ASARCo and drove the American Tunnel to strike the Sunnyside and Washington veins under Lake Emma. Unlike the old Sunnyside company, Marcy-Shenandoah did not site the tunnel at Eureka, but instead started from the Gold King Tunnel at Gladstone. Marcy-Shenandoah enlarged the tunnel, and renamed it the American. But before Marcy-Shenandoah made progress, it sold to the Standard Uranium Corporation, based in Moab, Utah, in 1960. Standard Uranium reorganized as Standard Metals to include the new assets and pushed ahead with the original plan.[475]

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[472] Colorado Mine Inspectors' Reports: Osceola, Pride of the West; *Minerals Yearbook*, 1955, V.3: 284; *Minerals Yearbook*, 1957, V.3: 301; *Minerals Yearbook*, 1958, V.3: 238.
[473] Colorado Mine Inspectors' Reports: Lucky Jack, Osceola; *Minerals Yearbook*, 1957, V.3: 301.
[474] Bunyak, 1998: 80.
[475] Bunyak, 1998: 80; Colorado Mine Inspectors' Reports: American Tunnel; *Minerals Yearbook*, 1959, V.3: 238.

To provide immediate income, Standard Metals reopened the Shenandoah-Dives Mine and Mayflower Mill and worked them together. Miners sent some ore to the mill in 1960 and increased production in 1962. Meanwhile, workers drove the American Tunnel to the impressive length of two miles, connected it with the old Sunnyside workings, and began hauling ore out by the trainload. The volume was sixty tons per day in 1962, which continued to increase beyond the 800-ton record that the Sunnyside company established during the late 1920s. The American Tunnel was a complete success and funneled a constant stream of ore into the late 1970s. As a result, the county's yield increased to more than $4 million per year.[476]

During the 1960s, the number of active operations decreased to six small mines, one medium-sized outfit, and one large producer. Continuing the trend of the 1950s, these were based around limited pockets of ore and therefore tended to be short-lived and inconsistent.[477] From 1960 through the 1970s, independent outfits further waned in stability and production, and the county's mining industry became synonymous with Standard Metals. In 1970, a failed copper mine in Arizona bankrupted Standard Metals, and the Washington Mining Company assumed the American Tunnel. Washington continued heavy production until 1978, when weak ground in the highest workings collapsed and drew Lake Emma's waters into the mine. The day was fortunately Sunday, when no miners were at work, or they would have perished. The force of the water rushing through the passages and out the tunnel scoured the interior of the mine and destroyed nearly all structures and equipment. The operation never recovered, despite attempts by three successive companies to bring the tunnel back into production. The American Tunnel, the county's last significant mine, closed definitively in 1991.[478]

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[476] Colorado Mine Inspectors' Reports: American Tunnel, Mayflower; ***Minerals Yearbook***, 1960, V.3: 246.
[477] The number of active mines was derived from a survey of Colorado Mine Inspectors' reports.
[478] Colorado Mine Inspectors' Reports: American Tunnel; Henn, 1999: 35; Marshall and Zanoni, 1998: 203.

Section E 2: Mining and Milling Methods, Technology, and Equipment

Following is a discussion of the general methods and technologies used to find and extract metals from the hardrock and placer deposits of San Juan County. In many cases, specific methods and technologies correspond to particular periods of significance, while others apply over the course of the county's mining history from 1860 through 1991. This portion of the text has been adapted from Section E of a previous Multiple Property Documentation Form, *The Mining Industry in Colorado* (revised 2008).[529] This adaptation is with permission from authors Jay Fell and Eric Twitty. Content relevant to mining in San Juan County is presented in an edited format. Inapplicable property types from the statewide context were deleted. Embedded illustrations were removed in compliance with more recent National Park Service guidance.

Placer Mining

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 unusual physical circumstances and otherwise remains in its native state. Superheated fluids and gases associated with geothermal and magmatic activity tend to deposit gold in the forms of veins, replacement bodies, and disseminated deposits in rock formations. Typically, mountain-building events such as those that uplifted the San Juans created the fluids, gases, and the geologic conditions for gold ore, which often included other metals such as silver, lead, and zinc.

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 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 and then rivers.

Because erosion is an unending process, fresh gold was constantly freed from its parent veins while the older material continued to accumulate on the bedrock floors. Hence, fine gold

[529] Jay Fell and Eric Twitty, *The Mining Industry in Colorado Multiple Property Documentation Form* (Denver: Office of Archaeology and Historic Preservation, Colorado Historical Society, 2008).

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 San Juan County, prospectors and miners encountered three 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 stream flows, the gravel tended to be coarse, the gold particles large and rough, and the gravel beds thin.

Miners recognized the second type of deposit as a *river placer,* and it was created when streams introduced gold into the Animas River. The water 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. 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.

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 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 profitable quantities, he was ready to begin mining.

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 individuals who worked by hand, and by companies with complex systems that depended on infrastructures. River 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 streambeds, 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 and featured either several branches feeding into a trunk line or several parallel sluices. Common sluices ranged from 2' wide and as deep, to 4' wide and 4' deep. They stood on timber piers supported by timber or stacked rock footers and featured a relatively gentle gradient so fine gold was not washed off. 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 extensive deposits. 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 masse through sluices, where riffles often retaining mercury collected the gold. 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 and practiced in San Juan County, 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 great that miners were unable to swing 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 pressure box. The structure was basically a rectangular tank made of planks retained by stout framing at least 6' wide, 6' high, and 8' long. A pipe known as a penstock, often at least 24" 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.

Hardrock Mining

The Nature of Hardrock Ore Deposits

Although placer gold initially drew prospectors to San Juan County, it was hardrock ore that kept them in the region. In general, profitable minerals and metals found in the hard, metamorphic and igneous rock formations of the mountains constituted hardrock ores. In the county, the principal precious and semiprecious metals were silver and gold, while the principal industrial metals were lead, zinc, and copper. Uranium drew interest but saw little production, and a few companies extracted small tonnages of tungsten between 1900 and around 1920.

The common traits shared by most of the hardrock ores, which influenced how companies mined them, were the nature of the ore formations. Most of the ore formations were functions of the volcanism that built the San Juan 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, 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 San Juan County's geology, some understanding is necessary to appreciate how the mining industry extracted ore.

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 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, outcrops of quartz veins, dykes, unusual mineral formations, and minerals rich with iron. 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.[530]

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 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 digging prospect pits with pick and shovel, hauling soil samples to a body of water over rough terrain, and panning in cold streams. It seems likely that the French party discovered the Little Giant Mine with these methods.[531]

One of the greatest drawbacks to systematic panning was that it detected only gold but missed silver and industrial metals, which were actually San Juan County's claim to fame. To find minerals in addition to gold, prospectors scanned the stream gravel and other areas of exposed soil for what they termed *float*, or 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

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[530] Charles A. Bramble, *The ABC of Mining: A Handbook for Prospectors* (Santa Monica: Geology, Energy & Minerals Corporation, 1980 [1898]) 11-13; Robert Peele, *Mining Engineer's Handbook* (New York: John Wiley & Sons, 1918): 381-5; George Young, *Elements of Mining* (New York: John Wiley & Sons, 1946) 19-26.

[531] Bramble, 1980: 11-13; Peele, 1918: 381-5; Young, 1946: 19-26.

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.[532]

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 twelve and eighteen holes, 18” to 24” 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 stronger but more expensive dynamite. Until economic ore had been proven, the operation was classified as a *prospect adit* or *prospect shaft*.

Deep Exploration and the Development of Ore Bodies

A *prospect* differed greatly from a *mine*. A prospect was an operation in which prospectors sought ore. The associated workings ranged from groups of pits to shallow adits or shafts with as much as hundreds of feet of horizontal and vertical passages. 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, and then to profitable extraction.

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. San Juan County was no exception, and the methods fell into common patterns. The most elementary was converting the prospect into a mine once a company proved ore. Usually, the company hired a crew of miners who proceeded to enlarge the prospect adit or shaft and systematically block out the mineral body. At the point where a tunnel or shaft penetrated the formation, miners developed it 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.

[532] Ibid.

Mining engineers discerned between vertical and inclined shafts. One contingent of engineers preferred inclined shafts because 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 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 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*.[533]

Despite the hypothetical advantages of shafts and tunnels, 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 tunnels. 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 profitable, then the mining company carried out extraction through the adit.[534]

One additional, significant factor influenced the decision to sink a shaft instead of driving a tunnel. 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 San Juan County, the recognized hardrock claim was 1,500' long and 300' to 500' 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.[535]

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[533] Eric Twitty, *Riches to Rust: A Guide to Mining in the Old West* (Montrose, CO: Western Reflections, 2020) 36.

[534] Colliery Engineer Company, *Coal & Metal Miners' Pocketbook* (Scranton: Colliery Engineer Company, 1893) 257; International Textbook Company, *A Textbook on Metal Mining: Steam and Steam-Boilers, Steam Engines, Air and Air Compression, Hydromechanics and Pumping, Mine Haulage, Hoisting and Hoisting Appliances, Percussive and Rotary Boring* (Scranton: International Textbook Company, 1899) A40:8.

[535] *Morrison's Mining Rights*, Denver, CO, 1899:17, 20; Peele, 1918:1474.

The Mine Surface Plant

Driving underground workings required support from facilities on the surface. 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 had simple facilities. Regardless of whether the operation was small or 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 components.

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 a tunnel portal, and transportation arteries permitted the free movement of men and materials into and out of these openings. At tunnel operations, miners usually used ore cars on baby-gauge 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 tunnel 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.

Mines underwent an evolutionary process in which the discovery of ore, the driving of a prospect shaft or tunnel, 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.[536]

Surface Plants for Tunnels

The surface plants for tunnels and shafts shared many of the same components. Yet, because of the fundamental differences between these two types of mines, the designs and characteristics for each were different. Following is a list and description of the principal components found at most tunnel operations.

The Tunnel Portal

The tunnel 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 ingoing miner, and headroom had to be ample enough to house compressed air lines and ventilation tubing. Some mining engineers defined production-class tunnels as being at least 3½' to 4' wide and 6' to 6½' high, and anything smaller, they claimed, was merely a prospect adit.[537]

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,

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536 Eric Twitty, *Reading the Ruins: A Field Guide for Interpreting the Remains of Western Hardrock Mines* Masters Thesis (Denver: University of Colorado, 1999): 30-2.
537 Peele, 1918: 459; George Young, *Elements of Mining* (New York: John Wiley & Sons, 1923): 463.

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 logs were available.[538]

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. Mining engineers recognized the functionality of wheelbarrows but classified them as strictly serving the needs of subsurface prospecting because of their light duty.[539]

Outfits driving substantial underground workings required a vehicle with a greater capacity. The vehicle most outfits chose was the ore car, which consisted of a plate iron body mounted on a turntable riveted to a rail truck. Cars were approximately 2' high, 4' long, and 2½' wide. They held at least a ton of rock and 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 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 rails included 12, 16, 18, and 20 pounds per yard, and heavy rail weighed from 24 to 50 pounds per yard. Prospecting outfits usually purchased light-duty rail because of its transportability and low cost. Mining engineers erecting production-class transportation systems had miners use at least medium-duty rail because it lasted longer.[540]

The specific type of rail system installed by a mining outfit reflected the experience and judgment of management, the financial status of the company, and the extent of the underground workings. The basic system used in nearly all Colorado mines consisted of a main 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 spurs underground extending to tunnel faces, stopes, and ore bin stations. Substantial mines with extensive surface

538 International Textbook Company, 1899: A40-42.
539 Twitty, 2002: 36.
540 International Textbook Company, 1899: A40, 53; Young, 1923: 192.

plants also featured spurs on ground-surface extending 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 hand-tramming single-ore cars were the most cost-effective transportation at small and medium-sized operations. But at large mines, they strongly recommended pulling trains with 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. 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 San Juan County proved slow. Locomotives required special mechanical and electrical engineering, were too big for the tortuous workings of most mines, and required considerable capital. A small locomotive cost $1,500 and $7.50 per day to operate. 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.[541]

Upgrades to the rail line presented the engineer with additional costs. Mules were able to draw between three and five ore cars weighing approximately 2,500 pounds each, for which16-pound rails spiked at an 18" gauge proved adequate. But electric locomotives and their associated ore trains usually weighed dozens of tons, and as a result they required broad tracks of heavier rail. Mining engineers recommended that at least 20-pound rail spiked 24" apart on ties spaced every 2' be laid for small to medium-sized locomotives. Heavy locomotives required rail up to 40-pounds per yard spiked at 36" gauge. The reason for the heavy rails and closely spaced ties was that the machines pressed down on the track 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.[542]

Some 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 San Juan County's mining companies employed battery-powered locomotives because they were costly and required a recharging facility.

A few 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, had plenty of motive power, spread fresh air wherever they

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[541] General Electric Company, *Electric Mine Locomotives: Catalogue No. 1045* (Chicago: General Electric Power and Mining Department:, 1904) 23; Peele, 1918: 862, 871.

[542] Colliery Engineer Company, *Coal Miners' Pocketbook* (New York: McGraw-Hill Book Co., 1916): 767; International Textbook Company, *International Library of Technology: Hoisting, Haulage, Mine Drainage* (Scranton: International Textbook Company, 1906): A55, 6; International Textbook Company, *International Correspondence School Reference Library: Rock Boring, Rock Drilling, Explosives and Blasting, Coal-Cutting Machinery, Timbering, Timber Trees, Trackwork* (Scranton: International Textbook Company, 1907): A48, 2; International Textbook Company, *Mine Haulage: Rope Haulage in Coal Mines, Locomotive Haulage in Coal Mines, Mine Haulage Systems, Calculations, and Cars* (Scranton: International Textbook Company, 1926) 1; Young, 1923: 192.

went, operated on the ubiquitous 18" rail gauge, and did not require complex electrical circuitry. However, compressed air locomotives cost as much as their electric cousins and required a costly compressor capable of delivering air at pressures of 700 to 1000 pounds per square inch. Locomotives and the necessary improvements were well beyond the financial means of most of San Juan County's mining outfits. The companies continued the traditional method of pushing single cars by hand.

The Mine Shop

Every mine required the services of a blacksmith who maintained and fabricated equipment, tools, and hardware. The common rate for driving a tunnel with hand-drills and dynamite in hard rock was approximately 1' to 3' per 10-hour shift. Over the course of such a day, miners blunted drill-steels in substantial quantities, and for this reason, the blacksmith's primary duty was to sharpen those steels.[543]

To permit the blacksmith to work in foul weather, mining companies erected buildings to shelter the shop. The building tended to be small, simple, and rough, and operations lacking capital often relied on local building materials such as logs. Prospecting and mining outfits almost invariably located the shop adjacent to the tunnel portal or shaft collar to minimize unnecessary handling.

In general, blacksmiths required few tools but much skill for their work. A typical basic field shop consisted of a forge, bellows or blower, anvil, quenching tank, hammers, tongs, swage, cutter, chisels, hacksaw, snips, small drill, workbench, iron stock, hardware, and basic woodworking tools. Prior to the 1910s, outfits deep in the backcountry often dispensed with factory-made forges and used local building materials to make vernacular versions. The most popular type of custom-made forge consisted of a gravel-filled, dry-laid rock enclosure usually 3' by 3' in area and 2' high, and miners in forested regions substituted small logs. A tuyere, often made of a 2' 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.

The size of a shop and its appliances were functions of capital, levels of ore production, and era. The shops at small mines typically featured a forge and blower in one corner of the building, an anvil and quenching tank next to the forge, a work bench with a vice along one of the walls, and a lathe and drill press. The appliances were usually manually operated.

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 traditional facilities augmented with 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 4' x 4' free-standing iron pan model, a gravel-filled iron tank 4' in diameter and 2' high, or a 3' x 3' gravel-filled wood box. In addition to the above

[543] Herbert C. Hoover, ***Principles of Mining*** (New York: McGraw-Hill Book Co., 1909) 150; International Textbook Company, 1907:A48, 13; Peele, 1918: 184; Young, 1946: 87.

appliances, many shops at large mines were also equipped with a mechanical saw, grinder, and pipe threader, which may have been power-driven.

The physical composure of a shop building reflects the financial state of a mining company. In general, the buildings were rough and vernacular in design and construction. Vernacular is defined as an adaptation of conventional forms and construction to the conditions, function, capital, and materials available to the mining outfit. The buildings were rarely designed by professional architects and instead were planned to meet specific needs. Outfits with limited financing used local building materials while well-capitalized mining companies often erected frame buildings. Two traits shared by most shops were windows for natural light and earthen floors to minimize the risk of fire started by loose embers.

At large, substantial mines, the primary function of shop laborers continued to be drill-steel sharpening. But when compressed-air powered rock drills, used to bore blast-holes, became common during the 1890s, the sooty blacksmiths changed their sharpening methods. The noisy and greasy machines produced high volumes of dulled drill-steels and broken fittings. Contrary to today's popular misconceptions, San Juan County's mining outfits did not immediately adopt rock drills when they were introduced during the late 1870s. Instead, the conversion required thirty years, and during the period, blacksmiths became proficient in sharpening both hand-steels and machine drill-steels, each of which had specific requirements.[544]

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 costly and few were employed in San Juan County. The Silver Lake Mines Company was among the few organizations to use the early sharpeners. During the 1910s, rock drill 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 with increased frequency through the 1910s. Most companies with limited funds, on the other hand, continued to rely on traditional forge sharpening methods for decades afterward.

The most profitable mining companies equipped their shops with additional power appliances for advanced fabrication. The power hammer permitted a single blacksmith to complete work requiring a team of two. Well-capitalized companies installed factory-made models consisting 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. Those companies unwilling to buy the factory-made hammers instead adapted heavily worn but operational rock drills. The drill was fixed onto a stout vertical timber, and when a shop opened the air valve, the drill's chuck rapidly tapped an iron table.[545]

Mine Ventilation

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[544] International Textbook Company, *International Library of Technology: Mine Surveying, Metal Mine Surveying, Mineral-Land Surveying, Steam and Steam Boilers, Steam Engines, Air Compression* (Scranton, International Textbook Company, 1924) A24, 1.
[545] Twitty, 1999: 77.

The use of explosives, open flame lights, laboring miners' respiration, and natural gases often turned the atmosphere in underground workings into an intolerably stifling and even poisonous environment. Mining outfits approached this problem by installing one or a combination of two basic ventilation 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 production-class in duty and required elementary engineering.

Some prospecting outfits cleverly combined passive and mechanical means. One of the simplest was a canvas windsock on a wooden pole, which drew air from breezes and directed it through canvas tubing or stovepipes into the underground workings. The drawback was poor performance on calm days. Another system involved convection currents created by ordinary woodstoves to draw foul air out of the underground workings. The stove stood near the mine opening, and ventilation tubes extended from the stove into the underground workings. When a fire burned in the stove, the hot gases rising up the stovepipe created a vacuum in the ducting and siphoned foul air out of the mine.[546]

A few prospecting operations employed primitive mechanical systems for ventilation. These outfits used large forge bellows or small, hand-turned blowers to force air through stovepipes or canvas tubing into the workings. A bellows effectively ventilated shallow adits and shafts, but it lacked the pressure to clear gases from deep workings. Hand-turned blowers cost more money and took greater effort to pack to remote locations, but they forced foul air more surely from workings.

The simple windsocks and hand-turned blowers were insufficient for medium-sized and large mines, and engineers applied better methods. One of the most popular 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.[547]

Mechanical ventilation proved to be the most effective, but also was more expensive than passive systems. One of the most popular and effective was the use of power-driven fans and blowers, offered three basic varieties by machinery manufacturers. Engineers termed the first design, dating 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 steamboat 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 in 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 buildings, 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

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[546] Twitty, 1999: 51.

[547] International Textbook Company, 1899: A41, 133; International Textbook Company, *Coal and Metal Miners' Pocket Book* (Scranton: International Textbook Company, 1905) 381; Robert S. Lewis, *Elements of Mining* (New York: John Wiley & Sons, Inc:, 1946 [1933]) 454; Peele, 1918: 1038; Young, 1923: 255.

housing. The *propeller fan*, the third type of blower, was similar to the modern household fan, and it too was enclosed in a shroud.

Surface Plants for Shafts

The surface plants that supported work in shafts incorporated many of the same components as those for tunnels. However, due to the vertical nature of shafts, their surface plants also included hoisting systems, which had to meet specific engineering requirements. Typical hoisting systems installed by outfits in San Juan County consisted of a hoist, headframe, power source, and hoisting vehicle. As always, the financial state of the outfit, physical accessibility, and the quantity of proven ore governed the sophistication and cost of the system.

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. Where a prospecting outfit strongly suspected or had confirmed the existence of ore, they sank a better, more formal shaft conducive to deep exploration and production. By the 1880s, mining engineers distinguished between temporary-class and production-class shafts.

Engineers understood that the size of a shaft directly influenced how much ore could be hoisted out of the ground. Temporary-class shafts often featured one large compartment 3½' x 7' 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 the interior into a *hoisting compartment* and a *manway*, also known as a *utility compartment*, as well as guide rails in the hoisting compartment for a hoisting vehicle. Further, mining engineers defined the hoisting compartment as being at least 4' x 4' in the clear. By the late nineteenth century, the definition expanded as a result of larger vehicles. Mining engineers felt that a 4' x 5' hoisting compartment was better suited for ore production, and 5' x 7' was best.[548]

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 a 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 companies anticipating production over an extended period of time invested the capital in balanced systems. The Sunnyside Mining Company did exactly that during the late 1910s when it sank its Washington Shaft.

[548] Lucien Eaton, *Practical Mine Development & Equipment* (New York: McGraw-Hill Book Company, 1934) 13; International Textbook Company, 1905: 261; Peele, 1918: 251; Young, 1923: 171, 461.

Mining companies in San Juan County chose from 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 to primitive conditions. The typical ore bucket consisted of a body with convex sides that permitted the vessel to glance off shaft walls without catching on obstructions. Manufacturers forged a loop into the bail to hold the hoist cable on center and riveted a ring onto the bottom of the bucket so the vessel could be upended once it had reached the surface.

Mining companies engaged in deep shaft sinking took great risks when they used ore buckets. To prevent the bucket from catching on the shaft walls and emptying its contents onto the miners below, some mining companies installed a hybrid ore bucket hooked to a frame that ran on guide rails 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. Besides safety, another advantage was that miners working underground were able to switch empty buckets with full ones. Many small, poorly financed companies favored this type of hoisting vehicle because of its low cost. In any form, mining engineers considered ore buckets as temporary-class hoisting vehicles.

A mining industry institution for over 120 years, the cage consisted of a steel frame fitted with a deck for miners and rails for an ore car. Nearly all cages used in San Juan County featured a stout cable attachment at top, a bonnet to fend off falling debris, and steel guides that ran on special fine-grained 4” x 4” 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. Most dogs were toothed cams controlled by springs kept taut by the weight of the suspended cage. If the cable broke, the springs retracted, closing the cams onto the wood rails.

Cages proved highly economical because mining companies did not have to spend time manipulating ungainly ore buckets. When the cage stopped at a station underground, a miner merely pushed on an ore car, and when the cage was at the surface, another worker withdrew the car. But cages presented mining companies with several drawbacks. One of the biggest lay in boring a shaft that had enough space not only for the cage, but also 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 became popular in Colorado’s mines. The skip consisted of a large iron or wood box on wheels that ran on a rail line. The vehicles had little deadweight, held much rock, and, because they ran on rails, could be raised quickly. Skips were lighter than cages because they did not have the combined deadweight of the vehicle and ore car, resulting 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 gained momentum slowly through the 1900s, accelerated during the 1910s, and by the 1930s most large and many medium-sized mines used skips.

Hoists

When either prospectors or mining companies sank a shaft, they had to install a hoist to raise material out of the underground workings. 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 a manually powered winch consisting of a spool made from a lathed log fitted with crank handles. Because the windlass wound by hand, its working depth was limited to approximately 100’. Prospectors sinking inclined shafts had the option of using what was 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 its frame had to be anchored onto a well-built timber structure.[549]

[549] Twitty, 2002:145.

Table E 2.1: General Hoist Specifications: ***Type, Duty, and 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	3' x 3'.	Square or Rectangular	Flat	Timber
Horse Whim: Malacate	Shallow Sinking	7' - 10'. diameter	Ovoid Depression	Cable Reel Axle Located in Pit	Timber
Horse Whim: Horizontal Reel	Sinking	4' x 4'.	Rectangular	Timber Footers in Depression	Timber
Horse Whim: Geared	Sinking	4' x 4'	Rectangular	Timber Footers in Depression	Timber
Steam Donkey	Sinking	Portable	Rectangular	None	None
Gasoline Donkey	Sinking	Portable	Rectangular	None	None
Single Drum Gasoline	Sinking	2.5' x 8' to 4' x 14.5'	Rectangular	Flat	Timber or Concrete
Single Drum Gasoline	Sinking	2.5' x 8' to 4' x 14.5'	T-Shaped	Flat	Timber or Concrete
Single-Drum Steam	Sinking	6' x 6' and smaller	Rectangular	Flat	Timber or Concrete
Single-Drum Steam	Light Production	6' x 6' to 7.5' x 10'	Square or Rectangular	Flat	Concrete or Masonry
Single-Drum Steam	Moderate Production	7.5' x 10' and larger	Rectangular	Irregular	Concrete or Masonry
Double-Drum Steam	Moderate Production	4' x 7' to 7' x 12'	Rectangular	Irregular	Concrete or Masonry
Double-Drum Steam	Heavy Production	7' x 12' and larger.	Rectangular	Irregular	Concrete and Masonry
Single-Drum Geared Electric	Sinking	5' x 6'and smaller	Square or Rectangular	Flat	Concrete
Single-Drum Geared Electric	Production	6' x 6'and larger	Square or Rectangular	Flat	Concrete
Single-Drum Direct Drive Electric	Production	5' x 6' and larger	Square or Rectangular	Flat	Concrete
Double-Drum Geared Electric	Heavy Production	6' x 12'	Rectangular	Irregular	Concrete
Double-Drum Direct Drive Electric	Heavy Production	6' x 12'	Rectangular	Irregular	Concrete

(Reproduced from Twitty, 2002: 319).

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 popular because it was relatively inexpensive, portable, and 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, mining engineers felt that horse whims were well-suited for backcountry prospecting, but too slow and limited in lifting power for ore production. Regardless, mining companies with little income continued to use whims in San Juan County into the 1910s.

Prospect outfits could select from several types of horse whims. The simplest and oldest, 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 to rotate in a shallow pit 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 prospectors usually laid a plank over the cable trench for the animal to walk across. The controls consisted of brake and clutch levers mounted to the shaft collar, and connected to the apparatus by wood or iron linkages that passed through the trench.[550]

Mining machinery makers offered factory-made horse whims that were sturdier and performed better than the older handmade units. The *horizontal reel horse whim* consisted of a spoked iron cable reel mounted on a timber foundation 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 prospectors into the 1910s. The machine consisted of a cable drum mounted vertically on a timber frame, and a beveled gear that transferred the motion from the draft animal's harness beam. Geared whims were faster, could lift more than horizontal reel models, and featured controls and cable arrangements like the other types of whims. A horse whim required a headframe over the shaft, and the structures were small, simple, and temporary-class in duty. Prospectors favored a tripod, tetrapod, or a small four-post derrick that was just wide enough to straddle the shaft.[551]

Prospect operations working deep shafts began using steam hoists 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 poorly financed outfits. Steam hoisting systems included a heavy hoist and boiler, cable, pipes, headframe, and foundations. The mining company also had to provide a reliable source of 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, clutch, brake mechanism, and throttle.

[550] Twitty, 2002: 161.
[551] Twitty, 2002: 162.

Mining engineers selected the specific model and size of hoist primarily according to budget and secondarily on speed and anticipated depth of the workings. Nearly all sinking-class hoists had bedplates smaller than 6' x 6' in area and were driven either by gearing or by a friction-drive mechanism. A friction drive consisted of rubber rollers that 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. The sinking-class hoists had strength often less than 40 horsepower, a slow speed of 350' per minute, and a payload of only several tons. Regardless, many mining companies used these hoists for ore production.[552]

Steam equipment presented two sets of problems for those prospect outfits working deep in the backcountry. Not only did the outfits have to haul and erect the hoisting system, but also continuously fed it fuel and water, which was costly. In the early 1890s, the Witte Iron Works Company and the Weber Gas & Gasoline Engine Company both developed practical petroleum engine hoists, which alleviated these issues. These innovative machines were smaller than many steam models, required no boilers, and their concentrated liquid fuel was by far easier to transport than wood or coal.

Despite the potential advantages of petroleum hoists, mining companies in San Juan County did not immediately embrace the apparatuses. Steam technology, the workhorse of the Industrial Revolution, held convention in the mining industry into the 1910s for several reasons. First, many mining companies were by nature conservative and continued to rely on steam out of familiarity. Second, petroleum engine technology was relatively new and not yet widely used, especially for hoisting. The outfits employing petroleum hoists during the 1890s found the engines to be cantankerous and their performances limited. Further, petroleum hoists were slow with speeds of 300' to 400' per minute, had lifting capacities of at most 4,500 pounds, and were restricted to working depths less than 1,000'. For these reasons, professionally educated mining engineers felt the hoists were barely adequate for sinking duty, and total acceptance took approximately fifteen years.[553]

The petroleum hoists available to San Juan County's mining outfits were similar in form to 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 was connected to a heavy crankshaft 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 hoists, steam technology maintained supremacy into the 1920s, when electric motors were finally advanced enough. Machinery manufacturers offered production-class steam hoists in a wide array of sizes, as well as with *first-motion* or *second motion* drive trains. First-motion drive, also known as *direct-drive*, meant that the steam engine's

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[552] Twitty, 2002: 319.
[553] Twitty, 2002: 173.

drive rods were coupled directly onto the cable drum axle, like how the drive rods were directly pinned onto the wheels of a steam locomotive. Second-motion, also 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, permitting the use of small steam cylinders and a compact footprint. First-motion hoists, on the other hand, required the cable drum be mounted at the ends of large steam cylinders so 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 high-quality production-class machines that saved money only over protracted and constant use. Geared hoists were intended to be inexpensive and meet the short-term needs of modestly capitalized mines. They were not as strong, fast, or fuel-efficient. The large size, high-quality steel, and the fine engines made the cost of first-motion hoists three to four times that of geared hoists, costing from approximately $1,000 to $3,000 for light to heavy models. First-motion hoists had speeds of 1,500’ to 3,000’ per minute, compared with 500’ to 700’ per minute for geared hoists. Geared hoists usually relied on old-fashioned but durable slide valve engines, while first-motion hoists usually were equipped with Corliss valves engines, which consumed half the fuel.[554]

While the costs of purchasing first-motion hoists were high, so were the installation expenses. Because geared hoists were self-contained on a common bedplate, the construction crew merely had to build a simple foundation with anchor bolts and drop the hoist into place. First-motion hoists, on the other hand, required raised masonry pylons for the steam cylinders and the cable drum bearings, a well for the drum, and anchor bolts for the brake posts. The hoist pieces then had to be maneuvered into place and simultaneously assembled.

Mining engineers chose specific hoists for the power they delivered, proportionally relative to the hoist’s overall size. Geared hoists smaller than 6’ x 6’ were for deep exploration and delivered less than 40 horsepower. Hoists between 7’ x 7’and 9’ x 9’ were for minor ore production and offered 75 to 100 horsepower. Hoists 10’ x 10’ to 11’ x 11’ were for moderate production and generated up to 150 horsepower, and larger units were exclusively for heavy production. Mining engineers rarely installed geared hoists larger than 12’ x 12’, because for a little more money, they could have obtained an efficient first-motion hoist.[555]

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 performance because they increased production while saving energy costs. They achieved this through balanced hoisting as 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, and sinking and timbering a shaft with two hoisting compartments constituted a great cost.

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554 Twitty, 2002: 199-201.
555 Twitty, 2002: 320.

Like single-drum hoists, double-drum units came with geared or first-motion drives. Geared models, ranging in size from 7' x 12' to 12' x 17', were slower, less powerful, and noisier than their direct-drive brethren, but cost much less. 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' x 25' to over 30' x 40' 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 of a company's financial status, levels of productivity, and quality of engineering.

As early as around 1895, San Juan County's well-capitalized mining companies, such as the Silver Lake Mines Company, embraced electric hoists for work underground. By 1900, electric hoists also saw greater use on the surface, as well. Like steam hoists, 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 much like their steam ancestors. 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 as the cable drums.[556]

As with steam hoists, mining engineers classified single-drum electric hoists smaller than 6' x 6' in area as sinking-class in duty. Most production-class hoists 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 speeds of less than 600' per minute, a limited payload capacity, and were unable to work in the deepest shafts.[557]

During the capital-scarce Great Depression, many mining companies had to settle for small, slow, sinking-class hoists out of economic necessity. These companies used hoists with motors rated at only 15 horsepower, which in better times might have been used for light work underground. Some outfits cobbled together hoists from machinery that had been cast off during earlier decades. Miners exercised creativity in reusing obsolete machinery, and their solutions fell into several basic patterns. One common method involved obtaining an old, geared steam hoist, stripping the steam equipment, and adapting an electric motor. Another clever means was to leave the steam equipment intact and substituted compressed air for steam to power the hoist. The only drawback was that a costly, multistage 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. A third practice was to assemble hoists from odd 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 allowed many mining operations to turn a

[556] Eaton, 1934: 86, 295; Lewis, 1946: 187; William Staley, *Mine Plant Design* (New York: McGraw-Hill Book Co., 1936) 137; Young, 1946: 203; E.N. Zurn, *Coal Miners' Pocketbook* (New York: McGraw-Hill Book Co., 1928): 760.
[557] Twitty, 1999: 341.

small profit. Lacking the money and 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.[558]

Some small and medium-sized mining outfits were able to afford factory-made gasoline hoists during the Great Depression. 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. By examining the footprint of a foundation, the researcher 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. Foundations greater than 8’ x 8’ in area may feature a depressed center that once accommodated a large cable drum. 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 include 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’ x 5’ in area, and features four anchor bolts.

Direct-drive 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 those toward the front supported the cable drum’s bearings. Single-drum hoists required one depressed well between the footers for the cable drum, and double-drum hoists required two wells. In addition, a masonry pylon stood between the wells to support the drum axle. Foundations for single-drum hoists are rarely larger than 14’ x 19’ in area, and those for double-drum hoists are greater.[559]

Steam Boilers

Boilers were necessary components 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

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558 Twitty, 1999: 341, 343.
559 Twitty, 2002: 240.

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 for neglect and abuse. The problem that boilers presented was that they were bulky, heavy, cumbersome, and required engineering to install.

During the 1870s, the *Pennsylvania boiler*, *locomotive boiler*, and *upright boiler*, also known as the *vertical boiler*, quickly gained popularity among the county's prospect operations. These boilers were well-suited to the county's difficult geographic and physical environment because they were self-contained and freestanding, ready to fire, and able to withstand mistreatment. Because the three types boilers were designed to be portable at the expense of efficiency, mining engineers declared them fit only for sinking duty.

In general, the above 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.

The boiler front featured a glass sight tube much like the level indicator on a coffee urn so the fireman could measure the water level. Boiler tenders usually kept the boiler three-quarters full, 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 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, a half ton equaling the heat generated by a cord of wood, and as a result mining operations proximal to commercial centers 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 boiler consisted of a horizontal shell with a firebox built into one end and a smokestack projecting out of the other end. Nearly all models stood on wood skids and were easily portable, but some required a small masonry pad underneath the firebox and a masonry pillar supporting the other end. Locomotive boilers were usually 10' to 16' long, 3' in diameter, and stood up to around 6' 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, enough to run a hoist.[560]

Upright boilers were the least costly of all models. They tolerated abuse well and were the most portable, but they were highly inefficient and could not generate much horsepower. Upright boilers consisted of a vertical water shell that stood over a firebox and ash pit integral with 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. Upright boilers required little floor space and maintenance and were so durable that they almost

[560] Twitty, 1999: 204.

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.[561]

The third sinking-class boiler widely used was the Pennsylvania model. This unit combined the form and portability of the locomotive boiler with the function of the Scotch marine boiler, discussed below. Like the other portable boilers, the Pennsylvania boiler featured an enclosed firebox surrounded by a jacket of water. The flue gases traveled through tubes in the shell, rose into a small smoke chamber at the rear, reversed direction, traveled toward the front through more tubes, and escaped through a smokestack. The Pennsylvania boiler, which originated in the Keystone state's oil fields, proved to be remarkably efficient.[562]

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 became popular because convention dictated the use of other types, and because it was heavy, large, and difficult to haul to remote locations.[563]

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 innovative. 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. The masonry 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.

Return-tube boilers were workhorses that withstood the harsh treatment and neglect typical of the mining industry. However, boiler tenders had to attend to a few basic details to avoid accidental death, disastrous explosions or 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 verified that the water and

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561 Terrell Croft, Steam Boilers (New York: McGraw-Hill Book Co., 1921) 48; International Textbook Company, 1899: A18, 34; Frank B. Kleinhans, Locomotive Boiler Construction (New York: Norman W. Henley Publishing Co., 1915) 12; Rand Drill Company, Illustrated Catalogue of the Rand Drill Company, New York, U.S.A. (New York: Rand Drill Company, 1886) 47; W.H. Tinney, Gold Mining Machinery: Its Selection, Arrangement, & Installation (New York: D. Van Nostrand Company, 1906) 50.

562 Twitty, 1999: 206.

563 Colliery Engineer Company, 1893: 262; International Textbook Company, 1899: A18, 28; Peele, 1918: 2083; R.H. Thurston, A Manual of Steam Boilers: Their Design, Construction, and Operation (New York: John Wiley & Sons, 1901) 31.

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 companies with plenty of capital installed additional devices to improve the energy efficiency and performance of their return-tube boilers. First, they may have arranged feed-water tanks to allow sediment and mineralization to settle out. Second, some companies installed feed-water heaters, which were small heat exchangers that used some of the boiler's hot water or steam to preheat the fresh feed water. These moderated the shock of temperature changes to the boiler, prolonging the vessel's life and increasing fuel efficiency. A few engineers working at the largest mines automated the input of coal with mechanical stokers. Engineers also fitted heavily stoked boilers with rocking or shaking grates that sifted the ashes downward, promoting better combustion of the fuel. Last, companies wrapped the heater, steam pipes, and exposed parts of the boiler with horsehair or asbestos plaster as insulation.[564]

At the time when boiler technology was nascent, in 1856 an American inventor named Wilcox devised a boiler radically different and more efficient than the best return-tube models. Wilcox's system consisted of a large brick vault capped with several horizontal, iron water tanks and an assemblage of fifty to sixty water-filled iron tubes. The vault contained a firebox, ash pit, and smoke chamber. 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 manufactured by the firm Babcock & Wilcox.[565]

After Babcock & Wilcox's water-tube boiler had proven itself in 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 greater efficiency than return-tube boilers. In addition, the threat of a catastrophic explosion was almost nonexistent. By the 1890s, a number of mechanical engineers had devised other water-tube boilers, such as the Heine, Sterling, Wickes, Hazelton, and Harrisburg-Starr.

The problem with all of the above models, however, was that they required much more attention than the rugged return-tube boilers, were significantly more costly, and 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 professionally trained engineers. Both the Silver Lake and Iowa mines relied on such advanced boilers for most of their steam. As the prices of water-tube boilers fell during the 1900s and capital became abundant following the Silver Crash of 1893, their popularity grew, but the embrace of electricity in the 1910s prevented the widespread adoption of water-tube boilers.

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[564] Magnus Ihlseng, A Manual of Mining (New York: John Wiley & Sons, 1892): 581; International Textbook Company, 1924: A23, 53; *The Mining Catalog: 1925 Metal-Quarry Edition* (Keystone Consolidated Publishing Company Inc., 1925) 115; Peele, 1918: 2086.

[565] Croft, 1921: 18, 53; Horace Greeley, Leon Case, et. al.,*"Babcock and Wilcox Boiler,"* The Great Industries of the United States (Hartford: J.B. Burr.; International Textbook Company, 1872, 1899) A18, 35; C.B. Linstrom and A.B. Clemens, *Steam Boilers and Equipment* (Scranton: International Textbook Co., 1928) 30; Peele, 1918: 2083; Thurston, 1901: 34; Tinney, 1906: 63.

Headframes

Nearly all the mechanical hoisting systems built in San Juan County included 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 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, and engineers agreed that it was best for prospecting. The variety used by small operations usually consisted of two upright posts, cap timber, another cross-member several feet below, and diagonal back braces, all standing at most 25’ high. The cap timber and lower cross-member 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 stood on a timber foundation. The A-frame was based on the same design as the two-post gallows. The difference 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 small size, simplicity, minimization of materials, ease of erection, and portability. For comparison, a two-post gallows frame 20’ high cost as little as $50 and a slightly larger structure $150, while a production-class A-frame cost $650 and a production-class, four-post derrick headframe up to $900.[566]

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, a surge of force created when the hoistman quickly brought a vehicle to a halt in the shaft. The third was the horizontal pull of the hoist. To counter these forces, mining engineers often built their headframes with 8’ x 8’ timbers and installed diagonal back braces to counter the pull of the hoist. Usually, carpenters assembled the primary components with mortise-and-tenon joints, 1” diameter iron tie rods, and timber-bolts. Professionally trained mining engineers specified that diagonal back braces were most effective when they bisected a vertical angle and the diagonal pitch of the hoist cable. When a mining engineer attempted to find the mathematically perfect location for a hoist after erecting a headframe, he merely measured the distance from the shaft to the diagonal brace, doubled the length, and installed the

[566] Twitty, 1999: 215.

hoist. Many prospect operations followed this general guideline, but poorly educated engineers gave the diagonal braces either too much or too little angle.[567]

Unlike the simplicity of sinking-class headframes, production-class headframes were more complex, and designing them was rigorous. 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 be underestimated in San Juan County. Last, mining engineers had to plan for racking and swaying under loads and for vibration and shocks to the structure.[568]

Table E 2.2: 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

(Reproduced from Twitty, 1999: 281).

Building a headframe that could withstand the sum of the above forces was not enough at a producing mine. Mining engineers had to forecast how they thought the headframe would interact 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', to allow the hoistman room to stop the hoisting vehicle before slamming into the top. Highly productive mining operations often utilized vertical space and constructed multiple shaft landings. Some companies using skips 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*

[567] Twitty, 1999: 215.
[568] Ihlseng, 1892: 91; International Textbook Company, 1899: A23, 105; International Textbook Company, 1906: A53, 31; Milo S. Ketchum, *The Design of Mine Structures* (New York: McGraw-Hill Book Co., 1912) 41; Peele, 1918: 926; Twitty, 1999: 274.

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-frames up to 35' high were also erected to serve inclined shafts.[569]

Nearly all mining engineers built their headframes with heavy timbers assembled with mortise-and-tenon joints, timber-bolts, and iron tie rods. 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 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.[570]

Production-class headframes, weighing dozens of tons, required sound and substantial foundations to remain stable. A preplanned 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' 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. Well-financed companies substituted concrete or rock masonry to gain a lasting foundation.[571]

In the 1890s, the 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 because it did not decay, was strong, did not burn, and facilitated the erection of taller headframes. However, steel was significantly more expensive than timber, and as a result, few if any companies in the 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 affect 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 continued the practice of building four and six-post derricks and A-frames and still considered steel to be the ultimate material. 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 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

[569] Twitty, 1999: 275.
[570] International Textbook Company, 1906: A53, 35; Ketchum, 1912: 7; Peele, 1918: 935.
[571] Twitty, 1999: 283.

little material. When possible, these mining companies relocated entire headframes. 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.

One practice that many mining companies shared during the Great Depression was an extensive use of salvaged timbers. Stout timbers were a precious and costly commodity, 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 dimensions, weathering, and quality of wood. In addition, salvaged timbers frequently exhibit abandoned mortise-and-tenon joint sockets, and bolt and nail holes. The heavy use of such material for headframes, as well as for other structures, is typical of Depression-era structures.

Additional Surface Plant Components

The above descriptions of tunnel and shaft mines account for basic surface plant components. Productive mining companies often installed additional facilities that enhanced their ability to increase production and sustain work underground. The following components were characteristic of both tunnel and shaft mines.

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 rounds. Hand-drilling proved slow, but no practical alternative existed to take its place until machinery manufacturers began selling mechanical rock drills during the 1870s. When drilling by hand, miners typically advanced tunnels and shafts only 1’ to 3’ per shift in hard rock. By contrast, the mechanical rock drills offered during the 1880s and 1890s permitted miners to bore greater numbers of deeper holes and advance a tunnel or shaft approximately 3’ to 7’ per shift. As drilling technology improved during the 1890s and 1900s, miners were able to make even greater progress, convincing engineers that the relatively high cost was justified. Some of the early drills were powered by steam plumbed to the point of work, but the majority were driven by compressed air, generated and distributed through an engineered system.[572]

The air compressor lay at the heart of the system, and while those manufactured between the 1880s and 1920s came in a variety of shapes and sizes, they all operated according to a 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, and how fast the machine operated. The pressure capacity, measured as *pounds per square inch* (psi), depended on the above qualities,

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572 Halbert P. Gillette, *Rock Excavation: Methods and Cost* (New York: Myron C. Clark Publishing Company, 1907) 15; Hoover, 1909: 150; International Correspondence Schools, 1907: 13; Peele, 1918: 184, 213; Young, 1946: 87.

how stout the machine was, and on check-valves in the plumbing. Generally, high-pressure, high-volume compressors were large, strong, durable, complex, and therefore 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 were a basis for designs that served the mining industry well for over sixty 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 a 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.

During the early 1880s, mechanical engineers innovated several 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, and 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 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. Machinery makers began offering straight-line and duplex compressors capable of achieving what the industry termed *multi-stage 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, forcing semi-compressed air into the small, high-pressure cylinder, which highly compressed the air and released it into a receiving tank.

Machinery makers designed multi-stage, straight-line compressors with two and even three compression cylinders coupled onto the steam-driven piston, and they produced duplex compressors with several multi-stage 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 multi-stage compressors while operations with limited capital continued to rely on the less costly, conventional models.

Table E 2.3: Air Compressor Specifications: ***Type, 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, 2002: 306).

At the turn of the century, machinery makers began to offer air compressors that were smaller, more efficient, and provided better service than early models. They adapted several designs to be run by electric motors and gasoline engines, energy sources well-suited to remote mines. Gasoline and electric compressors underwent gradual acceptance, but proved their worth by the 1910s, and mining companies throughout San Juan County embraced them.

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 multi-stage 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 became popular.

Compressor makers also developed economical gasoline units ideal for remote 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, enough to run up to four small rock drills.[573]

The noisy gasoline machines had needs similar to their steam-driven cousins. Gasoline compressors required cooling, fuel, and a substantial foundation capable of withstanding intense vibration. 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 ¼" to ½" inch metal tubing. Motor-driven duplex and straight-line compressors dominated 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 common reliance on older designs, compressed air technology underwent dynamic changes after the 1910s. Mechanical engineers experimented with unconventional designs beginning in the 1900s, and during the 1910s several went commercial. The *upright two-cylinder compressor* was based on the automobile engine and featured similar valves and a crankshaft. Used on an experimental basis as early as the turn of the century, these units were inexpensive, adaptable to any form of power, and light. Further, machinery makers mounted them onto four-wheel trailers or simple wood frames for mobility. *V-cylinder compressors*, also known as *feather valve compressors*, adapted large-displacement truck engines and featured three to eight 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 only the foundation. However, as with hoists, based on that footprint, the researcher can often determine the exact type of compressor used. Following are descriptions of the foundations of common types of compressors. *Straight-line steam compressors* usually stood on foundations with a rectangular footprint and flat top studded with two rows of anchor bolts. In general, workers used masonry or concrete, although they bolted some machines less than 12' long to timbers. 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 the large, early *duplex steam compressors* consisted of a pair of elongated rectangular pads spaced several feet apart. The pads were usually mirror opposites, and their anchor bolts were symmetrical in pattern. Workers almost always used masonry or concrete, but arranged individual stone blocks for the components of large versions. The steam and compression cylinders and flywheel were bolted to their own sets of blocks.

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[573] Twitty, 1999: 126.

The foundations for the compact duplex compressors are easily identified today. The foundations are U-shaped, slightly rectangular, and several feet high. Units powered by a separate motor had a small pad for the motor at the open end of the U, while steam compressors lacked the additional pad.

Straight-line belt-driven compressors were bolted to foundations similar to those for their steam-driven counterparts. They also featured a separate pedestal at one end for the flywheel's outboard bearing, and a second, rectangular foundation for the drive motor.

Due to severe vibrations, *petroleum compressors* were usually bolted to stout, concrete foundations several feet high. The foundations are almost always rectangular, several feet wide, less than 9' long, with 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 had several cylinders were bolted to rectangular foundations between 3' x 3' and 4' x 5' in area. Foundations for machines with numerous cylinders were several feet wide and up to 10' long. In construction, the foundations had a series of closely spaced timbers bolted to either an underlying concrete pad or buried timber footer.

Electricity

Mining engineers in the west began experimenting with electricity as early as 1881. 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.[574]

During the late 1880s and early 1890s, well-capitalized companies in technologically advanced areas, the San Juan Mountains in particular, began to harness electricity for practical use. They made their first attempts in locations that featured a combination of water and topography that could generate hydro-power. In 1888, the Tomboy and Virginius mines at Telluride used electricity to run custom-made electric hoists and lighting. In 1890, power plants were built at Ames in San Miguel County and at Silverton. In 1891, Edward Stoiber erected a small plant for his Silver Lake Mine. Colorado, and especially the San Juan Mountains, acted as a proving ground for the application of electricity through the rest of the decade. Engineers foresaw electricity as an alternative to steam. Generating electricity at a central point and transmitting to remote mines eliminated the need to haul coal and steam equipment at great cost. Inherent limitations in electrical technology, however, slowed its initial use.

The earliest electrical circuits were energized with direct current (DC) with a unidirectional flow, although mining engineers also experimented with alternating, or oscillating, current (AC). Neither power source as they existed during early the 1890s was particularly well

[574] Eric Twitty, *"From Steam Engines to Electric Motors: Electrification in the Cripple Creek Mining District,"* The Mining History Journal (1998): 103.

suited for mining. AC current could be transmitted for miles with little energy loss, but AC motors were incapable of starting or stopping under load. Therefore, AC was unsuitable for running hoists, large shop appliances, or other machines that experienced sudden drag or required variable speed. AC electricity was effective, however, for running small air compressors, ventilation fans, and other 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 at distance 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.[575]

Based on the above, contemporary electrical technology offered mining companies little incentive to retire their steam equipment. However, progressive engineers such as Edward Stoiber conducted extensive experimentation during the early 1890s to harness both DC and AC currents. Around 1900, electrical appliance manufacturers made several 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 current that could be transmitted long distances. They also invented 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 consumers. Still, many mining companies were not yet willing to relinquish traditional steam technology completely. Voltage, amperage, and current had not yet been standardized among machinery manufacturers or various power generators. As such, the prevailing attitude was cautious.[576]

The rigors of mine hoisting proved to be a major obstacle, but by the turn of the century machinery manufacturers developed a variety of small AC and DC hoists that were reasonably reliable. The early electric models were similar in design to sinking-class geared steam hoists and were manufactured 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 remained slow with limited payload capacity.[577]

By the 1910s, engineering progressed to the point where mining companies could not deny that electric equipment performed as well as steam. When steam machines became worn, mining companies replaced them with electric models. One engineer asserted that where power was readily available, a steam-driven compressor cost up to $100 per horsepower per year to run while an electric model cost only $50. During the 1910s, engineers and manufacturers improved performance and reliability, and introduced double-drum units for balanced hoisting. By 1920, except for remote and poorly capitalized operations, most companies adopted electric power.[578]

Architecture

575 International Textbook Company, 1899: A23, 5; Peele, 1918: 1126; Twitty, 1998.
576 Twitty, 1999: 269.
577 Twitty, 1999:270.
578 Twitty, 1999:270.

Once a mining company had proven the existence of ore, investors expected the operation to perform throughout the year, until the ore had been exhausted. Complying with company wishes, engineers erected buildings to shelter surface plant components against the weather. They sheltered not only the mine crew, but machinery components from exposure to adverse weather. The engineer also had a tacit understanding that mine buildings possessed the ability to inspire investors. Large, well-built buildings such as those in Silver Lake Basin conveyed permanence, wealth, and industrial might.

Functional layout, design, and construction materials for mine buildings in San Juan County evolved between the 1870s and the 1920s. Most were vernacular expressions unique to each mining operation. Professional architects rarely designed these buildings, although professional and self-actualized engineers often proved capable builders despite formal training in architecture. They successfully adapted construction methods to the terrain, climate, transportation limitations, financial resources, and available materials of San Juan County. In many cases, engineers imitated mining industry architecture elsewhere and molded it to fulfill a particular need in a localized context.

Mining engineers considered four basic expenditures that influenced the type, size, and composition construction. These included the time necessary to design the building and the cost to purchase or fabricate basic construction materials. Third, materials had to be hauled to the site, and fourth, the cost of construction itself. Between the 1870s and the turn of the century, well-capitalized companies met the above considerations by erecting frame buildings sided with lumber, sometimes with some degree of pre-assembly or numbering of parts. Smaller or poorly funded operations substituted locally-available logs. Buildings erected by well-financed companies tended to be substantial and well-built, while those of operations with poor capitalization were crude, small, and rough.

The introduction of steel and iron materials to the mining industry in the 1890s changed some buildings. Steel makers began selling corrugated siding for commercial construction in the 1890s. While much siding was decorative, some varieties were designed with industrial applications in mind. Corrugated sheet metal particularly found favor with the mining industry and its use spread rapidly. Engineers increasingly utilized the material such that by the 1910s it had become ubiquitous siding for siding. The advantages of corrugated sheet metal were its affordability, light weight (and thus ease of shipping), ability to cover a substantial area, and rigidity. These qualities made corrugated sheet metal ideal where remoteness rendered lumber too costly.[579]

The other significant use of metal in mine buildings occurred during the 1900s when a few prominent companies began experimenting with girders for framing large buildings such as mills. The Gold Prince Mill, erected at Animas Forks in 1903, exemplified the practice. Architects began using steel framing to support commercial and industrial brick and stone masonry buildings as early as the 1880s, but mining companies in general found that wood

[579] Twitty, 1999: 304.

framing met their needs 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 offered a sound structure resistant to high winds, but also often cost less than the thousands of board-feet of lumber required to erect the massive buildings.

The general types, forms, and designs of mine buildings followed a few patterns, regardless of the materials. Between the 1870s and 1910s, most engineers enclosed the primary surface plant components clustered around the shaft in a multi-purpose *shaft house*, and the plant components associated with a tunnel in a *tunnel house*. These buildings contained machinery, the shop, mine entrance, and workspace. Smaller shaft houses in San Juan County were often constructed of post-and-girt framing, gabled rafter roofs, and unsubstantial foundations. Larger shaft houses were based on custom-designed frames of heavy timbers capable of supporting the roof independent of the walls. Regardless of frame design, carpenters clad the walls with board-and-batten siding, several layers of boards, and, by the 1900s, corrugated metal siding. Even after electric lighting was available, engineers continued to design large multi-pane windows at regular intervals for daylight.

Most shaft houses conformed to a few standard footprints influenced by the arrangement of machinery. Overall, the buildings tended to be rectilinear to encompass the hoist, anchored some distance from the shaft, with lateral extensions for the shop, water tank, boilers, and either coal or cord wood storage. Professional 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.[580]

The roof profile 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 headframe backbraces. Tall iron boiler smokestacks pierced the roof proximal to the hoist. The forge stovepipe extended through the roof near the shaft collar. The shaft house also sometimes featured other stove pipes at the hoistman's platform and carpentry shop. The tall smokestacks were usually guyed with baling wire against strong winds. The shaft houses at high elevations often had plank flooring to improve insulation. In some cases the shop and boiler areas, where workers dropped smoldering embers, hot pieces of metal, and nodules of fresh clinker were also floored with planking, despite fire hazard. Customarily the mining engineer designed the flooring flush with the top surfaces of the machine foundations, permitting steam and other pipes to be routed underneath.

By the late 1910s, the U.S. Bureau of Mines outlawed shaft houses made of flammable materials. The surface plants then changed to consist of a cluster of smaller buildings surrounding an exposed headframe. Instead of a shaft house, mines featured a *hoist house* for the hoist, boilers, and shop. At large operations, individual buildings housed some surface plant components separately. The shop had its own building, as with the *compressor house* and

[580] Twitty, 1999: 306.

electrical substation *transformer house*. The mine plant may have also featured a miner's *change house*, also known as a *dry*, a storage building, stable, and carpentry shop.

The difficult economic climate of the Great Depression changed general construction methods for mining architecture to some degree. Overall, the buildings became smaller, incorporated more salvaged materials, and were less well built than in previous decades. These trends continued through mining's decline in the 1960s. Mining companies with capital erected buildings that were spacious with lofty, gabled roofs when possible. Engineers continued to take advantage of natural light and provided broad, custom-made doors at key functional points. Engineers either floored principal structures with poured Portland cement, inexpensive due in part to the proliferation of trucking, or used wood planking. Preferred materials included lumber, sheet iron, and factory-made hardware. In most cases, mining engineers emphasized function and economy in their designs with no superfluous ornamentation. Poorly funded outfits could not afford quality materials or tools, experienced engineers, or skilled workers. Many favored single-slope shed roofing with salvaged irregular doors and windows. Overall, these buildings assumed an ad-hoc quality, but were ultimately well-built and offered shelter. Some buildings lacked formal framing or were simple balloon-frame construction. Builders used a patchwork of planks and sheet metal for siding, often layered to prevent wind damage.

Ore Storage

Although capitalists, engineers, and miners often held differing opinions in running 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 typical of San Juan County's hardrock mines. *Ore bins* were functionally different from *ore sorting houses*, and mining companies based choice of structure on the type of ore being mined. Some ores were fairly consistent in quality and rock type and warranted storage in an ore bin. Low-grade and complex ore 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*, *sloped-floor bin*, and hybrid *compromise bin*. Mining companies with regular ore production often erected large sloped-floor ore bins. The solidity of these structures 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 heavy timber footers on terraces of waste rock. To ensure the structure's durability against the onslaught of sharp rock, 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 with numerous cells to hold either different grades of ore, or batches of payrock produced by multiple companies of lessees working within the same mine.

Mining companies with limited financing and ore production erected flat-bottom bins because such structures were inexpensive. Rarely did these structures attain the 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 contended with pressure on all four walls, while sloped-floor bins directed the pressure against the front wall and diagonal floor. Flat-bottom bins also were seasonal because they could not be roofed.

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 concentration and storage. In keeping with the gravity-flow engineering typical of mining, engineers usually designed sorting houses with multiple levels for input, processing, and storage. These structures usually featured a row of receiving bins or chutes on 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 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 sloped, and the structure usually stood on a foundation of heavy timber pilings or log cribbing walls.[581]

The general path the ore followed began when miners underground characterized the nature of the ore they were extracting. They communicated their assessment via a labeled stake, a message on a discarded dynamite box panel, or a tag placed in the ore car. A trammer then hauled the loaded car out of the mine and pushed it into the sorting house. He emptied the contents into one of several bins, depending on how impure the ore was. High-grade ore went into a small special 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. Low-grade payrock combined with waste rock, known as mixed ore, went into one of several bins located in the center of the ore sorting house. When released from the car, the mixed ore slid onto a heavy grate known as a *grizzly*. The rich portions of the ore fractured into fines, while the large cobbles that remained intact after blasting and shoveling contained waste rock that needed to be cobbed, or knocked off by surface laborers. The valuable fines dropped through the grizzly directly into the holding bins at the bottom of the structure, while the cobbles rolled off the grizzlies and into chutes that fed onto sorting tables. There, laborers worked to separate the ore from waste.

Explosives Magazines

Explosives were fundamental to mining as the prime mover of rock. Mining companies had to store enough dynamite and blasting powder to carry them through the weeks spanning freight deliveries, and they often informally stacked 50 pound boxes, the standard shipping container, in heavily used mine buildings or underground workings. Worse, during cold months, much of the year at high altitude, miners stored boxes of dynamite near boilers, in blacksmith shops, and near hoists where it remained in a thawed and ready state. Such storage practices

[581] Twitty, 1999: 153.

were dangerous, and in response, some engineers instituted explosives magazines where storage could be carried out in a more controlled and orderly manner.

Well-built magazines came in a variety of forms and sizes, but all shared the common goal of concentrating and sheltering the mine's supply of explosives away from the main surface plant. Trained engineers felt that magazines should be bulletproof, fireproof, dry, and well-ventilated. Magazines should be constructed of brick or concrete, or if frame construction, the walls needed to be sand-filled and sheathed with metal. These features not only could protect explosives from physical threats, but regulate the interior environment. Extreme temperature fluctuations and pervasive moisture damaged 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. Mining engineers recognized proper magazine construction as comprised of stout masonry or concrete with a heavy arched roof and metal doors in steel jambs. Other magazines were similar to root cellars, consisting of a plank-lined chamber excavated out of a hillside, often 8' x 10' in area, and roofed with earth and rubble. Usually magazines were located away from the mine's surface plant. Regardless of degradation and obvious safety hazards, many small and medium-sized mining companies stored explosives in crude and even dangerous structures. Miners erected sheds sided only with corrugated sheet metal. In other cases, capital-poor operations took even less precaution and stored explosives in sheet metal boxes similar to doghouses, in earthen pits roofed with corrugated metal, or in abandoned prospect adits.

Aerial Tramways

San Juan County possesses extremely hostile terrain. Some of the county's most promising mines were also some of its most inaccessible. Sheer cliffs, excessively steep slopes, heavy snowpack, and ragged bedrock confounded numerous attempts to establish roads negotiable by wagon. Some locations were so difficult to reach that pack trains were the only viable means of transporting in materials and hauling out ore. Inadequate transportation had the potential to ruin otherwise profitable operations. Pack trains were costly, and approximately eleven burros or donkeys were required to carry out one ton of ore. The aerial tramway, for which San Juan County became known, was a productive solution to the transportation problem.[582]

Andrew S. Hallidie, a San Francisco engineer and mining machinery maker, was the first to develop a continuously operating tramway with a significant carrying capacity. In the late 1860s, he devised a system that consisted of a series of wooden towers, a continuous loop of wire rope, and loading and unloading terminals at both ends. A procession of ore buckets was fastened to the wire rope and traveled a circuit between the stations. The system operated under gravity, and as the loaded buckets gently descended downslope, they pulled the light empty ones back up to the mine. The wire rope passed around large sheave wheels in the terminals, and in

[582] Ihlseng, 1892: 137.

between coasted over idler wheels on timber cross-members, which were bolted to the towers. When empty buckets entered the top terminal, workers loaded them with payrock while the buckets were in motion. The buckets then passed around the sheave wheel and traveled down to the bottom terminal. When the buckets entered the bottom terminal, a guide rail upset them such that they dumped their contents into a receiving bin, and then returned to the top terminal. Hallidie's design changed little from the 1870s, when mining companies began experimenting with it, until the 1890s when other designs came to dominate.

Although the Hallidie design was the best contemporary tram design for moving large volumes of ore, it had limitations. Theodore Otto and Adolph Bleichert, two German engineers, developed an alternative system introduced to Europe in 1874. The *Bleichert Double Rope* tramway utilized a *track rope* spanning from tower to tower, and a separate *traction rope* that tugged the ore buckets around the circuit. The track rope was fixed in place and served as a flexible rail, which the buckets coasted over on special hangers fitted with guide wheels. The traction rope attached to the bucket hanger via a mechanical clamp known as a *grip*. Like Hallidie Single Rope tramways, Bleichert Double Rope tramways incorporated top and bottom terminals where the buckets were filled and emptied, usually aided by gravity.[583]

The principal difference lay with the grip, which was releasable and allowed workers to detach the buckets from the traction rope and stop their motion. The workers could thus manually push the buckets around the interior of the terminal on suspended rails and fill them at leisure without spillage. The double-rope system also permitted the entire tramway circuit to be extended up to four miles in length and at almost any pitch. Given this, even though Bleichert systems were up to fifty percent more expensive than Hallidie tramways, they proved better for heavy production because they had greater carrying capacities.

Mining companies began experimenting with Bleichert Double Rope systems in the 1880s, and due to superior performance, Bleichert systems eclipsed the less expensive Hallidie tramways by the 1890s. Still, some companies with limited production and moderate amounts of capital continued to install Hallidie systems after the turn of the century. Designing and building aerial tramways were beyond the skills of most engineers because the systems were complex and required advanced economic and engineering calculations. Installation usually required at least some direction from technicians dispatched by the tramway maker. Although mining companies purchased standardized tramway equipment from manufacturers, rarely were two systems alike in the county, in part because the physical and economic conditions of each mine were different.

Tramway systems were materials-intensive and required substantial structures. The basic components included a top terminal near the tunnel or shaft, a bottom terminal located adjacent to a road, railroad, or ore concentration mill, and a series of towers for the bucket line. Engineers developed four basic types of towers for both Bleichert and Hallidie systems. These included the *pyramid* tower, *braced hill tower*, *through tower*, and *composite tower*. The pyramid tower consisted of four upright legs that joined at the structure's crest. The through tower resembled an A-shaped headframe consisting of a wide, rectangular structure stabilized by fore and back

[583] Ihlseng, 1892: 138; International Textbook Company, 1905: 122; Lewis, 1946: 372; Peele, 1918: 1563; Robert A. Trennert, *"From Gold Ore to Bat Guano: Aerial Tramways in the West,"* The Mining History Journal (1997): 6.

braces, the tram buckets passing through the framing. Composite towers usually had a truncated pyramid base topped with a smaller frame supporting a cross-member. The braced hill tower was similar to the through tower, except it had exaggerated diagonal braces tying it into the hill slope. Towers for both Bleichert and Hallidie systems required stout cross-members that supported the wire ropes. Towers had to be far away enough so the buckets could swing in the wind and not strike the towers. Hallidie systems, with their single-wire rope and fixed buckets, needed only one cross-member with several idler wheels or rollers. Because the buckets suspended from a long hanger fixed onto the cable, the cross-member was bolted to the top of the tower. Bleichert systems, on the other hand, required a stout cross-member at the tower top to support the stationary track cable, and a second cross-member 3' to 7' below to accommodate the moving traction rope. The second cross-member almost always featured either idler wheels or a broad, steel roller.

Tramway terminal design challenged engineers with integrating the system with ore production. Terminals had to be physically arranged to permit the input and storage of tons of ore, facilitate the transfer of payrock into or out of the tram buckets, and resist the tremendous pull on the sheave wheel by the traction rope. In the case of Bleichert systems, terminals also anchored the track cables. Mining engineers designing small-capacity tramways attempted to solve all of the above problems within a single structure, while the terminals for large-capacity tramways required complex buildings.

Regardless of the type of tramway, the engineer had to design timber framing for the sheave wheel capable of resisting the tremendous horizontal forces of keeping the traction rope taut. The sheave in the top terminal usually fixed to a heavy timber framework anchored to bedrock and partially buried with waste rock ballast. In some designs, the wheel canted at the same angle as the pitch of the bucket line, so the cable did not derail, causing a potentially costly and fatal catastrophe. With Bleichert systems, framing usually surrounded the sheave for maximum strength, unlike Hallidie systems. Because the buckets were fixed to the traction cable, they had to pass around the wheel, which meant the wheel had to be exposed on all but the front side. Typical sheave wheels, 6' in diameter for small systems and 12' for large systems, featured a deep, toothed groove for the rope, fixed onto a heavy steel axle set in cast-iron bearings bolted to the timbers. Brake levers, usually installed in both terminals, were typically very long to provide leverage, located adjacent to or on a catwalk immediately over the wheel. The lever controlled heavy wooden shoes that pressed against a special flange fastened to the sheave wheel. At the bottom terminal, the sheave had to be moveable to take up slack in the bucket-line. In many cases, the wheel was fastened onto a heavy timber frame pulled backward by adjustable anchor cables or threaded steel rods.

Both Hallidie and Bleichert tramways were typically too large and expensive for smaller operations. Yet, rugged terrain and locations high on the sides of mountains presented no less of an access problem for these limited operations. In response, smaller companies erected *single-rope reversible* and *double-rope reversible* trams. Well-engineered single-rope trams consisted of simple components. A fixed line extended from an ore bin located high up at the mine down to another ore bin below. A hoist at the mine wound a second cable that pulled a bucket up, and when the bucket was full, a worker lowered it via hand brake. Double-rope tramways, also known as *jig backs*, featured two fixed lines and two buckets that counter balanced. A worker lowered a full bucket down to the bottom terminal with a hand brake, and it pulled the lighter, empty one up to the top terminal. Lengthy double-rope tramways often featured a series of towers similar to those for Bleichert systems.

Ore Beneficiation: Smelting, Ore Concentration, and Amalgamation

Mining was the first stage in a long process to convert ore into refined metals for consumption. When extracted from the ground crude ore required treatment to separate the metal content from waste. The industry referred to the entire process as beneficiation, with numerous steps involved. The process was not straightforward because in San Juan County nearly all forms of ore were highly complex blends of silver, zinc, lead, copper, and gold, which strongly resisted treatment. This forced metallurgists to develop advanced chemical and mechanical processes. Simple pure ores, and some did exist, required few steps, while complex ore required time-intensive treatment. In overview, the process began with crushing and grinding the ore, followed by separating metalliferous material from waste through *concentration*. The resultant *concentrates* roasted and smelted in a furnace, which furthered separation and yielded a blend of metals known as *matte*. Advanced smelters located in Durango, Denver, Golden, Colorado Springs, and the Midwest refined matte into pure metals or *bullion*.

In San Juan County, a variety of facilities carried out one or all of the steps necessary to process crude ore. They operated either as independent mills or in conjunction with specific mines. *Smelters* were turnkey facilities that reduced crude ore to metals and matte. The Greene, Martha Rose, Walsh, and Kendrick-Gelder smelters operated sequentially in the county between 1874 and 1909. The Durango and Standard smelters operated in Durango between 1882 and 1931. Unlike smelters, *concentration mills* did not reduce ore to matte, but instead, merely separated waste from ore metal content. *Amalgamation mills*, rare in the county, crushed gold ore and relied on mercury to amalgamate with the gold.

Smelters

To produce metals, smelters incorporated mechanical, chemical, and roasting processes that a metallurgist tailored to the general character of the county’s ore. Basic smelting began when wagons delivered crude ore to the facility, where workers dumped it 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 before loading 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 saw use in the county. The earliest, employed by the Rough and Ready and Little Dutch smelters, 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 were supposed to collect molten liquid as it ran off the ore and segregate the metal content from slag according to gravity. The exact design of these early smelters is unknown, because they largely failed.

The most successful furnaces, employed at the Martha Rose smelter, were cylindrical steel vessels 4' to 12' in diameter and lined with fire bricks. They stood on stout rock or brick masonry foundations and featured tap spouts and tuyeres, ports that admitted air blasts at graduated intervals. At center was a columnar charge of fuel, where workers dumped crude ore 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.[584]

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 the 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 appeared, indicating an end to the metal. Workers repeated the process, keeping the furnace in continuous operation for days or weeks.[585]

Because metallurgists used gravity to draw ore through the processing stages when possible, they usually sited smelters at the base of 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, assay office, and vault. Each smelter 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. Some smelters also featured roasters and mechanized concentration mills to prepare the ore and enhance separation prior to smelting.

Concentration Mills

Only a few companies in San Juan County possessed enough capital and ore to warrant the erection of a dedicated smelter. Most companies shipped their ores to custom smelters, which extracted the metals for a fee. The shipping charges and smelting fees often constituted considerable overhead, and in response, well-capitalized mining companies attempted to save money by building concentration mills near their workings. Concentration mills relied on mechanical and chemical processes to reduce ore, separate the metalliferous materials, and prepare the resultant concentrates for shipment to a smelter for final treatment. In so doing, mining companies accomplished many intermediate steps that smelters charged for and did not

[584] Lynn Bailey, *Supplying the Mining World: the Mining Equipment Manufacturers of San Francisco 1850-1900* (Tucson: Western Lore Press, 1996) 80; Will Meyerriecks, *Drills and Mills: Precious Metal Mining and Milling Methods of the Frontier West* (Tampa: 2001) 173.
[585] Bailey, 2002: 82-3; Meyerriecks, 2001: 174.

have to ship heavy crude ore. Concentration mills were not equipped, however, to produce finished bullion.

Concentration mills were usually built over a series of terraces incised into a hillslope so gravity could draw the ore through the various processing stages. Mills existed in a variety of sizes, and large facilities usually required stone masonry or concrete terraces, 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, and even tertiary stages of crushing, screening, and concentration. The Silver Lake Mill even featured several parallel sequences of these processes. Small mills, by contrast, usually provided 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 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" in diameter, which descended to a *secondary crusher* located on the platform below. The secondary crusher pulverized the ore to sand and slurry, to pass through a screening system. Oversized material returned for secondary crushing while the remainder passed on to concentration at smaller mills, or tertiary crushing followed by concentration at larger mills. By 1900, engineers favored *trommel screens* or *shaking screens* to sort the sand. A trommel consisted of a concentric series of cylindrical screens that rotated, allowing fine material to drop through while oversized cobbles rolled out of an open end. A shaking screen was a stack of rectangular pans with screen floors.[586]

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 metallurgical assessments were alike, each mill was custom. However, engineers followed certain trends 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 that mill workers partially filled with sand, gravel, and water. The cylinder slowly rotated, and the iron rods in tube mills or iron balls in ball mills tumbled in the chamber,

[586] Peele, 1918: 1623, 1627; Tinney, 1906: 191.

reducing the material to slurry. Both grinding appliances rose to popularity around 1900 and by the 1930s were used in place of crushing rolls and stamp batteries. The end product of crushing and grinding were *fines* and *slurry*.[587]

Following another screening, ore descended to subsequent mill platforms for concentration Several devices proved efficient at separating out metals, and most metallurgists assembled a concentration sequence involving more than one appliance. The *jig* relied on water currents and agitation to separate heavy metalliferous material and classify particles by size and weight. The jig consisted of a wooden trough, often 4' x 9' in area and 4' 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 the county from the late 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' x 15' in area, was suspended by an oscillating mechanism from a chassis bolted to a timber foundation. The belt moistened and as the machine vibrated, heavy metalliferous material settled against and stuck to the rubber while a jet of water washed off waste. As the belt wrapped down around one of the rollers, the metalliferous material dropped into a flume and proceeded for further concentration.[588]

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, Colorado, in 1896. By the 1910s, metallurgists adapted the concept for nearly all types of metal ores. A vibrating table featured a tabletop, often 5' x 15' in area, clad with rubber or linoleum held down with fine riffles. The tabletop slanted 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. Edward Stoiber and his metallurgist Robert J. McCartney designed the Stoiber-McCartney table specifically for San Juan County ore.[589]

By the mid-1910s, *flotation cells* proved their worth operating according to principles that seemed to defy traditional concentration technology. The technology pioneered in the county in 1914 and concurrently elsewhere in the state, became rapidly common. Local metallurgist Louis Bastian designed his own version. Flotation cells consisted of a large rectangular tank divided into compartments filled with water and slurry. Oils or detergent compressed air while agitators worked the mixture into froth. In contrast to other devices, the froth carried metalliferous material upward while wastes settled to the bottom of the cells. Revolving paddles then swept the metalliferous material into troughs.

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[587] Peele, 1918: 1630.
[588] Lynn Bailey, <u>*Shaft Furnaces and Beehive Kilns: A History of Smelting in the Far West, 1863-1900*</u> (Tucson: Westernlore Press, 2002) 64, 112; Tinney, 1906: 204.
[589] Peele, 1918: 1680; Tinney, 1906: 204.

While vibrating tables and flotation cells proved effective for silver and industrial metal ores, they provided limited success for complex gold ores, including telluride. At the turn of the century, mining companies first in Cripple Creek and then in Boulder County began experimenting with *cyanidation*, pioneered in New Zealand. Cyanidation crushed and ground ore as above, concentrating it into slurry. A worker transferred the metalliferous material into *cyanide tanks*, large wooden vats that agitated the slurry in a dilute cyanide solution. The cyanide bonded with gold, the waste flumed out, and a worker tapped the solution into *precipitating boxes* where he introduced zinc, to which cyanide attracted over gold. The chemical reaction caused the precious metal to precipitate out. Cyanide mills featured one or a series of cyanide tanks, depending on the purity and volume of ore.

Most mill processes liquefied slurry with water to mobilize the material and allay dust. However, at the end of the process, concentrates had to dry for shipment. Engineers installed various dewatering devices ranging from conical and pyramidal settling boxes to Dorr thickeners. Mill workers introduced slurries into settling boxes where the fines accumulated and exited through spigots in the bottom. The Dorr thickener, devised for high volumes of material, featured a tank at least 20’ 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.[590]

Gravity drew the metalliferous fines from one crushing and concentration stage to the next. However, each step also facilitated returning inferior material back for reprocessing, which often meant sending the 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, via which buckets emptied into one another. Spiral feeds, effective for moving fines short distances, typically featured an auger that rotated in a sheet iron shroud. As the auger turned, it moved material upward and deposited it into a bin.

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 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 1900, with electricity commonly available in the county, engineers began using motors.

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, a component of a concentration mill. Under the right mineralogical conditions, companies based an entire facility around a stamp battery to recover metals without smelting or advanced concentration. The ore had to feature relatively simple gold

[590] Peele, 1918: 1669.

or silver compounds and be easily crushed. A jaw crusher usually provided primary crushing, while stamps further reduced the ore. 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 only required a fraction of the equipment installed at more complex concentration mills, they were smaller and simpler. Regardless, stamp mills shared a few fundamental aspects. First, due to the various stages of crushing and metals recovery, these facilities were also arranged on a series of platforms to use gravity to advantage. Second, stamp mills usually featured a receiving bin above the primary crusher to hold crude ore destined for processing. Third, the mid or lower platform housed the power source, often a horizontal steam engine and boiler. Last, the mill required a water source. Metallurgists often also installed tertiary crushing and a concentration appliance in some stamp mills to better prepare the ore for amalgamation. In such cases, the mill became an *amalgamation stamp mill*, such as the Intersection Mine in the Eureka district.

Arrastras

An arrastra was a simple and inexpensive, yet labor-intensive and inefficient means of recovering metals from ore. Arrastras primarily functioned during the first years of hardrock mining in San Juan County to treat simple gold ore. The county's first mine, the Little Giant, relied on an arrastra. While a few capital-starved outfits continued to employ the technology through the 1910s, the quick exhaustion of simple gold ore rendered these primitive treatment facilities obsolete by around 1875.

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' in diameter. A beam 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, while the mullers featured convex bottoms and iron hooks hammered tight into drill holes. The traditional Spanish arrastra relied on slave labor as motive power, which draft animals replaced. With the improvement of technology, scarcity of labor, and desire for increased 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.[591]

To build an arrastra, a worker leveled a platform, excavated a pit at center, and installed the capstan, which had to be stout enough to resist great horizontal force. The worker paved the platform with a layer of fine clay and carefully fitted the floor stones together using more clay as mortar. With the floor complete, he erected the sidewall, which consisted either of more

[591] Meyerreicks, 2001: 194.

stonework or planks. During the twentieth century, concrete became a substitute for masonry. Once the beam and mullers were in place, the arrastra was ready for operation.[592]

Running an arrastra required more skill and experience with local ores than engineering or formal metallurgy. First, a worker scattered a *charge* of ore across the arrastra's floor, completely covering the stones, and 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 mixture. The mullers continued to reduce the ore into a combination of sand and fine particles known as *slimes*. 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 with local ores came into play, as the arrastra operator added enough mercury to form an amalgam paste, but not in excess, at peril of creating 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.[593]

The next stage of arrastra ore processing was *cleanup*, where worthless *gangue* was removed and the amalgam recovered from the arrastra's interior. First, the operator drained the interior either by bailing, breaching the sidewall, or opening a port near the wall's base. The operator then shoveled the sand and slime out, leaving a mud and sand layer on the flooring stones. The operator 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. The operator next disassembled the floor stones, if small, and washed and scraped off the amalgam. 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. Finally, the operator rebuilt the arrastra and repeated the process with another load of ore.[594]

[592] Young, 1987: 69-71.
[593] Meyerreicks, 2001: 143, 195; Young, 1987: 71.
[594] Ibid.

Section F: Property Types and Registration Requirements

INTRODUCTION

Section F describes the property types common to San Juan County's historic mining industry. The types are categorized by function: prospecting, mining, beneficiation of ores, and associated settlement. The objective is to standardize cultural resource management and historic preservation, and to contextualize information for education and interpretation. A list of common archaeological, engineering, and architectural features follows the property types. These descriptions were reproduced from the statewide Multiple Property Documentation Form, *The Mining Industry in Colorado* with author permission and as adapted to the resources of San Juan County. Registration requirements have been tailored to conditions specific to the county. The researcher should review the mining methods and equipment in Section E for additional background and terminology. The Periods of Significance and relevant National Register of Historic Places (NRHP) Areas of Significance are summarized below. A Period of Significance is defined as a discrete timeframe during which formative trends and events occurred. Although this discussion highlights general significance for some areas, individual nomination would in turn further compare and elaborate on the appropriate level of significance.

The following Property Types and Subtypes are developed in this section:

Placer Mine	Hardrock Prospect	Hardrock Mine	Aerial Tramway
Stream Placer	Prospect Complex	Shaft Mine	Single-Rope Reversible
Gulch Placer	Prospect Shaft	Tunnel Mine	Double-Rope Reversible
Hydraulic Placer	Prospect Adit		Hallidie Single-Rope
			Bleichert Double-Rope

Ore Concentration Facility	Smelter	Settlement and Residence	Rural Historic Mining Landscape
Concentration Mill		Prospector's Camp	
Amalgamation Stamp Mill		Workers' Housing	
Arrastra		Isolated Residence	
		Unincorporated Settlement	
		Townsite	

Regarding any nomination of any property type or subtype, the researcher should refer for additional information to the suite of publications published by the National Park Service's National Register of Historic Places program. Of particular interest may be the following National Register bulletins: *How to Apply the National Register of Criteria for Evaluation*; *How to Complete the National Register Registration Form*; *Guidelines for Evaluating and Registering Archeological Properties*; *Guidelines for Identifying, Evaluating and Registering Historic Mining Properties*; *Guidelines for Evaluating and Documenting Rural Historic Landscapes*;

Guidelines for Evaluating and Documenting Properties Associated with Significant Persons; and *Defining Boundaries for National Register Properties*.

OVERVIEW OF PERIODS AND AREAS OF SIGNIFICANCE

The Gold Rush, 1860 – 1861

The first Period of Significance began in 1860, when Charles Baker and party discovered gold in Baker's Park, and ended the following year with the dissolution of the ensuing rush. Exploration/Settlement is the most relevant Area of Significance and possesses aspects of statewide significance. The so-called San Juan Humbug was the earliest rush and resulted in a large incursion of new settlers into southwestern Colorado. While gold was the initial premise, the actual product was initial exploration and quantification of the San Juan mountain region. Later, this knowledge played a key role in permanent settlement, establishment of San Juan and adjoining counties, and growth of a nationally celebrated mining industry. Few historic resources clearly attributable to the Baker's Park rush survive. The dominant activities were simple placer mining and temporary settlement, thus the only resources that may remain are hand placers, prospectors' camps, and cabin sites. Much has been lost to natural decay and land use associated with 110 years of mining and settlement.

Return to the San Juans, 1870 – 1874

The second Period of Significance began in 1870, when the next wave of prospectors arrived to engage in exploration through 1874, by which date the foundation for the mining industry was firmly established. The relevant Areas of Significance are Exploration/Settlement, Industry, and Politics/Government. Dominant activities were prospecting, settlement, and initial development of mines. Associated resources include prospects, small mines, prospectors' camps, and cabin sites. Few historic resources survive, however.

Area of Significance: Exploration/Settlement

In terms of Exploration/Settlement, the county underwent an initial period of exploration, quantification, and development. The first prospectors arrived in the drainage in 1870, developing the Little Giant, the earliest mine, the following year. Its success stimulated further exploration for gold as well as silver after 1872, when it became increasingly apparent that the region possessed abundant silver veins, but fewer gold deposits. By 1874, prospectors established baseline knowledge regarding regional geography and natural resources and in turn a template for the county's pattern of settlement. In 1874, prospectors established camps in the northeast and at the mouths of California and Eureka gulches. These camps later became the towns of Mineral Point, Animas Forks, and Eureka. At the same time, community organizers formally platted Howardsville and Silverton, which grew into the county's population centers. Trends related to exploration and settlement are significant at the local level.

Area of Significance: Industry

In terms of Industry, basic requirements for a viable mining industry were established. First, outside investors began to take an interest in the San Juans, thus introducing capital. By funding the Little Giant Mine, the Greene Smelter, and other operations, the investors established an important precedent. Second, prospectors located and began developing veins, many of which became major producers in future years. In so doing, the prospectors formed a foundation for a mining industry. Finally, three smelters were erected during the Period, and mining in the San Juans was economically dependent on local ore treatment. While the smelters were failures at first, they pioneered the ore treatment industry. The historical trends related to industry were significant mostly on a local level.

Area of Significance: Politics/Government
In terms of the Politics/Government Area of Significance, the Animas River drainage hosted several forms of frontier government during the Period. In particular, prospectors organized the region's first mining districts, and a body of elected representatives drafted laws that regulated behavior. In the absence of formal recognition by the Territorial Legislature, and the unresolved issue of who owned the San Juans, the districts were the only form of government until 1874. At that time, the Territorial Legislature officially took possession of the Animas River drainage, created La Plata County, and designated Howardsville, and then Silverton, as county seat. The historical trends related to politics were significant largely on a local level.

Settlement and Establishment of Industry, 1875 – 1881
The third Period of Significance began in 1875 and ended in 1881, marking a major transition when the factors for a successful mining industry coalesced and fostered a major wave of prospecting and ore production in meaningful volumes. This period initiated enough momentum to secure the industry's future. The Greene Smelter, which began successful operations in 1875, contributed heavily as it provided needed local ore treatment capacity. Between 1875 and 1879, individuals and small outfits developed at least 345 prospects, forty-eight small mines, three medium-sized mines, one large mine, and two placer operations. The large number of prospects and high proportion of small mines highlights that the mining industry was nascent and growing. Prior to 1875, the number of prospects and mines was much smaller. A small mine is defined as an operation with shallow underground workings, a handful of workers, basic surface facilities, and limited output. A medium-sized mine was usually a company endeavor with between five and thirty workers, fairly extensive workings, and a surface plant with at least several buildings. A large mine had extensive workings, a surface plant with multiple components and some machinery, a workforce greater than fifty, and significant output. The period ended in 1881, a year before the Denver & Rio Grande Extension Railroad ushered in another major transition.

The dominant activities during the latter half of the 1870s were prospecting, settlement, and initial development of mines. The most relevant Areas of Significance are Exploration/Settlement, Industry, Commerce, Communication, Transportation, and Politics/Government. Associated resources are prospects, small mines, prospectors' camps, and cabin sites.

Area of Significance: Exploration/Settlement

In terms of Exploration/Settlement, the county's geography was still relatively unexplored when the period began. The areas around Animas Forks, Eureka, Howardsville, Mineral Point, and Silverton had been explored, but not the county's remote recesses and perimeter. During this period, prospectors finally penetrated most of the county and quantified its general geography, although it would be another ten years before the territory was thoroughly explored. Through examination, sampling, and claim development, prospectors defined the areas with the highest concentrations of veins and most of the principal ore bodies in those areas. This information guided investors willing to risk their capital.

Prospectors and community organizers also completed the template for the county's pattern of settlement. Howardsville and Silverton cemented their roles as the county's most important towns, with Silverton assuming the role of administrative, financial, and transportation center. Other towns took shape from prospectors' camps. Mineral Point was the northernmost commercial outpost for the Mineral Point district. Animas Forks and Eureka were the commercial centers for the Eureka district, and Animas Forks was also the eastern gateway into the county. Gladstone was the commercial and, for a brief time, ore treatment center for the Cement Creek drainage. Trends related to exploration and settlement were important on local and statewide levels of significance.

Area of Significance: Industry

A true mining industry finally took hold in the county. Coupled with the Greene Smelter, general investment and infrastructure improvement fostered transition from prospecting to mining, as measured by ore production. Capitalists organized companies that developed nascent prospects into substantial operations, in turn inspiring confidence among other investors. Collectively, the companies, regardless of size or productivity, improved the transportation system, reinforced the settlement pattern, contributed to the local economy, and increased the county's prominence statewide. The industry attracted the Denver & Rio Grande Railroad, whose directors established the town of Durango and financed a large smelter. These two factors increased the upward momentum of the mining industry and allowed it to blossom into a full boom. Trends related to industry were important on local and statewide levels of significance.

Area of Significance: Politics/Government

In terms of Politics/Government, the increase in population and growing prominence of the mining industry altered the political map of southwestern Colorado. The Territorial Legislature carved San Juan County out of northern La Plata County and designated Silverton as county seat. Community organizers established primitive municipal governments to administer to matters for the principal settlements. In the large towns, municipal governments were elected, while in the camps, these consisted of founding members or townsite company officials by default. Local governments conducted improvements, established guidelines for development, and promoted communities. In general, these systems have persisted throughout the county's subsequent history.

Area of Significance: Communications
Commerce, related investment, and politics fostered a need for a communication system superior to word-of-mouth and out-of-date newspapers. As a result, entrepreneurs and the Postal Service established three modes of formal communication. The Postal Service subsidized post offices in Animas Forks, Eureka, Highland Mary, Howardsville, Mineral Point, Niegoldstown, Poughkeepsie, and Silverton. The agency also contracted with carriers who brought mail in all seasons, first from Del Norte and from Durango when the Denver & Rio Grande established its terminus there in 1880. Journalists began regularly printing newspapers in Silverton, and for brief periods in Animas Forks, Howardsville, and Poughkeepsie. Around the same time that Denver received its first telephone, so did Silverton. In 1881, the Colorado Telephone Company established a central office in Silverton and wired a line over Engineer Pass to Lake City. These two offices became nodes of a regional system built over the following several years. These three means of communication contributed to the growth of the mining industry, connected it with the outside world, and improved quality of life in the county.[1]

Area of Significance: Commerce
Regarding Commerce, San Juan County's mining industry and population grew large enough during this period to constitute an economic web with a local, statewide, and national role. In terms of investment, most individuals who developed prospects and small mines were of regional importance, some larger operations on a statewide scale, and a few based outside of Colorado. Their capital supported growth of the county, development of its mining industry, and associated communication, banking, and commercial systems. Prospecting and mining in the county's districts further contributed to regional, statewide, and national consumer markets. Mining companies diverted money into the local economy by paying wages to their workers, hiring consultants for various services, and purchasing small items from businesses in the major towns. Such expenditures directly fostered growth of the local economy. Companies acquired large machinery and other industrial goods from manufacturers in Denver and to a lesser degree outside of Colorado. The manufacturers in Denver in turn purchased their materials from sources within and outside of Colorado. The mining companies and prospectors in the county thus supported Colorado and other industrial economies. Miners and prospectors consumed food and other domestic goods purchased. Packing companies shipped preserved food from the Midwest and on west coast, while fresh food came from Colorado farms and ranches. Domestic goods came from manufacturing centers nationwide, primarily in the east.

Area of Significance: Transportation

[1] Nossaman, 1998: 38, 68.

An efficient transportation system was as important for mining and local ore treatment. At first, mining interests relied on burros and pack trails to import needed materials and export ore. Because this system limited the movement of freight, development was slow and productive mines were able to produce only the highest grades of ore, which were in short supply. Between 1875 and 1881, the San Juan County commission and local investors developed basic regional network of wagon roads. A network of feeder roads directed wagon traffic from all major drainages to transportation, milling, and commercial centers in the Animas River valley. Trunk lines connected the valley with Otto Mears' toll road system to the east at Lake City and all-season roads in the lowlands to the south. Wagons decreased the cost of freight and increased the tonnages of ore that could be shipped, thus allowing mining companies to increase production. The increased production in turn encouraged activity and investment and fostered further industry expansion.

The Early 1880s Boom, 1882 – 1885

The fourth Period of Significance began in 1882 and ended in 1886, during which time the mining industry reached a boom state and boosted San Juan County as one of Colorado's most important industrial regions. The transportation and smelting network that the Denver & Rio Grande Railroad established in 1882 created the conditions for the boom. In particular, decreased freight costs, local smelting and ore concentration at reasonable rates, and an increase in the amount and variety of goods available in the county were key contributing factors. The net result was that the cost of production fell for mining companies with the shipment of higher tonnages of ore, medium-grade payrock now rendered profitable to produce, and quality of life improved. The number of mines that produced ore between 1882 and 1885 nearly doubled from the previous peak of the late 1870s. Similarly, population rose from around 1,100 people in 1880 to 2,000 in 1885. Ore production increased exponentially from a total of $40,000 for silver, gold, and lead in 1880 to almost $1 million in 1885. However, countywide problems began to materialize in 1885 and reflected in 1887 production figures, a total of $607,000 for all metals. The downward trend indicated that the mining industry was passing into a slump.[2]

During this period, San Juan County hosted events and trends significant on local, state, and national levels. Mine development, ore production, and community organization dominated, with relevant Areas of Significance including Industry, Engineering, Commerce, Communication, Community Planning and Development, Transportation, and Politics/Government.

Area of Significance: Industry

Mining reached one of its greatest production peaks between 1875 and 1881, a key indicator of a discrete Period of Significance. While mining comprised the underpinning of Euro-American settlement in San Juan County, the industry's ability to attract the railroad and Durango Smelter changed the entire region. Denver & Rio Grande officials graded the railroad and built the

[2] Henderson, 1926: 216; Schulze, 1977: 1880-3; Schulze, 1977: 1885-1891.

smelter due to the business potential offered by the mining industry, which conversely caused the mining industry to boom. As during the late 1870s, companies continued to improve the transportation system, reinforce the existing settlement pattern, contribute to the local economy, and increase the county's prominence. Productive mines generated so much ore that they fostered a wave of local ore buying and treatment facilities, which complimented the final processing offered by the Durango Smelter. By providing a market for ore from small mines, the facilities fostered an overall increase in production.

Area of Significance: Engineering
The mining industry depended on effective milling methods for treating ore and separating metals content from waste. Determining effective methods was complicated by the complexity of the ore, which also differed in character from mine to mine. During the 1870s and early 1880s, a number of firms built smelters and concentration mills. Nearly all failed, eroding confidence in the county's mining industry. This period eventually saw expert metallurgists puzzle out the problems and devise successful methods for specific areas in the county. While many failures still followed, successful mills set a lasting precedent that ultimately saved the industry.

Area of Significance: Communications
Communications remained important during this period, and their function and role as outlined previously continued. The mining industry, population, and business sector all supported the communication systems developed previously, as well as expansion of the telephone network and construction of a telegraph line to Durango.

Area of Significance: Commerce
Commerce increased and became more influential as the county's economy grew in wealth and complexity.

Area of Significance: Community Planning and Development
During the late 1870s, the county's pattern of settlement materialized as a function of exploration and prospecting, thus partially in flux. The arrival of the railroad, resultant boom, and development of the Red Mountain district (Ouray County) cemented nascent patterns, which changed little for the next twenty-five years. The county's most important towns thrived in the Animas River valley, including, west to east: Silverton, Howardsville, Middleton, Eureka, and Animas Forks. Secondary towns appeared in minor drainages and included Chattanooga at the head of Mineral Creek and Gladstone in Cement Creek. The hamlets of Poughkeepsie and Mineral Point occupied the county's northeastern reaches.

These settlements assumed particular roles in response to conditions created by the boom. Silverton fulfilled many functions, broadly as the principal point of entry into the county and gateway into the Red Mountain district. The town was also the exchange point where people and goods flowed into the county and ore flowed out. Given this, Silverton was the county's commercial, communications, financial, transportation, social, and administrative hub.

Howardsville served a similar function for the Las Animas and southern Eureka districts, in addition to serving as source for most of the county's meat and dairy products. Middleton was a working community for the mines around Minnie and Maggie gulches. Eureka served the commercial needs of the central Eureka district. Animas Forks was larger than Eureka because it was the eastern gateway into the county, a commercial center for the northern Eureka district, and a base for local miners. Chattanooga was the commercial point for the upper Mineral Creek drainage and entry into the Red Mountain district. Gladstone was center to a tiny mining industry, and Poughkeepsie and Mineral Point were primarily prospectors' camps that offered a few services.

All the county's settlements experienced significant growth during the boom. The degree to which a municipal planning process, or divisions among class and ethnicity, guided growth remains unknown. Animas Forks, Chattanooga, Gladstone, Mineral Point, and Poughkeepsie followed growth patterns typical of mining camps. Specifically, collections of prospectors' cabins served as nuclei, a few businesses followed, and additional residents congregated around the businesses. The only constant was an attempt to develop some semblance of a "main street. By contrast, Eureka, Howardsville, and Silverton were formally platted with lots, blocks, and streets on a defined grid. While these towns were the most prominent communities, other settlement subsisted. Most mines and prospects were too far for a reasonable commute by foot, so miners and prospectors lived at their points of work. The residences at large mines often were boardinghouses, while cabins sufficed at smaller operations. Broadly speaking, worker residences scattered amid mines was a settlement pattern typical of the entire Rocky Mountain region. The location of the mine and the suitability of adjacent sites were the primary governing factors.

Area of Significance: Transportation

Investors, in conjunction with the county commission, improved the road network essential for mining. In addition, the county paid to build a road from Chattanooga over Red Mountain Pass and into the Red Mountain Mining District. The purpose was to increase the county's relationship with the district and secure a role as gateway community over rival Ouray. The arrival of the railroad was a critical transportation event during this period, dramatically lowering the costs of mining and living, increasing tonnages of ore that companies could ship, providing a direct link with the Durango Smelter, making a wider variety of goods available at lower prices, and improving the overall quality of life. The railroad was a principal agent that allowed the mining industry to boom.

Area of Significance: Politics/Government

Regarding Politics/Government, trends in county and local government continued. In addition, the success of industry increased the political standing and power of investors and government representatives, which they used to influence state and federal policy. For example, because the county's mining industry depended on silver, legislators and politically connected investors fought change to the federal policy on silver acquisition.

The Value of Silver is Restored, 1890 – 1893

This period began in 1890 and ended in 1893. An increase in the value of silver in 1890 brought the mining industry out of the major recession of the latter half of the 1880s caused by a variety of factors. First, miners exhausted most of the county's shallow ore veins, forcing mines to close because veins had little left to offer. Second, substantial veins contained large ore reserves, but the character of the ore became complex, low in grade, and difficult to treat with depth. Most of this ore was thus unprofitable with existing technology. Third, the price of silver and industrial metals declined during the latter half of the 1880s. As prices fell, mining companies found that the cost of extracting available ore exceeded returns and suspended operations. The lack of production and troublesome ore in turn impacted the milling sector, spread throughout the local economy, and affected business and population. The federal government increased the price of silver by means of the 1890 Sherman Silver Purchase Act, stimulating a countywide revival and reversing some of the problems created by the recession. However, the revival was not immediate and required a year to fully take hold. The value of silver began to ebb again and the Sherman act was repealed in 1893.

During this period, San Juan County hosted events and trends significant on local, state, and national levels. The relevant Areas of Significance include Industry, Engineering, Commerce, Communication, Community Planning and Development, Transportation, and Politics/Government. The dominant activities were mining, ore treatment, ongoing residence, community building, and construction of infrastructure.

Area of Significance: Industry

The mining industry continued as the main stimulus for Euro-American presence in San Juan County, as well as the foundation for the economy and institutions on which business and population depended. San Juan County's industry was also the principal supporter of the railroad and Durango Smelter. By providing these entities income, the county's mining industry contributed to the success of mining elsewhere in the San Juans. The railroad and Durango Smelter provided needed transportation and cost-effective ore treatment.

Area of Significance: Engineering

Engineering was critical on a local level during this period, with several sub-areas worthy of consideration. Regarding milling and ore treatment, the mining industry depended increasingly on effective methods for treating complex, low-grade ore. Finding effective methods required calculation, knowledge of metallurgy, and trial and error. Successful mills served as templates. Failed mills exemplified conventional practices and types of appliances that not applicable to regional ore.

The second sub-area is electricity. The mining industry relied primarily on steam and draft animals for power due to the cost of hauling in steam equipment and fuel, except for those extremely well-funded operations. This limited remote outfits to only small tonnages of high-grade ore. However, electricity had the potential to revolutionize mining. In theory, mining companies merely had to haul motors into the backcountry and transmit power over wires from a convenient generation point. During the early 1890s through the turn of the century, electrical technology was in an experimental state not yet fully adaptable to the needs of mining. Direct current (DC) motors could start and stop under load, as required for many mining applications, but could not be transmitted far without suffering significant power losses. Current thus had to be used close to the point of generation. For remote mines, hauling in a generator, its power source, and motors provided little advantage over steam equipment. Alternating current (AC), by contrast, could be transmitted far, but AC motors were unable to start and stop under load and were therefore impractical for machinery such as hoists and large air compressors. Despite these drawbacks, a few highly progressive mining experts in the county harnessed electricity in an attempt to lower operating costs. Stoiber built one of the earliest AC systems in the mining industry to run mill machinery at Silver Lake Mine. John Terry installed a DC system at the Sunnyside Midway Mill in Eureka Gulch, and in so doing minimized the amount of fuel coal that had to be regularly carried up. Edward M. Brown did likewise at the San Juan Chief near Mineral Point. These successful applications contributed to the development of electrical technology and its application to mining, rendering the San Juans a center of electrical technology.

The third sub-area is aerial tramways. In the San Juans, where topography is extreme, transporting ore from mine to mill was slow and costly. As illustrated by the Little Giant Mine in Arrastra Gulch, aerial tramways offered a solution because ore could be lowered down to a mill or shipping point, regardless of terrain or weather. In general, the greater mining industry adopted the technology gradually because of its high initial cost and exacting engineering. By the early 1890s, companies realized that the expense would quickly be offset by reduced shipping costs and increased production. During this period four companies successfully experimented with the technology. Thomas Trippe operated a tramway at the Titusville in 1889, the San Bernardino company in 1890, Rasmus Hanson in 1891, and the Victoria company in 1893. These tramways exemplified the efficiency of this transportation solution. Within a few years, many companies followed, and the San Juans became a center of tramway engineering.

Areas of Significance: Communications, Commerce, and Politics/Government

Communications, commerce, and politics/government remained significant as the types of systems and their roles defined above continued.

Area of Significance: Community Planning and Development

Community Planning and Development remained significant for specific settlements. During the first half of the 1880s, the county's general pattern of settlement matured. The pattern then contracted as a result of the late 1880s recession, and all settlements shrank while a few neared abandonment. By the early 1890s, the pattern stabilized and principal towns thrived. However, because the towns did not grow much, there was little additional municipal planning. Of note, Animas Forks, the commercial center of the northern Eureka district, declined. When the town burned in 1891, most remaining residents and businesses left. Chattanooga and Gladstone revived on minor scales, while Poughkeepsie was abandoned.

Area of Significance: Transportation
Regarding transportation, mining companies and the county commission continued to improve the road network requisite for mining. The railroad remained a principal agent allowing the mining industry to revive.

The Silver Crash, 1894 – 1897
The sixth Period of Significance began in 1894 and ended in 1897. The Silver Crash of 1893 caused the value of silver to topple to its lowest point since Colorado achieved statehood. The price collapse at first wrecked mining in the west and in turn contributed to one of the worst economic depressions to strike the nation. Colorado and San Juan County suffered deeply and underwent major transitions. Colorado entered a depression, but the county adjusted and ultimately faired better than most of the state's other mining regions. Although fewer mines were active than during the early 1890s, the production of gold, silver, and lead increased.

First, the owners of several of the county's largest mines pursued the strategy of producing and milling ore in economies of scale. Through heavy capital investment, advanced technology, and carefully designed mills, the companies lowered operating costs enough to render low-grade ore profitable to produce. This type of ore was the most abundant resource in the county but had been ignored in favor of higher grades of material. When economic conditions forced the matter, well-financed outfits realized they either had to cease operating or find a way to profit from the low-grade ore. They succeeded, and their significant yield made up the bulk of the county's overall production.

Secondly, some investors used the poor economic climate to purchase proven mines offered for sale. At the same time, a few owners unwilling to allow their properties to remain idle attempted to reopen. Both groups invested capital in development and machinery to lower operating costs and increase output, which also contributed to the county's production figures. Nearly all county mining districts saw several such ventures, although while county production figures were substantial, this did not reflect a vibrant mining industry. Most mines remained idle or operated at reduced capacity.

The last factor was a strong interest in gold. With the price of silver at an all-time low, mining outfits focused on ore with high gold content because that metal held a constant value. Most mines that generated substantial tonnages of ore prioritized gold and considered silver to be secondary profit. Because nearly all ore in the county featured gold and silver in combination, the pursuit of gold resulted in the production of silver as well. The interest in gold fostered the first true rush that the county witnessed in years. When gold ore was discovered in the Bear Creek drainage in 1893, it created a considerable excitement. The town of Sylvanite, also known as Bear Creek, and a handful of profitable mines resulted, but were short-lived. The period ended in 1897, when economic recovery drew the mining industry into one of its most important eras.

During the sixth Period, San Juan County hosted events and trends that were important on local, state, and national levels. The applicable Areas of Significance include Industry, Engineering, Commerce, Communication, Community Planning and Development, Transportation, and Politics/Government. The dominant activities were mining, ore treatment, ongoing residence, community building, and construction of infrastructure. .

Area of Significance: Industry

The mining industry continued as foundational for the population, economy, and other institutions, largely as a function of large productive mines since most small operations were idle. The railroad and Durango Smelter also remained central to the central San Juans during the post-Silver Crash depression because they provided the only cost-effective transportation and ore treatment. Without them, the regional mining industry might not have survived. Owners of the large mines pioneered and demonstrated how production and milling in economies of scale could offset the low value of silver and render low-grade ore profitable. This required major capital investment to employ mechanization and automation to lower operating costs and maximize output. Few companies were able to employ this strategy because capital was scarce, but by the late 1890s,the practice swept Colorado's mining industry and helped it to restore the economy. According to some industry experts, San Juan County was the birthplace of the economies-of-scale strategy.[3]

Area of Significance: Engineering

Engineering was significant on local and national levels during this period. The sub-areas of milling, electricity, and tramways, were vital to production in economies of scale, the strategy for which hinged on exploiting low-grade ore as a commodity, only possible through efficient ore treatment. Successful companies overcame problems that had vexed mill operators for nearly two decades, devising effective concentration methods through calculation, knowledge of metallurgy, invention, and an understanding of how to adapt existing equipment. Electricity facilitated savings on energy costs. These companies improved generation and transmission technology in addition to electrical application to mining. Similar evolutions impacted aerial tramway engineering, which large companies increasingly relied on to reduce the costs of transporting ore to their mills and supplies up to the mines. Some of Colorado's longest systems included those built for the Iowa, Siler Lake, and other local operations. Application of engineering technologies and machinery on a massive scale enabled production, transportation, and concentration of ore in unprecedented volumes. In turn, machinery was refined and applied to increasingly specific functions and integrated into complex systems through engineering, coordination, planning, and management.

Areas of Significance: Communications, Commerce, and Politics/Government

[3] Burbank and Luedke, 1969: 4; Ransome, 1901: 23; *Silverton Standard* (11 Jan 1902).

Communications, Commerce, and Politics/Government remained significant during this period in roles defined above.

Area of Significance: Community Planning and Development
The trends discussed continued to apply, although the southeastern county received its first and only settlement in response to the minor gold rush at the end of 1893. Bear Creek, formally known as Sylvanite, remained viable into the mid-1890s.

Area of Significance: Transportation
Regarding transportation, mining companies and the county commission continued to improve the road network, as Otto Mears built the Silverton Northern Railroad from Silverton to Eureka, lowering the cost of transportation for companies in the eastern portion of the county. Aerial tramways began their ascent to prominence during the period. The Silver Lake Mines Company and other large organizations erected tramways as a solution to transportation problems posed by remote locations and difficult terrain. Tramways provided an effective alternative to labor and pack animals, moving materials and ore over hostile terrain in all weather. Although the initial cost was high, tramways allowed many companies to develop advanced mines, achieve high volumes of production, and become profitable.

The Great Mining Revival, 1898 – 1910
The seventh Period of Significance began in 1898, when conditions fostered a revival of mining on a scale not yet seen in the county. Production peaked quickly, tapered toward 1906, and dropped off at the end 1907 due to a national recession and collapse of metals prices. The revival, however, lasted through 1910 when activity and production declined significantly.

Although popular histories romanticize the county's early 1880s boom, the 1898 revival was also critical to shaping county and statewide trends. During the revival, nearly all quantifiable indictors for mining in the county reached an apex. The population increased from 1,600 in 1890 to 2,300 in 1900, further ascending to 3,000 in 1910. The county featured more medium-sized and large mines than any time before or after the revival, as well as a spike in prospecting. In total, the mines produced around $700,000 in silver, as much in lead, and over $1 million in gold annually during the first years of the revival, although less afterward. The county also saw its first meaningful zinc recovery in 1904, and thereafter the metal became an important resource.[4] Production figures must be considered in the context of low metals values. Silver fetched around $.60 per ounce, 30 to 35 percent less than during the peak years, and yet the dollar amount exported remained high. The mining industry thus arguably produced greater tonnages of ore and waste rock than at any other time in its history. Ore production and milling in economies of scale, major development both above and below ground, heavy mechanization, and widespread investment were hallmarks of the revival.

[4] Schulze, 1977: 1890-7; Schulze, 1977: 1900-10; Schulze, 1977: 1910-18; Henderson, 1926: 216 for production figures.

During this period, San Juan County hosted events and trends significant on local, state, and national levels. The most relevant Areas of Significance include Industry, Engineering, Transportation, Commerce, Communication, Community Planning and Development, Social History, and Politics/Government. A large proportion of historic resources date to this period, during which the dominant activities were mining, ore treatment, ongoing residence, community building, and construction of infrastructure.

Area of Significance: Industry

The mining industry continued to provide the Durango Smelter and railroad with the majority of their income as they were instrumental in facilitating the revival. A greater number of large mines contributed to innovation in production and milling in economies of scale. With capital available again during the late 1890s, companies invested in infrastructure, development, and workforce. Although the economies-of-scale strategy was a statewide movement, the large companies in the San Juans participated to a greater proportionate degree. Extreme topography, harsh environment, and complex ore required adaptation of mechanization and methods to the region. The county's mining industry contributed heavily to Colorado's economy during the revival. Contributions to total state metals output ranged from 3 percent in 1901 to 8 percent in 1907.[5] The revival included small operations, prospects, businesses, and infrastructure, in addition to the large mines.

Area of Significance: Engineering

During the seventh period, the mining industry was significant in the area of Engineering on a national level. In an attempt to lower operating costs, increase production, and recover higher yields of metals from low-grade ore, the mining industry innovated some of its greatest engineering contributions. Large companies participated in the development of complex systems such as electric grids, compressed air, interconnected mine workings, and ore concentration processes. Tramways saw extensive development as the county became known as a center of tramway engineering. Through the successful design and construction of numerous systems, the county's industry contributed to improvement of tramway technology. The large companies also advanced the field of industrial systems management to coordinate their infrastructures, underground workings, and milling. The industry adopted machinery on an unprecedented scale and made its use commonplace. The mining industry forwarded the understanding of metallurgy. Mill design and machinery were much more efficient and applied to larger plants than ever. The county was home to some of Colorado's biggest mills, including the Silver Lake, Gold King, and Gold Prince. The industry also experimented with new apparatuses and processes, such as vibrating tables and magnetic separators for zinc, adopted nationally.

Area of Significance: Transportation

[5] Henderson, 1926: 97.

Regarding transportation, the county's ground system reached build-out during this period. The Gold King owners and Otto Mears completed the last additions to the county's railroad network, the former grading the Silverton, Gladstone & Northerly Railroad from Silverton up Cement Creek to Gladstone. Direct rail improved access in the Cement Creek drainage and enhanced the effect of the revival there. Mears extended the Silverton Northern Railroad in two directions, first from Howardsville up Cunningham Gulch to the Green Mountain Mine, improving the flow of machinery and supplies into and ore out of the valley. The other was from Eureka up to Animas Forks, instrumental in the construction of the Gold Prince operation and lowering transportation costs for other outfits. The county's road network drew considerable attention, as companies continued to improve existing arteries and graded new roads to individual mines. Roads played a critical role in widespread adoption of machinery by allowing wagons to haul larger and heavier loads. Finally, the industry relied on aerial tramways as a solution to ground transportation problems of remote mines. Tramways allowed companies to develop small mines into significant operations. The net result was an increase in the county's overall ore production.

Area of Significance: Communication, Commerce, and Politics/Government

Communications, commerce, and politics/government remained significant areas, with the trends discussed above amplified by the revival.

Area of Significance: Community Planning and Development

Community Planning and Development was significant on a local level as the revival drew a higher population and greater number of industrial operations throughout the county. Those towns that survived the 1890s enjoyed growth. The degree to which a municipal planning process, or divisions among class and ethnicity, guided the growth remains unknown. Animas Forks, Chattanooga, Gladstone, Mineral Point, and Poughkeepsie followed patterns that were typical of mining camps with worker housing and businesses including a mercantile, saloon, butcher, and assay shop as foundations. Additional residents congregated around this core. The larger towns of Eureka, Howardsville, and Silverton grew in accordance with their platted grids.

Area of Significance: Social History

Regarding social history, on a local level the heavy demand for mine labor impacted the county's demography significantly. Women were present since the mid-1870s, but during the revival their numbers increased. Women constituted around 20 percent of the population in 1880 and 25 percent by 1890. Most lived in Silverton, less in the other principal settlements, and few amid the mines. Contemporary Victorian values discouraged women from the male-dominated workplace. By 1900, women constituted slightly more than 30 percent of the population, however, and they could be found among the large mines where both single and married individuals worked for wages or helped their husbands. It became not uncommon to find women cooks, hostlers, maids, and even boardinghouse managers. Lena Stoiber exemplified the involvement of women in the mining industry, managing labor for nearly all of Silver Lake Basin. In the towns, women had greater latitude for employment options and ran or worked in restaurants, bakeries, hotels, boardinghouses, mercantiles, tailor shops, and schools. In summary, the revival facilitated a softening of gender barriers, greater acceptance of women, and opportunity for their employment. These trends were not limited to San Juan County.[6]

Labor demand created by the revival fostered a shift in the county's ethnic diversity. In 1880 and 1890, approximately 35 percent of residents had immigrated from England, Ireland, Scotland, Germany, and other northern European countries. A few were Italian and French. By 1900, almost 50 percent of the residents were immigrants, with Italians and Slavs heavily represented. Italian miners in particular helped the Western Federation of Miners maintain a strong presence locally. The diversification of the population was part of a larger trend in Colorado's mining industry.[7]

During the revival, the county's industry participated in broad trends significant on state and national levels. Specifically, the cycles of boom and bust fostered the development of mobile, diverse, and adaptable society. Each boom, and especially the revival, drew laborers from a variety of backgrounds, and the busts propelled them to other areas and economic sectors. This contrasted sharply with traditional agrarian occupations.

The development of corporate mining during the revival sharply exacerbated the growing trend of a class-based social structure. At large mines workforces stratified into unskilled labor, skilled labor, several tiers of administrative personnel, and owners and investors. Labor had little mobility to ascend into higher positions, in part because increased mechanization required that supervisors and mangers possess formal education and training. Because large mines collectively employed the highest numbers of workers, they contributed heavily to the class-based social system.

The World War I Revival, 1915 – 1921

The eighth Period of Significance spans the years 1915 to 1921, when demand for and value of silver and industrial metals increased together, fostering a revival of mining. World War I was the root cause as European nations sought economic security in silver and consumed industrial metals for wartime production. The value of and demand for silver and industrial metals increased dramatically, stimulating mining. Prior to the revival, a few large mines contributed most of the county's output, while smaller operations were idle. During the revival, large mines conversely declined in production, offset by an increase in the small and medium-sized operations. The revival was relatively short-lived and plagued by factors that suppressed the full effect of the price increases and high demand for metals. The influenza epidemic, wartime administration of railroads, associated freight rate increases, and dwindling ore reserves prevented many companies from profiting. On the other hand, the introduction of flotation

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[6] Susan Armitage and Elizabeth Jameson, *The Women's West* (Norman, OK: University of Oklahoma Press, 1987) 150, 181; Joseph Conlin, *Bacon, Beans, and Galantines: Food and Foodways on the Western Mining Frontier* (Reno: University of Nevada Press, 1986) 158; Sandra L. Myres, *Westering Women and the Frontier Experience, 1800-1915* (Albuquerque: University of New Mexico Press, 1999) 243; Reyher, 2000: 51; Schulze, 1977: 1900-14; Sally Zanjani, *A Mine of Her Own: Women Prospectors in the American West, 1850-1950* (Lincoln, NE: University of Nebraska Press, 2002) 29, 72, 108, 264, 306.

[7] Schulze, 1977: 1900-14; Duane A. Smith, *"The San Juaner, A Computerized Portrait,"* The Colorado Magazine 2.2 (1975): 140-1.

concentration and improvements to other milling technologies allowed some companies to produce ore previously too complex or low in grade.

In 1921, most of the county's mines closed, which brought the eighth period to an end. The national economy regressed into a post-war depression, so demand for and value of industrial metals fell sharply. Silver continued to fetch around $1.00 per ounce because the Pittman Act was in place, but this was insufficient to offset the problems with industrial metals. The sour economy discouraged investors from financing development and improvements, compounding the situation. Companies grappled with a decline in the amount and quality of available ore, increased operating costs, and dissipation of skilled labor.

Even though the World War I revival was minimized, it still exhibited events and trends significant on local, state, and national levels. The dominant activities were mining, ore treatment, ongoing residence, community building, and construction of infrastructure. The most relevant Areas of Significance include Industry, Engineering, Transportation, Commerce, Communication, Community Planning and Development, Social History, and Politics/Government. Many historic resources are likely to date to this period.

Area of Significance: Industry

The mining industry continued to be the economic foundation on which the population depended. The industry continued to support the railroad and Durango Smelter, without which it, might not have survived. The large mines contributed to ongoing development of production and milling in economies of scale. The extreme topography, harsh environment, and complex ore required a greater degree of mechanization than elsewhere in the state. The strategy fostered innovations in the field of ore treatment, in particular flotation and the recovery of zinc. The county industry contributed heavily to Colorado's economy during the revival. Contributions to the state's total metals output ranged from 4 percent in 1916 to 15 percent in 1920.[8] The revival included all sizes of operations. On local and statewide levels, the industry participated in the tungsten rise of the mid-1910s. Tungsten allowed steel makers to produce hardened alloys outstanding for durable hardware and weapons, material which came under heavy demand for the first time due to World War I. Colorado offered some of the richest known deposits, which drew investment, improved the state's profile in the greater mining industry, and fostered geological and mineralogical studies. San Juan County, and especially the Cement Creek area, participated in the tungsten interest.

Area of Significance: Engineering

The mining industry continued to be significant on local, state, and national levels. In an attempt to lower operating costs, increase production, and recover a higher yield of metals from low-grade ore, the local industry stimulated technological advancement. In the field of ore concentration, metallurgist Louis Bastian innovated the flotation process at the Gold King Mill in

[8] Henderson, 1926: 97.

1914.[9] In the absence of this technology, production was limited to specific types and grades of ore, while complex payrock remained fallow. San Juan County was notorious for its complex ore, and mines there offered an opportunity to test flotation and validate the extent of its effectiveness. During the mid-1910s, at least nine prominent mills experimented with flotation, collectively serving as a proving ground for the technology. Flotation became a commonplace process across the west by the 1920s.

The mining industry continued to experiment with other concentration apparatuses and processes such as vibrating tables and magnetic separators for zinc. During the mid-1910s, Arthur Redman Wilfley pioneered multi-deck vibrating tables at the Iowa and Mears-Wilfley mills. Commercial models were later released, allowing other companies to improve efficiency at their mills. At least the Sunnyside, Silver Ledge, and Kittimac used electrostatic and magnetic separators to recover zinc. Proving successful, the separators saw widespread use, and zinc became an important mill product.

In the arena of ore production, mining companies contributed to the practice of adaptive use as operating costs increased and available capital fell during the 1910s. Companies adapted existing resources to meet needs instead of purchasing new materials. Innovation and expertise in engineering were required to adapt salvaged materials, saving capital and permitting companies to produce in economies of scale. In the county, companies realigned entire tramways, refitted concentration mills, and reused machinery and construction materials.

Area of Significance: Transportation

Regarding transportation, the Denver & Rio Grande Extension remained the principal carrier of ore and concentrates from the county and Red Mountain district to the Durango Smelter and goods needed for industry and residence into the county. The Silverton, Silverton Northern, and Silverton, Gladstone & Northerly railroads also continued vital service of collecting ore and concentrates and distributing fuel coal and supplies to consumers. The county's road network served a similar function. Aerial tramways continued to be significant on a local level by allowing remote mines to maintain high levels of production.

Area of Significance: Communication, Commerce, and Social History

Communications, commerce, and social history remained significant during this period.

Area of Significance: Community Planning and Development

The principal towns survived the early 1910s slump and continued the trends discussed above. The settlement pattern saw a few changes as smaller towns either contracted or were abandoned. Silverton continued to serve as the commercial, communication, financial, transportation, and cultural center. Howardsville was the commercial hub of the Las Animas district. Eureka continued as a milling town when ASARCo built the Sunnyside Mill and was the principal commercial center for the district. Middleton remained a community of workers employed at the

[9] Colorado Mine Inspectors' Reports: Gold King; Henderson, 1926: 50; *Mineral Resources*, 1914: 299.

Kittimac, Hamlet, and nearby mines, and provided for their basic needs. Gladstone and Silver Ledge shrank to the size of Middleton. Animas Forks, Mineral Point, and Poughkeepsie were abandoned.

Area of Significance: Politics/Government

Trends in local government continued. The electorate further contributed to national policy on silver mining subsidies. When World War I stimulated an increase in silver prices, Congress drafted the Pittman Act in 1918 to lock the price at $1.00 per ounce. Opponents objected on grounds that the Act merely subsidized silver mining, but it became law, in turn stimulating mining throughout the west with accompanying increase in jobs and revived regional economies.

Great Depression Era Revival, 1933 – 1939

This Period of Significance began in 1933, when President Franklin Delano Roosevelt increased the value of gold, stimulating mining. Roosevelt signed into law the Gold Reserve and Silver Purchase acts the following year, formalizing increases in the values of gold and silver. The acts initiated a revival of mining across the west. period ended in 1939, when the county revival and mining slowed. The county's statistics and historical trends reflect what we can refer to as the Depression-era mining revival. The revival, which spanned 1933 through 1939, saw a spike of mining ventures in the county. The number of active mines tripled from 1920 or the period following World War II: twenty-eight small mines, eight medium-sized operations, six large producers, and several placer mines. Although the spike was minor compared to previous peaks of activity, it was significant in the context of the Great Depression. In the county, as elsewhere, the economy was dismal, financial insecurity high, unemployment increased, and sources of income few. Residents realized that the mines offered the only source of income in the county, gleaning ore for mere subsistence earning. By settling for whatever payrock existing mines offered, most residents were able to stay in the county.

While not lucrative or even stable, the mining industry participated in events and trends significant on local, state, and national levels. Dominant activities were mining, ore treatment, ongoing residence, community building, and construction of infrastructure. The most relevant Areas of Significance include Industry, Engineering, Transportation, Commerce, Communication, Social History, and Politics/Government.

Area of Significance: Industry

The mining industry continued as the economic foundation on which the population depended. The county's industry also contributed to regional and statewide economies, both of which were depressed.

Area of Significance: Engineering

Regarding engineering, the Shenandoah-Dives Mining Company developed one of the most advanced and efficient mines in the state, if not the west. The operation featured dozens of miles of underground workings that tapped low-grade ore veins and connected to the old workings of earlier mines. Precision and expertise were required to complete such a network. The mine capitalized on ore production as workers generated enormous volumes of payrock sent down a tramway to the Mayflower Mill. The tramway and mill were so efficient at exploiting economies of scale that the company was able to profit even though metals values were low. By contrast, other mining companies explored adaptive use of existing properties. Capital was scarce, and companies salvaged materials and equipment. This practice required innovation, planning, a general understanding of structures and mechanical systems.

Area of Significance: Transportation
The Denver & Rio Grande Extension was the principal carrier of ore and concentrates from the county to distant smelters and goods needed for industry and residence into the county. Without the railroad, mining may have stopped. Aerial tramways remained locally significant as previously noted.

Area of Significance: Communication
Communications systems remained locally significant as noted above. .

Area of Significance: Commerce
The flow of goods and capital through the county and to outside economies was significant on the local level in the context of the Great Depression.

Area of Significance: Social History
The Great Depression forced people into a greater degree of self-reliance than before, and these qualities are prevalent in American culture today. Isolated regions dependent on single industries, like San Juan County, reinforced this trait because when their industries faltered, the residents had to either leave or become self-sufficient. When the residents eventually did move on, they spread the tendency to be self-reliant to other groups of people through cultural diffusion. The way in which the Great Depression manifested in the county also contributed to the trend of a mobile, diverse, and adaptable society. The boom and bust cycles of mining, exacerbated by the Depression, forced county residents to move in search of employment and adapt to changing conditions. The movement of people ensured that the population remained diverse.

Area of Significance: Politics/Government
The trends regarding county and local government continued from the previous periods, in addition to the ramifications of implementing national policy on pricing silver and gold. Western legislators supported the Gold Reserve and Silver Purchase acts in response to industrial interests as well as constituents in their voting districts.

Post World War II Recovery, 1946 – 1954

The tenth Period of Significance began in 1946, when post-ward conditions fostered a final widespread surge of activity among the county's mines. Although gold and silver were the most desirable components of ore, industrial metals including lead, zinc, and copper became mainstays. The demand for and value of these metals doubled from wartime levels and were higher than any previous time in national history. These factors, combined with low production costs and improved milling technology, rendered uneconomical grades of ore profitable to produce. The period ended in 1954, when county production abruptly dropped, and many mines closed. The Shenandoah-Dives Mining Company closed in 1953, but other outfits continued to send ore to the company's Mayflower Mill for custom treatment. Later in the year, however, the company closed the mill as well, leaving most independent outfits with no local facility to process ore. In response, most outfits ceased production. Although limited mining continued in the county, the industry never recovered.

During the post-war recovery, the mining industry participated in events and trends that significant on local and state levels. Dominant activities were limited to mining and ore treatment. The relevant Areas of Significance include Industry, Transportation, Commerce, Communication, and Politics/Government.

Area of Significance: Industry

The mining industry continued to be the economic foundation for the county's population, allowing residents to stay rather than gravitate to urban centers. The county industry also contributed to regional and state economies through ore production and consumption of goods and services.

Area of Significance: Transportation

The county mining industry depended on trucks to haul ore to the Mayflower Mill and concentrates from the mill to the railroad at Silverton for shipment to distant smelters. The industry also made extensive use of trucks to haul in machinery and supplies. The traffic prompted improvement of the road network and arteries connecting with Durango and Ouray.

Areas of Significance: Communication and Commerce

Communications and commerce remained significant in the systems and roles defined previously, allowing capital flow to support rural populations in southwestern Colorado during the post-war years.

PROPERTY TYPES AND REGISTRATION REQUIREMENTS

PROPERTY TYPE: PLACER MINE

Placer mine operations featured interests ranging from those of individuals to capitalized companies processing stream gravel and soil to collect particles of gold. A fundamental difference exists between *placer workings* and *placer mines*. At one time, the Animas River featured thousands of feet of continuous placer workings that manifested as tailings piles, pits, and infrastructure features. Some of these may still be evident. 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 that blend together. Archival research and the physical examination of extensive workings may be necessary to identify specific mines in heavily worked areas.

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 year round 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 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 usually 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, sometimes represented today by earthen platforms.

Gulch Placer: Companies and individual miners created gulch placers when they worked a gulch, or 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 redeposited 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 extant sites tend to be expansive with 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 workers on site. In general, engineering and archaeological features are prevalent at hydraulic mine sites.

Placer Mine Significance

Placer mining was of local significance to San Juan County in 1860 and 1861. The discovery of placer gold in Arrastra and Cunningham gulches, and along the Animas River from Silverton to Eureka, brought the first large numbers of Euro-Americans to the region. They were also the first Euro-Americans to penetrate the deep San Juans and document their findings. Early miners established a baseline understanding of the county's physical attributes and geography, thereby drawing attention to the region. Coupled with their discovery of gold, exploration became the foundation that lured prospectors during the early 1870s. This second wave was the beginning of permanent settlement and a nascent mining industry. Placer mines that date to the early 1860s are thus associated with Exploration/Settlement.

Placer mining was also of local significance during the revival of the late 1890s and 1900s. During this time, several companies developed large hydraulic placers in the Eureka area. These provided jobs, contributed to the local economy, and added to the county's overall gold output. Placer mines active during this timeframe were important in the areas of Industry and Economics. During the Great Depression, placer mining provided income and subsistence for unemployed workers. Placers worked during the Great Depression are associated with Commerce and Social History.

Steam and Gulch Placers: As a property subtype, stream and gulch placers were similar types of operations and share aspects of significance. They were locally important primarily during two Periods of Significance. The first is during 1860 and 1861, and the second is 1933 to 1939 for the reasons noted above.

Hydraulic Placer: Hydraulic mining was active primarily during the late 1890s and early 1900s. The Eureka district and Animas River were the only portions of the county with the necessary sedimentology for hydraulic mining. Although hydraulic mining was not widely practiced, it was locally significant in the areas of Economics, Industry, and Engineering. In economic terms, hydraulic placers provided jobs, contributed to the local economy, and added to the county's overall gold output. In terms of Industry, hydraulic placers were part of the county's industrial fabric. Regarding engineering, hydraulic mines required complex water distribution systems and the defensible allocation and use of water rights.

Placer Mine Registration Requirements

Steam and Gulch Placers: The eligibility of stream and gulch placers is predicated on meeting at least one of the NRHP criteria and adequate integrity to convey their significance. Placer mines eligible under Criterion A must be associated with at least one Area of Significance noted above, events and trends important in the development of the county. Placers may be eligible under Criterion B provided they reflect the direct and active contribution in the life of an important person or persons. To be eligible under Criterion C, a resource must clearly represent the stream or gulch type of placer mine and possess enough integrity to convey the historic placer operation. Character-defining features will likely include excavations, tailings piles, work stations, and infrastructure. Intact buildings and structure are rare and thus manifestly strengthen site eligibility. Stream placers may further be contributing elements of historic mining landscapes or larger districts.

Stream and gulch placers may be eligible under Criterion D, especially when studies of the infrastructure features of large mines, including networks of ditches, sluice beds, and work areas, may enhance 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.

Stream and gulch placers must retain aspects of physical integrity relative to its Period of Significance. Because structures may have been removed or destroyed subsequent to their productive period, integrity will relate to the property's ability to convey its significance or "recognizability" (see the National Register Bulletin: *Guidelines for Evaluating and Registering Archeological Properties*). For instance, material evidence may represent the work areas, engineering features, and structures or remnants of structures related to the historic mining operation. Eligibility of setting, feeling, and association is particularly crucial to the eligibility of these resources.

Hydraulic Placer: The eligibility of hydraulic placers is predicated on meeting at least one of the NRHP Criteria and adequate integrity to convey their significance. Hydraulic placers eligible under Criterion A must be associated with at least one Area of Significance noted above, events and trends important to the county. Hydraulic placers may be eligible under Criterion B because they were usually designed and subsequently supervised by mining engineers. To be eligible under Criterion C, a resource must clearly represent a hydraulic placer mine with integrity from the turn of the century. Character-defining features will likely include systems of water allocation and distribution, hydraulic workings methods, and the locations of sluices. In general, hydraulic mines were uncommon in the county and extant resources are therefore rare today. For this reason, examples are significant representations of formally engineered placer operations. Hydraulic placers may further be contributing elements of historic mining landscapes or larger districts.

Hydraulic mines may be eligible under Criterion D, especially when studies of infrastructure features, including water allocation and distributions systems, sluice beds, and work areas may enhance current understanding of engineering adapted to hydraulic mining. Testing and excavation of buried archaeological deposits may reveal information regarding workers' lifestyles as well as the functional layout of the operation.

Hydraulic placer mines must retain aspects of physical integrity relative to its Period of Significance. Because structures may have been removed or destroyed subsequent to their productive period, integrity will relate to the property's ability to convey its significance or "recognizability" (see the National Register Bulletin: *Guidelines for Evaluating and Registering Archeological Properties*). For instance, material evidence may include remnants of engineering features such as cut-banks, ditches, flumes, pipelines, sluice beds, penstocks, and reservoirs.

Integrity of design, setting, feeling, and association is particularly crucial to the eligibility of these resources.

Features Common to Placer Mines

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 Ruin: 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 circular, cleared of rocks, and had a footing near center for the nozzle. The stations were strategically located amid hydraulic workings.
Penstock: A pipeline that carried water under great pressure for hydraulic mining. The penstock descended steeply from a pressure box down to the hydraulic workings, where feed pipes connected with hydraulic monitors. The penstock had gradual reductions in diameter, which increased the velocity and pressure of the water within.
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.
Pressure Box: A wooden or masonry structure, usually far upslope from a hydraulic mine, that directed water into a penstock featuring a steep descent. A ditch or pipeline carried water to the pressure box from a stream or reservoir. The pressure box's elevation and the penstock's descent provided enough pressure for hydraulic mining.
Pressure Box Platform: Pressure boxes stood on earthen platforms cut out of the ground below a ditch or reservoir. A penstock, or its bed, will descend from the platform, which may feature stone masonry or timber footers.
Refuse Dump: A collection of industrial and structural debris cast off during operations.
Reservoir: A void behind a dam for water storage.

Shop Platform: Most company placer mines had simple blacksmith shops were tools and maintained and hardware manufactured. Shops stood on platforms of earth or tailings, which usually represent the building's footprint. An artifact assemblage of shop refuse including anthracite coal, hardware, and forge-cut iron scraps is a defining characteristic.
Shop Ruin: A collapsed shop.
Shop Refuse Dump: Blacksmiths threw shop refuse outside their buildings. When work was sustained, the volume of material became high enough to qualify as a dump. The artifact assemblage includes anthracite coal, forge-cut iron scraps, hardware, and forge clinker, a scorious residue generated by burning coal.
Sluice: A sluice was an indispensable structure for placer mining. It was a lengthy wooden flume with plank walls and a floor featuring riffles. A water current carried gravel through the sluice and the riffles caught the gold. Such a function required that the sluice be located on the floor of placer workings. Sluices ranged in size from 2' wide x 2' deep, to 6' wide x 6' deep. Piles of rocks and timber piers supported sluices.
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.

PROPERTY TYPE: HARDROCK PROSPECT

A prospect is a manifestation of an effort to locate profitable ore, and resources range in scale from shallow pits to extensive underground operations. A lack of significant production, the absence of ore storage facilities, minimal property development, and little capital investment were characteristic of development. Although most prospects tended to be simple, shallow, and lacked machinery, some were fairly advanced and possessed surface plants that required formal engineering and equipment. When a prospect was abandoned, equipment and structures may have been removed. The researcher is likely to encounter prospect sites with varying degrees of archaeological, engineering, and architectural integrity. Substantial operations were usually centered on an adit or a shaft with an associated waste rock dump of some volume, representing deep workings. While most prospects were labor-intensive, deep operations sometimes employed 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 when a site was abandoned, leaving primarily archaeological evidence such as building platforms, machine foundations, and artifacts. Prospect sites can be grouped into three general subtypes:

Hardrock Prospect Subtypes

Prospect Complex: When prospectors attempted to locate mineral formations, 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, also 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 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’. If they determined to continue sinking, the prospectors were forced to install a mechanical hoist and either sought capital or sold their property to an organized prospect outfit. Prospectors may have installed a horse whim, which was inexpensive and provided adequate depth capacity for further underground exploration. However, whims were slow and limited in performance such that many organized outfits installed power hoisting systems driven by steam or petroleum engines by the turn of the century.

When a shaft was deep enough to warrant a power hoist, the outfit usually erected other facilities as well. Blacksmiths maintained tools and fabricated hardware in shops, miners shuttled waste rock away from the shaft in ore cars on tracks, and portable boilers provided steam power. Surface plant components were usually clustered around the shaft, and a residence stood nearby if the shaft was in a remote location. All buildings and equipment met what the greater mining industry recognized as temporary-class criteria, which it defined as low in cost, portable, impermanent, and easy to construct. By definition, prospect shafts lacked evidence of ore storage or processing facilities.

If the shaft failed to encounter ore in profitable volumes, the outfit abandoned the site and usually 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 drove an adit to explore and sample it at depth. An adit was a horizontal entry underground usually 3' x 6' or less, and prospectors chose an adit over a shaft because an adit 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 track. As the adit's length exceeded the penetration of fresh air, prospectors may have installed a hand-powered blower, a bellows, or a windsock to force air underground through tubing.

Surface plant components were usually clustered around the adit portal, and a residence usually stood nearby if the adit was in a remote location. By definition, prospect adits lacked evidence of ore storage or processing facilities. If the adit failed to encounter ore in profitable volumes, the outfit abandoned the site and usually removed all items of value. 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.

Hardrock Prospect Significance

Because profitable ore could only be found through prospecting, this activity was a cornerstone of San Juan County's development. Small parties of prospectors began subsurface exploration in 1870 and were rewarded with the discovery of the Little Giant and other lodes. During the mid-1870s, prospectors arrived in significant numbers, explored the county's geography, defined its centers of mineralization, and found many of the significant veins. Their informal camps also became the seeds for the county's principal settlements. Arrival of the railroad in 1882 incited a wave of prospecting that lasted until around 1885. Between 1870 and 1885, most of the important ore formations were discovered, and the principal mines were started. Specific Areas of Significance apply to prospecting and extant associated resources, including prospect complexes, adits, and shafts.

In terms of *Exploration/Settlement*, prospectors and their outfits laid the groundwork for the establishment of a regional mining industry. They were usually the first to conduct extensive physical and mineralogical exploration, relaying information critical to subsequent mining interests. Prospectors were the first Euro-Americans to inhabit the region.

Regarding *Engineering*, simple prospect shafts and adits represent the application of systematic, strategic sampling, a hallmark of experienced prospectors, to prove the existence of ore. When developing deep prospects, organized outfits adapted known technology, machinery, and methods to primitive environmental conditions characterized by difficult terrain and climate and unknown geological conditions. Prospects also adapted conventional geological knowledge and technology to predict the occurrence of mineral formations and ore. In so doing, they collectively contributed to understanding of the county's structural geology and mineralogy.

Regarding *Social History*, prospectors were an unusual segment of society with particularly adventuresome, independent, curious, robust, and survivalist qualities. Most possessed some formal education, learning further about geology and mineralogy through experience. Prospecting brought unconventional individuals to San Juan County, and they imparted their values and behaviors to the mining industry.

Regarding *Politics/Government*, prospectors organized the earliest mining districts in the San Juan Mountains, setting precedent for districts elsewhere in the mountains during the 1870s. Mining districts constituted an important frontier government that brought order to mining and settlers. These districts contributed to the formal division of southwestern Colorado into counties. In response to the surge of prospecting and mining in the Animas River drainage, the territorial legislature designated La Plata County in 1874. With regional growth, the legislature then carved San Juan County out of La Plata.

Hardrock Prospect Registration Requirements

Hardrock Prospects:

The eligibility of hardrock prospect complexes is predicated on meeting at least one of the NRHP Criteria and adequate integrity to convey their significance. Hardrock prospects eligible under Criterion A must be associated with at least one Area of Significance noted above, events and trends important to the county. Hardrock prospects may be eligible under Criterion B provided they reflect the direct and active contribution in the life of an important person or persons. To be eligible under Criterion C, a resource must clearly represent an organized prospect effort, wherein the assemblage of excavations reflects a systematic pattern with evidence of support facilities such as the blacksmith shop, if any existed. Prospect complexes may also be eligible under Criterion C if the resource possesses intact architectural or engineering features reflecting a type, period, or method of construction associated with prospecting. Hardrock prospects may further be contributing elements of historic mining landscapes or larger districts.

Hardrock prospects may be eligible under Criterion D, especially when charting the distribution of excavation types and sizes may reveal patterns. These patterns may reflect planning, sampling methods, and strategy specific to an area's geology or timeframe. Regional differences may also be determined by comparing prospect complexes. The methods and planning that prospectors employed is a central research topic. If the resource possesses building platforms, testing and excavation of buried archaeological deposits may reveal information regarding prospectors' lifestyles and social structures, which are not well documented. Meanwhile, prospect complexes featuring random excavation will reveal few buried archaeological deposits.

Hardrock prospects must retain aspects of physical integrity relative to its Period of Significance. Because these prospects featured few, if any, buildings or structures, integrity will often relate to the property's ability to convey its archaeological significance or "recognizability" (see the National Register Bulletin: *Guidelines for Evaluating and Registering Archeological Properties*). Integrity of design, setting, feeling, and association is particularly crucial to the eligibility of these resources.

Prospect Shaft and Prospect Adit: Because prospect shafts and adits shared the same function, registration requirements are similar. The eligibility of both prospect shafts and adits is predicated on meeting at least one of the NRHP Criteria and adequate integrity to convey their significance. Prospects shafts and adits eligible under Criterion A must be associated with at least one Area of Significance noted above, events and trends important to the county. They may be eligible under Criterion B provided they reflect the direct and active contribution in the life of an important person or persons. To be eligible under Criterion C, a resource must clearly represent a typical shaft or adit operation. Character-defining features of prospect shafts may include the shaft, hoisting system, blacksmith shop, and other facilities or their remnants. In terms of prospect adits, features may include the adit portal, transportation system, blacksmith shop, and other facilities or their remnants. Because equipment and buildings may have been removed subsequent to productive operation, extant buildings, structures, and equipment or evidence of deep prospecting will contribute strongly to a site's eligibility. Prospect shafts and adits may further be contributing elements of historic mining landscapes or larger districts.
Prospects shafts and adits may be eligible under Criterion D, especially if a site possesses intact structures or buildings, and detailed examination may reveal how prospect outfits adapted conventional mining architecture and engineering to the environmental and geological conditions of the San Juan Mountains. Accessible and intact underground workings are especially significant, because few formal studies have been carried out regarding the underground work environment, engineering, equipment, and practices of drilling, blasting, and removing rock. Further, if workers lived on site, the residential area may offer meaningful buried archaeological deposits, such as privy pits. Testing and excavation may uncover artifacts capable of enhancing current understanding of the workers employed at prospect operations and how they lived.

As a property subtype, prospect shafts and adits are somewhat common, but examples retaining high degrees of integrity are rarer. Prospects shafts and adits must retain aspects of physical integrity relative to their Period of Significance. Because these prospects featured few, if any, buildings or structures, integrity will often relate to the property's ability to convey its archaeological significance or "recognizability" (see the National Register Bulletin: *Guidelines for Evaluating and Registering Archeological Properties*). Integrity of design, setting, feeling, and association is particularly crucial to the eligibility of these resources.

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.

Claim Marker: Prospectors erected claim markers at the corners of their claims. Some were 300 by 1,500 feet in area, and others were 500' x 1500' 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.

Claim Stake: A claim stake was the universally recognized form of claim marker. Claim stakes were usually 4" x 4" posts 4' high, although prospectors often substituted logs.

Draft Animal Track: Horse whims required a circular track around the apparatus so the draft animal could wind the cable drum. The tracks tended to be around 20' in diameter and cleared of major obstacles. Prospectors often graded semi-circular platforms adjacent to a shaft for a track.

Forge: Nearly all prospect operations of substance featured a forge where a blacksmith heated steel implements. Most forges were vernacular in construction in that they were assembled with local materials. Prospectors built walls 3' x 3' in plan and 2' high with rocks or small logs, inserted a tuyere, and filled the interior with sorted gravel. In some cases, prospect outfits imported factory-made iron pan forges to their sites.

Forge Remnant: Forges collapsed over time and may manifest as a mound of gravel and remnants of the walls, usually impregnated with coal and forge clinker. When coal burned at high temperatures, it left a scorious, dark residue known as *clinker*.

Headframe: 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.

Headframe Ruin: The collapsed remnants of a headframe.

Headframe Foundation: Headframe foundations usually manifest as parallel timbers that flank a shaft and extend toward the area where a hoist was located.

Hoist: Hoists at prospects were usually horse whims, steam, petroleum, or small electric models.

Hoist Foundation: 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' 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' x 2' 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' x 6' to as little as 2' x 3' 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' x 6' 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: Hoist houses, usually at least 20' from the shaft, enclosed a hoist, its power source, and often a blacksmith shop. Most prospect outfits followed a form conventional to the mining industry, a rectangular footprint and a front-gabled or shed roof. Hoist houses were vernacular in that they had no recognized architectural style, consisted of available materials, and were built as needed by the outfit.

Hoist House Platform: Hoist houses stood on platforms of leveled earth or waste rock at least 20' from, and aligned with, the shaft. Often, a platform is all that represents a hoist house, and it usually reflects the building's size and footprint. Evidence of a hoist and a shop is usually present.

Hoist House Ruin: The collapsed remnants of a hoist house.

Horse Whim: A horse whim was the most primitive type of mechanical hoist, and it was powered by a draft animal. Two types of whims were popular at different times (discussed above), and the researcher should specify the type of whim when recording a site. The *horizontal reel whim* consisted of a horizontally oriented cable reel at least 3 feet in diameter, fitted with a harness beam on top. The *geared whim* was compact and featured a vertical cable drum in a frame. A capstan, geared to the drum, featured a harness beam on top.

Horse Whim Pit: Prospectors often placed horse whims in shallow pits so the hoisting cable could pass through a trench to the headframe and pose no obstacle to the encircling draft animal. They often lined the pits with planks or logs to retain soil. Over time, the lining collapsed, leaving a concave depression where the whim was anchored, and a linear depression extending to the shaft. The pit should be at the center of a draft animal track.

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, usually less than 8' wide, provided access to prospect workings.
Prospect Adit: A horizontal entry underground denoted by a waste rock dump. An adit tended to be short and less than 3' x 6', while a tunnel was larger. 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 of shallow depth. When intact, shafts tend to be rectangular, and either 4' x 6' or 4' x 8' in interior dimension. When collapsed, shafts manifest as circular areas of subsidence.
Prospect Trench: A linear excavation flanked by a small volume of waste rock.
Shop: A building that enclosed blacksmith 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. Most prospect outfits followed a form conventional to the mining industry, rectangular footprint and gabled roof. Shops were vernacular, consisting of available materials, and built as needed by the outfit. In general, logs were commonly used prior to 1890, and lumber as early as 1880.
Shop Platform: Shops usually stood on earthen platforms near the entry underground. The platforms may feature forge remnants and almost always possess artifacts such as forge-cut iron scraps, anthracite coal, and clinker, which is a scorious, ashy residue created by burning coal.
Shop Ruin: The collapsed remnants of a shop.
Waste Rock Dump: The waste material removed from underground workings.

PROPERTY TYPE: HARDROCK MINE

Hardrock mines were underground operations that produced ore, but were not necessarily profitable. High operating costs, mismanagement, and ineffective technologies often consumed the income generated from production. Company mines ranged in scale from small and labor intensive to extensive, mechanized operations. Most shared basic characteristics, such as ore storage facilities, support buildings and structures, waste rock dumps often at least 125' x 125' in area, and roads for the transportation of materials and ore.

Although small mines were similar in composition to advanced prospects, in that surface plants included facilities to accommodate ore production. Ore bins permitted companies to store payrock between shipments, and companies that mined complex ore often erected ore sorting houses where workers manually separated waste and ore according to quality. Large mines differed greatly from prospects in that their surface plants supported intensive work underground. To facilitate ore extraction and materials handling large companies usually employed machinery and erected substantial buildings. Some companies further attempted to produce ore in economies of scale while minimizing energy consumption and costly labor, relying on advanced machinery and efficient ore handling systems. Shaft operations featured power-driven hoisting systems that raised high tonnages of payrock from deep workings. Both tunnel and shaft operations employed compressed air systems, which permitted miners to bore blast holes with mechanical rock drills. Those companies that were either highly productive or in remote locations sometimes featured their own concentration mills to separate metalliferous material from waste.

The shop was a key facility differentiating large and small operations. The mechanical systems typical of large mines created heavy demand for advanced metalwork and carpentry. To meet these needs, substantial mining companies erected spacious shops equipped with power-driven appliances. Where possible, companies located the shop adjacent to the mine opening to minimize undue handling of heavy materials. Many shops featured a basic array of power appliances, including drill presses, lathes, trip hammers, and pipe cutters. The turn of the century saw a number of companies employ electric motors to power their shop appliances, by contrast to the upright steam engines of previous 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 new type of facility. To overcome the challenges of winter weather and hostile terrain, many companies in the county built aerial tramways that descended from the mine to a shipping point or a concentration mill. Smaller operations installed simple single-rope reversible systems. Moderately-financed companies strung double-rope reversible systems, consisting of two-track cables and a pair of tram buckets linked by a cable loop. The Bleichert double-rope system, with its continuous loop of buckets, was the most efficient and costly, limiting the system to heavily capitalized companies.

In many cases, surface plants erected by highly productive companies required elaborate complexes. For efficient servicing, minimized plumbing, and better engineering, these companies generally clustered mechanical components and shops 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 independent. In general, the surface plants of substantial operations featured a primary shaft or tunnel house surrounded by several smaller buildings.

Hardrock Mine Subtypes

Shaft Mine: Shaft mines produced ore from vertical or inclined underground entries. Companies frequently arranged critical surface plant components around the shaft collar. Large shaft mines possessed complex, mechanized surface plants with multiple structures and buildings, while small operations were simple and featured facilities similar to those 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 shaft mines with diminished integrity are relatively common resources, while sites retaining high integrity and large, complex shaft mines are rarer.

Tunnel Mine: Tunnel mines produced ore through a horizontal tunnel. Companies usually arranged critical surface plant components around the tunnel portal. Large tunnel mines possessed complex, mechanized surface plants with multiple buildings and structures. Small operations were simple and may have featured facilities similar to those 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 and moderate tunnel mines with diminished integrity are relatively common resources, while sites retaining high integrity and large, complex tunnel mines are rarer.

Hardrock Mine Significance

Hardrock mining in the county began in 1870 with the discovery of the Little Giant and other gold veins in Arrastra Gulch and spread throughout the Animas River valley by 1875. Through 1880, mining took form as an industry and slowly gained momentum. The successful operation of the Greene and Crooke smelters facilitated this growth. The industry further mushroomed when the railroad arrived in 1882, lowering the costs of mining, transporting ore to the large smelter at Durango, and improving the quality of life.

The industry declined sharply in 1885, reviving in 1890 with passage of the Sherman Silver Purchase Act. However, the price of silver collapsed at the end of 1893 when the Act was repealed. One result was a deep, nationwide economic depression and the other closure of silver mines across the west. In San Juan County, mining continued because the industry adapted. Attention shifted to gold and high grades of silver with mining companies developing the strategy of production in economies of scale. Because of this, the county's output remained substantial while much of the state suffered. When the general economy improved in the late 1890s, a revival swept Colorado and San Juan County. Companies across the state adopted the strategy of economies of scale, generating more tonnage of ore and higher yields than any time in the past. This trend lasted until 1910, when mining declined again. Increased demand and metals prices stimulated by World War I caused yet another revival in the county, which lasted through 1921.

The industry struggled into the Great Depression. Federal programs to increase the value of gold in 1933 and passage of the Gold Reserve and Silver Purchase acts the following year gave the industry renewed energy as well as job creation. World War II, and its drain on labor and resources, ended the Depression-era revival, although the industry recovered immediately after the war. This post-war revival ended in 1954 with closure of the Mayflower Mill.

Mining was consistently significant on a local level regardless of boom and bust cycles, but the industry was also often reflected state and national trends throughout the years discussed in Section E. Specific Areas of Significance may apply. *Exploration/Settlement* was relevant to the years preceding 1885. Mining companies, often on the heels of prospectors, brought social, economic, governmental, and transportation systems to this remote area. In short, regarding *Industry*, mining was the origin of settlement in the county. As the primary industry, mining also gave rise to developments in technology, engineering, and architecture related to ore production and milling, for which the county became known nationally among professional mining circles.

Regarding significance in the areas of Economics and Commerce, via investment, communication systems, banking, and acquisition and shipment of supplies, mining contributed to regional, state, and national economic systems, attracting prominent capitalists nationally.

Mining fostered a local economy by paying wages to workers, hiring consultants for services, and purchasing goods from sources mostly in major towns. Machinery manufacturers in Denver purchased material from sources within and outside of Colorado. Between the 1880s and 1930s, Denver hosted prominent mine-supply industries. The thousands of workers employed by the county's mining companies consumed food and domestic goods from a variety of sources. Employees thereby not only supported a complex national food transportation network, but the development of farming and ranching in Colorado. Finally, productive mining companies contributed to the area of Economics through the conversion of mineral resources into wealth, which infused the local economy with fresh capital that in turn fostered Commerce. The local level of significance continued through all Periods of Significance after 1861. Meanwhile, the county's total output was a major contribution to Colorado's wealth beginning in 1882.

Regarding Politics/Government, mining was integrally tied to and a direct function of political systems on statewide, national, and international levels. Political processes greatly influenced silver mining because the value of the metal was, at times, juxtaposed with government policy. 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 across the west prospected for and produced the metal. Government repeal of the Sherman Silver Purchase Act and subsequent collapse of silver's value brought silver mining and prospecting to a temporary halt. Passage of the Pittman Act in 1918 increased the value again and stimulated mining, and in turn repeal of the Act in 1922 wrecked the industry. Federal programs related to the international conflict and defense influenced the production of many industrial metals, including zinc, copper, and lead. While few individual mine sites can be directly tied to specific political acts and policies, as a whole, the county's mining industry and interests contributed heavily to state and national trends and policies.

Regarding *Social History*, participants in the county's hardrock mining industry participated in the development and evolution of a class-based social structure. Beginning in the late 1870s, with active production mine owners and investors began an ascent to wealth while laborers formed a working class dependent on wages. Through the 1910s, two general categories of capitalists acquired productive properties and financed exploration. The first consisted of local investors of limited means and the second a wealthy elite based in Denver, the Midwest, and east. Profits reinforced existing fortunes and contributed to the formation of a middle class. In turn, because mining depended on wage laborers, companies facilitated a robust local working class. Industrial operations created an employment market that drew workers from throughout Colorado and other states. Cycles of boom and bust required that workers be mobile, by contrast with agrarian sectors. Furthermore, boom tended to draw laborers from a variety of ethnic backgrounds and traditions. The result was a mobile, adaptable, and diverse society. The mining industry can reveal much about themes of class, ethnic heritage, gender, and demography.

Regarding *Engineering*, San Juan County's mining industry innovated technological and engineering developments not only adopted by the greater mining world, but also in other industries and public sectors. Some county mines were among the earliest in Colorado to employ mechanical rock drills. The county was a center for tramway engineering and featured some of the longest and most complex systems prior to 1920. A consortium of companies and the town of Silverton contributed to the development of electrical technology in general and specifically as applied to mining. In response to the extreme environment of the San Juan Mountains, engineers structurally designed buildings capable of withstanding tremendous natural forces, such as snow load, gale-force winds, and avalanche. The county was further a cradle for the strategy of producing low-grade ore in economies of scale through advanced engineering. Large companies pioneered the practice during the early 1890s and continued to refine it, rendering previously uneconomical ores profitable to produce and extending the viability of individual mines and even entire mining districts. Given that most county mines represented points along a spectrum of engineering and technology, no single operation may encapsulate all the above trends.

Hardrock Mine Registration Requirements

Shaft and tunnel mines range from small and simple to large and complex. As small mines are common resources, Barbara Wyatt's 2009 National Register White Paper "Evaluating Common Resources for National Register of Historic Places Eligibility should guide their evaluation. Large mines are much less common and may have contributed to the development of engineering or technological innovations. The eligibility of hardrock mines is predicated on meeting at least one of the NRHP Criteria and adequate integrity to convey their significance. Hardrock mines eligible under Criterion A must be associated with at least one Area of Significance noted above, events and trends important to the county. Hardrock mines may be eligible under Criterion B provided they reflect the direct and active contribution in the life of an important person or persons. To be eligible under Criterion C, a resource must clearly represent a tunnel or shaft mine. Because equipment and buildings may have removed when mines were abandoned, archaeological features may represent the operation. A site should reflect material evidence clearly conveying the mine's functional layout and surface plant design or individual components. Intact buildings, structures, and machinery are rare examples of the adaptation of engineering, technology, and architecture to mining. Some may reflect adaptation to the difficult environmental conditions high-altitude mining. Character-defining features of shaft mines may include remnants of the hoisting system, blacksmith shop, buildings, ore bin, or other facilities. Features of tunnel operation may include remnants of the tunnel house or shop, ore bin, machinery, or ancillary facilities. Hardrock mines may also be eligible under Criterion C if the resource possesses intact architectural or engineering features reflecting a type, period, or method of construction associated with mining. Hardrock mines may further be contributing elements of historic mining landscapes or larger districts.

If a site possesses structures and buildings, detailed examination may reveal how mining companies adapted conventional mining architecture and engineering to high-altitude conditions. Individual systems often lend themselves to detailed studies, and examples include compressed air, steam, hoisting, and ore sorting. Accessible and intact underground workings are an important source of information because few formal studies have been carried out regarding the underground work environment, engineering, equipment, and practices. Currently, historical references are the principal body of information that researchers rely on for studying aspects of mining. Documentation of underground workings will contribute material fact to this arena of inquiry.

Hardrock mines may be eligible under Criterion D, especially when buried archaeological deposits, such as privy pits, thick boiler clinker dumps, and refuse layers in waste rock dumps may be present. Deposits amid a mine surface plant may include artifacts capable of enhancing current understanding of daily worker behavior, diet, and residence. In general, large mine sites tend to possess at least one of the features noted above. Small mine sites, by contrast, may lack buried deposits of substance or intact buildings and systems.

Integrity of design, setting, feeling, and association is particularly crucial to the eligibility of these resources. For a resource to retain integrity of *design*, material evidence, including archaeological features, must convey the mine's organization and engineering. In many cases, mines developed episodically, with new operators changing and adapting surface facilities as needed. In such cases, a resource reflects the evolution of surface facilities over time. To retain integrity of *setting*, the surrounding area must not have changed a great degree from its Period of Significance. In terms of *feeling*, the resource should convey the sense of historic mining operations. Integrity of *association* exists where buildings, structures, machinery, or other features convey a strong sense of connectedness between the property and a contemporary observer's ability to discern the historic mining operation.

Features Common to Hardrock Mine Resources

Mine sites may possess an array of archaeological, engineering, and architectural features representing the surface plant. To help researchers identify and understand the features, their types are listed below according to the common systems that historically comprised surface plants. Because mines shared many of the same facilities as prospects, the features in common are not repeated below. Instead, the researcher should refer to Prospect Site Feature Types for additional context.

General Feature Types

Adit: A horizontal opening usually less than 3' x 6'. Collapsed adits manifest as linear areas of subsidence. Tunnels were larger horizontal openings greater than 3' x 6'.

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, and others were foundations.

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 Track: A rail line that facilitated the movement of ore cars around a mine.
Mine Track Remnant: When a 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: When disassembled, pipelines left evidence such as linear depressions, series of footers, and lengths of pipe.
Privy: Most mines of substance featured a privy for the crew's personal use. Privies usually are small frame buildings with a door in the front and a bench inside with one or several cutouts for toilet seats. The buildings were vernacular in construction and stood on foundations of logs, lumber, or rocks over a pit.
Privy Pit: A privy pit was the waste receptacle underneath a privy building. When a pit was full, workers relocated the building, sometimes threw refuse into the depression, and covered it with a cap of earth or waste rock. Pits tend to manifest today as depressions less than 5' 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' wide.
Shaft: A vertical or inclined opening underground usually at least 4' x 8' in area. Some shafts were divided into compartments. The largest compartment was the *hoisting compartment* and the smaller (usually less than 3' 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. Large shaft houses may have also encompassed an air compressor. Mine tracks extended away from the shaft and passed out of the building. Like typical mine buildings, shaft houses were vernacular in design and construction. They had no recognized architectural style, were assembled from available materials, and were built for function. Although each was unique, they were based on a handful of forms conventional to the mining industry. The most basic was rectangular in footprint with a front-gabled or shed roof and a cupola for the headframe. Large shaft houses may have been L-shaped, cross in plan, or possessed multiple extensions. The roof was highest over the headframe and sloped down toward the hoist. Logs were commonly used for small buildings prior to 1890, and lumber for large shaft houses as early as 1880.
Shaft House Platform: Shaft houses usually stood on leveled platforms of earth or waste rock. When dismantled, shaft houses left distinct footprints surrounding evidence of the hoist, boiler, and shop. Differences in soil types and consistencies can reflect a shaft house's footprint. Large shaft houses often stood on rock foundations that can define the structure's perimeter.
Shaft House Ruin: The collapsed remains of a shaft house.
Stable: Prior to the 1920s, mining companies relied on draft animals for both underground and surface transportation. The companies erected stables to house the animals, and the buildings

were often crude, low, and erected on poorly leveled ground. Distinguishing characteristics include wide doorways, feed mangers, and oat boxes.
Stable Ruin: The collapsed remnants of a stable.
Timber Dressing Station: Timber dressing stations were work areas where miners reduced logs into timbers for underground support. Most stations were outdoors near the mine opening, and they tend to be represented by collections of raw logs and numerous cut wood scraps. Some were within the shaft house or tunnel house.
Timber Stockpile: A stockpile of mine timbers, often located near the mine opening. Mine timbers are usually 6' to 7' 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 tunnel was a horizontal entry underground 3' x 6' (interior dimensions) or larger. Collapsed tunnels often manifest as linear areas of subsidence, possibly with pipes or rails projecting outward.
Tunnel House: A tunnel house was a building that enclosed the tunnel portal, a shop, and a ventilation blower. A mine track, and sometimes a trench or flume to divert drainage water, passed through the building. Large tunnel houses may have also encompassed an air compressor and timber dressing station. Like other mine buildings, tunnel houses were vernacular in design and construction. They had no recognized architectural style, were assembled from available materials, and were built for function. Although each was unique, they were based on a handful of forms conventional to the mining industry. The most basic was a rectangular footprint with a gabled or shed roof. Large tunnel houses may have been L-shaped or possessed several extensions for the shop and machinery. In general, logs were commonly used prior to 1890, and lumber as early as 1880.
Tunnel House Platform: Tunnel houses commonly stood on cut-and-fill platforms graded at the tunnel portal. Large versions often had rock or concrete foundations. The platform or foundation, as well as differences in soil types and consistencies, can reflect the building's footprint. Artifacts and machine foundations can reveal the types of facilities that the building enclosed.
Tunnel House Ruin: 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' x 4' 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 rock drills. Mining companies employed a variety of types that rose and fell in popularity between the 1870s and 1940s.
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.
Compressed Air Main: A pipeline that carried compressed air from a compressor into the underground workings.
Compressor House: Limited primarily to large mines, a compressor houses enclosed an air compressor and its receiving tank. If the compressor was steam-driven, then the building also usually enclosed the boiler. The buildings were vernacular in design and appearance.
Compressor House Platform: Compressor houses stood on platforms graded with waste rock or cut-and-fill methods. The platform should feature a compressor foundation, a motor mount or boiler setting ruin, and an artifact assemblage consisting of machine parts and pipe fittings.
Compressor House Ruin: The collapsed remains of a compressor house.

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 back braces. 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' high and stood on well-built timber foundations.
Headframe Foundation: Production-class headframes required solid foundations surrounding the shaft. The foundations were usually buried with waste rock ballast for stability and hence were embedded in the ground. Several structures were common. One was a squat timber frame, and the other was carefully leveled log cribbing. Concrete was occasionally used. The headframe was fastened to timber footers extending toward the hoist. The foundation's length usually equaled the headframe's height.
Headframe Ruin: The collapsed remnants of a headframe.
Hoist: To meet the needs of ore production, mining companies engaged in production almost always employed power hoists.
Hoist Foundation: Few shaft mines retain their hoists and instead feature foundations, which are distinct today.
Hoist House: See Prospect Site Feature Types.
Hoist House Platform: See Prospect Site Feature Types.
Hoist House Ruin: 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.

Boiler Foundation: Boilers were usually dismantled when a mine closed, and in some cases, the masonry setting was removed as well. Distinct pads and footers may remain, and the type of boiler can be determined from this foundation. Artifacts such as ash, clinker, and scorched rocks and bricks are usually associated with boiler foundations.

Portable boilers left the most elementary foundations. Vertical boilers stood on dry-laid brick or stone pads, and workers arranged rock alignments for the skids of locomotive units. Some locomotive boilers lacked skids and instead were supported by simple rock or brick pylons, discussed above under prospects. Typical return-tube boiler foundations were, flat, rectangular, and around 10' x 22' in area. Workers usually used rocks, although well-funded companies substituted bricks. In many cases a foundation may still retain the *bridge-wall*, which was a low row of bricks that forced flue gases against the boiler's belly. When visible, the bridge-wall crosses the foundation near its center.

Boiler Setting Ruin: When workers dismantled return-tube boilers, they almost always left the masonry foundation in situ. Collapsed settings range in appearance from mostly intact walls to mere piles of rubble. With some examination, the researcher may be able to determine the boiler type and location of the firebox. If the walls are intact, a ruin may feature the masonry bolts that anchored the façade, and the posts that supported the boiler shell. Most setting ruins also feature a bridge-wall, which was a low brick divider in the setting's interior. The wall usually stood between the firebox and the smoke chamber, and it forced flue gases up against the boiler's belly. Most return-tube boiler settings consisted of common bricks or rocks, and they featured cleaning ports near ground-level. Well-capitalized companies often lined fireboxes with fire bricks.

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' x 5' in area.

Motor Foundation: Due to great weight and stresses created by motion, workers anchored motors to stout concrete foundations usually less than 4' x 5' 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 often erected transformer houses to shelter electrical equipment. They usually located the buildings away from the rest of the surface plant in case of fire. Transformer houses are relatively small, rarely exceeding 30' x 30' 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. Construction is vernacular, and form may be shed or gabled.
Transformer House Platform: Workers usually erected transformer houses on cut-and-fill platforms that possess telltale artifact assemblages 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 Ruin: The collapsed remnants of a transformer house.

Ore Storage and Processing Features
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.
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 Ruin: 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 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 Ruin: 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 rock drills. A backing block consisted of an iron rod 4" x 4" or less in cross-section and up to 8' 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: During the 1910s, well-funded mining companies began adopting compressed air-powered machines to automate the process of sharpening drill-steels. Most sharpeners were upright units 2' x 3' in area, 3' to 5' high, and featured an assemblage of clamps and power hammers mounted on a cast iron pedestal. Sharpeners were always located in a shop.
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' x 3' 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 were popular, and most were 3' x 3' in area and 2' high. The *gravel-filled rock forge* consisted of dry-laid rock walls, the *wood box forge* had plank walls, and both were filled with gravel. The free standing *iron pan forge* featured an iron pan supported by iron legs. Companies that required high volumes of work also installed cylindrical and square iron box forges usually 4' x 4' 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 wood work. Lathes were usually bolted to parallel timbers around 2' x 8' in area or less.
Power Hammer Foundation: Mechanized mining companies installed power hammers to expedite metalwork. Many power hammers consisted of obsolete rockdrills bolted to timber posts, and they pounded items clamped to underlying tables. When removed, power hammers may be denoted by a heavy timber post up to 6' high and an adjacent timber stump where the table was located.
Shop: Nearly every mine had a shop for the manufacture and repair of tools, hardware, and machinery. Shops included blacksmith facilities at the least, some were equipped with power-driven appliances for advanced work, and many were equipped for basic carpentry. To minimize handling of heavy iron, mining companies built their shops near the mine opening. Shop buildings followed several basic vernacular forms in construction, appearance, and design. Most were custom facilities, built as needed with available materials, and planned according to a company's interpretation of function and efficiency. Prior to the 1890s, shops tended to be simple, rectangular, and had blacksmithing equipment in a major portion and a carpentry area in the rest. Many were of log construction, but mining companies preferred frame construction. During the 1890s, shops increased in size to accommodate more appliances, and by the 1900s, corrugated sheet iron grew in popularly for siding and roofs.
Shop Platform: Shops almost always stood on platforms of leveled earth or waste rock. When the building was removed, a distinct platform usually remained. 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 Ruin: The collapsed remains of a shop.
Shop Refuse Dump: A concentration of shop refuse generated by sustained blacksmithing and metalwork. The artifact assemblage is distinct and consists 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.

PROPERTY TYPE: AERIAL TRAMWAY

Aerial tramways were mechanized transportation systems that allowed companies to develop mines in some of the most difficult physical environments. Engineered with precision and built to exacting specifications, tramways bore ore from mine to receiving point over difficult terrain and in all weather. Although these systems required an initial investment of capital and labor, they ultimately lowered transportation costs. This asset factored heavily into San Juan County's mining industry's increased productivity from the 1890s through the 1930s. Tramways, especially advanced systems, facilitated production in economies of scale, and mining companies were able to generate higher volumes of low-grade ore from inaccessible deposits than was otherwise possible. Due to companies' broad success with these systems, they built more locally than most other mining regions nationwide. Coupled with the sophistication of systems like the Silver Lake and Sunnyside, San Juan County emerged as a recognized center of tramway engineering.

The county's mining industry favored four types of tramways, each related to variables of capital, production, and the skills of engineer and crew. The tramways, further described as Property Subtypes below, are the: single-rope reversible, double-rope reversible, Hallidie single-rope, and Bleichert double-rope. Although the types varied in scale, capacity, and cost, all shared a basic template. Tram buckets rode cables between an upper terminal at the mine and a lower terminal at a receiving point. Miners input ore into a bin at the upper terminal and transferred it into the tramway buckets, which carried the material to the lower terminal. There, workers emptied the buckets into another bin, sent the empty vehicles back up to the mine, and repeated the process. In the case of smaller operations, the lower terminal was often a shipping point where wagons carted the ore for the last leg of its journey to a mill or the railroad. At larger operations the terminal was often attached to a mill, and the tramway provided an important all-season link to the mine. When possible, tramways should be recorded with their associated mines or terminus stations. They can be recorded as independent resources, however, when other elements of a comprehensive system have been lost.

Aerial Tramway Subtypes

Single-Rope Reversible System: The single-rope reversible system was the simplest and least costly tramway. The builder had to be skilled in field engineering but did not need formal training in mechanical systems. Single-rope tramways were the first systems built in the San Juan Mountains, beginning with the Little Giant in 1871, and saw use through the 1950s. Their light duty and short range limited them to smaller outfits.

The single-rope tramway consisted of little more than a fixed cable descending from an ore bin down to another bin at the bottom terminal. A bucket, suspended from a pulley, rode the cable back and forth. When the bucket was empty, a worker winched it up to the mine with a second cable, and when the bucket was full, he lowered it via a hand brake. On some tramways, the winch was at the bottom terminal and the rope passed around a wheel at the top for mechanical advantage. The terminals consisted of little more than the two bins, possibly covered by roofs, with anchors for the cable. The top bin featured a mount for the winch and a chute for loading the bucket. The bottom bin had a plank platform so a worker could dump the ore. Winches ranged from hand-turned units to steam or gasoline hoists. As a resource type, extant single-rope reversible tramways are uncommon. Resources with intact engineering features, such as hardware and structures, are rare and may be significant examples of their type.

Double-Rope Reversible System: The double-rope reversible tramway operated much like the single-rope system, but its dual ore buckets increased carrying capacity. It remains uncertain when double-rope tramways were first introduced to the county, but they were in use by the 1890s. Also known as a *jig back tramway*, the double-rope system featured two buckets that rode over stationary track cables in a balanced fashion. At the mine a worker lowered a full bucket down to the bottom terminal with a hand brake, and it pulled the lighter, empty vehicle up to the top terminal. The cable connecting the buckets wrapped around a sheave wheel anchored to a heavy timber frame in the upper terminal. The wheel featured a flange for the brake shoe. Towers of frame construction were sometimes necessary to support the track cables on lengthy spans. As with the single-rope system, terminals consisted of little more than bins. However, each terminal had two bins with chutes, one for each bucket.

The system was inexpensive and within the technological grasp of experienced miners, making it ideal for companies with limited capital. Although the mining outfit only had to pay for hardware and installation, terminals required design and planning, even if informally and in the field. Often, terminals were vernacular in design and construction. The builder adapted the general double-rope template to the mine's surface plant and environment. Hardware may have been factory-made for the purpose, adapted from other uses, or salvaged from idle mines. Construction materials were either ordered according to the tramway's custom specifications or scavenged from elsewhere. As a resource type, extant double-rope reversible tramways are uncommon. Those resources with intact engineering features, such as hardware and structures, are rare and may be significant examples of their type. Archaeological potential may exist at other sites.

Hallidie Single-Rope System: The Hallidie system derived its name from the endless cable loop extending between top and bottom terminals. The loop rotated around sheave wheels in the terminals, carrying numerous buckets around the circuit. The system was mechanized in conjunction with a gravity operation, moving ore in a constant flow. With a series of frame towers supporting the cable and buckets, the tramway could be extended for thousands of feet over varied terrain, allowing a company to link an inaccessible mine with a shipping point or mill.

The buckets affixed to the cable were in constant motion, thus the design characteristics specific to the Hallidie system. The sheave wheel had to be firmly anchored within a stout frame in both terminals to resist powerful horizontal stress, but clearance around the wheel was required for the buckets. Thus, the wheel rotated on a long axle vulnerable to wrenching and distortion. When empty buckets entered the top terminal, workers loaded them with payrock while the buckets were in motion. The buckets then passed around the sheave, traveled down to the bottom terminal, and dumped their contents into a receiving bin. The towers featured pulleys or idler wheels to support the cable between spans, and a single cross-member at the tower crown provided a sufficient mount.

Hallidie systems saw limited use in the county because they were expensive, required exacting engineering, and were supplanted by the superior Bleichert design by the early 1890s. Hallidie systems combined vernacular and professional design and construction. Rarely were experienced miners, and even formally trained mining engineers, able to design and install a Hallidie system unassisted. Instead, a mining company often consulted a tramway manufacturer, who adapted system requirements to the specifics of the mine and its environment. The strict tolerances of the system's components, such as terminal structures and tower alignments, required integration and design by an engineer specialized in tramways. But these engineers were limited in some cases by the available construction materials, talent of local contractors, and budget of the mining company. As a resource type, extant Hallidie tramways are rare. Those resources with intact engineering features, such as towers and aspects of the terminals, are significant examples of their type. Archaeological potential may exist at other sites.

Bleichert Double-Rope System: The Bleichert tramway was based on the Hallidie design, but offered several important improvements. As the name implies, the Bleichert double-rope system featured two sets of cables to Hallidie's one. A stationary track cable linked the top and bottom terminals, as supported by a series of towers like the Hallidie system. A separate cable loop known as a traction rope pulled the buckets along a continuous circuit. The system was mechanized, usually operated under gravity, and moved ore in a constant flow. Unlike Hallidie tramways, the buckets were not permanently fixed to the traction rope and instead had a releasable grip. When buckets arrived in the top terminal, workers detached them, stopped their motion, pushed the buckets around the terminal interior on suspended rails, and filled them at leisure without spillage. When in motion, the traction cable tugged the buckets, which rolled along the fixed track cable on hangers with pulleys.

Because of the two cables, Bleichert systems had several performance advantages. They could work at almost any pitch, be up to four miles in length, and carry high tonnages of ore. Although Bleichert systems were more expensive than Hallidie tramways, they were more advantageous for heavy production for these reasons. The two cable sets and detachable grips resulted in design characteristics specific to Bleichert systems. The sheave wheel was enclosed on all sides in a heavy timber frame that could stand independently from the rest of the terminal's support structure. The loading area within the terminal was open, and a steel hanging rail for the buckets bolted to overhead stringers. The towers featured a single cross-member at top for the track cables and another cross-member 4' to 8' below for the traction cable's pulleys or idler wheels. Bleichert systems were the most widely used mechanical tramway in the county, even though they were expensive and required exacting engineering. Bleichert systems combined vernacular and professional design and construction in the same way as Hallidie tramways discussed above. As a resource type, extant Bleichert tramways are rare. Those resources with intact engineering features, such as towers and aspects of the terminals, may be significant examples of their type. Archaeological potential may exist at other sites.

Aerial Tramway Significance

Broadly speaking, tramways saw use throughout most of San Juan County's productive hardrock mining era. Dempsey Reese and partners erected the first locally and in greater southwestern Colorado in 1871 for the Little Giant Mine. Outfits continued to employ tramways on a limited scale as late as the 1960s. As a resource type tramways were significant during narrower timeframes as defined by the above-described Periods of Significance. Tramways began to play a key role in the county's mining industry in 1890, when systems at the Titusville and other mines demonstrated the value of the technology. Tramway installation increased exponentially over the next ten years and contributed materially to the mining industry's ongoing success. Tramways were in common use throughout the county by the early 1900s. The systems facilitated development of inaccessible properties and production of low-grade ore in economies of scale. When the industry declined sharply in 1921, so did the centrality of tramways. Tramways again became significant during the Depression era mining revival. However, by the 1940s, truck transportation replaced tramways at many large operations.

Specific Areas of Significance may apply tramway resources during discrete Periods of Significance. Regarding Industry and Transportation, tramways influenced the physical footprint of the mining industry as well as its rate of production. As a general transportation system, tramways allowed companies to develop properties and extract ore from otherwise inaccessible locations. Although development and production are related, development was an initial phase in advance of actual ore production, and more mines were developed in the county than yielded ore. Property development was a major source of employment, and expenditures stimulated the economy. Ore production, essential to industry success, was greatly enhanced by tramways. Further, tramways facilitated development of some remote mines into the county's largest producers, exemplified by the Silver Lake and Sunnyside mines. Tramways were instrumental in the production of low-grade ore in economies of scale, shuttling huge tonnages at little cost. In part due to tramways, previously uneconomical grades of ore became profitable to produce. By extracting and moving high volume of ore, tramways extended the lives of individual mines. In summary, tramways were central to the county positioning among Colorado's most productive regions during the Periods of Significance noted above.

Tramways were also significant in the area of Engineering as the county was recognized as a center for tramway use featuring some of the longest, most advanced, and innovative systems in the west. Individual systems such as the Silver Lake and Gold Prince particularly contributed to the field of tramway engineering, while other large systems served as proving grounds for engineers to solve problems such as linking segments, angling around or over mountains, developing hardware, and assembling functional systems amidst difficult environmental conditions. On a broader level, tramway systems of various sizes globally contributed to mechanical engineering as a general field. Engineers adapted large-scale design templates, mechanical principles, types of structures, and standardized hardware to the unique conditions of mining in the San Juan Mountains.

Finally, tramways contributed to the field of systems engineering, especially in the mining industry. The operation of a mine, production of ore, transportation of material to a mill or shipping point, and processing was a large-scale comprehensive system. Tramways provided the critical link of transportation as coordinated within a holistic operation. In a fundamental physical sense, the tramway interfaced with a mine's activity requirements as related to input of supplies and output of ore. Overall, the system had to function efficiently in a continuous flow of materials. Variables included design, carrying capacity, speed of operation, and communications between the top and bottom terminals. Systems management also included economic factors. The engineer had to consider construction and maintenance costs as juxtaposed with resultant benefits.

Aerial Tramway Registration Requirements

Aerial tramways range from small simple single-rope iterations to large Bleichert systems of documented significance. The eligibility of aerial tramways is predicated on meeting at least one of the NRHP Criteria and adequate integrity to convey their significance. Aerial tramways eligible under Criterion A must be associated with at least one Area of Significance noted above, events and trends important to the county.

Tramways may be eligible under Criterion B provided they reflect the direct and active on-site contribution in the life of an important person or persons. Some tramways, especially large systems, can be traced to particular engineers and construction contractors.

To be eligible under Criterion C, a resource must clearly represent a type of aerial tramway. Because equipment and buildings may have removed when mines were abandoned, archaeological features may represent the system. A site should posses material evidence clearly conveying the system design, end points, or individual components, such as tower locations. Intact buildings, structures, and hardware are rare examples of the adaptation of engineering, technology, and architecture to mining. Some may reflect adaptation of tramway engineering to the difficult environmental conditions high-altitude mining. Character-defining features of tramways may include foundations or platforms for towers and terminals representing the tramway alignment in total. If the terminals were components of larger buildings, such as an ore sorting house at the mine or a mill at the bottom end, the terminal itself need not be fully distinguishable if that larger building is no longer extant. Material evidence of the larger building, however, should be present. Extant short single and double-rope reversible tramways may lack integrity, while larger systems often possess more compelling extant archaeological, architectural or engineering features clearly conveying aspects of the system in total. In summary, tramways may be eligible under Criterion C if the resource possesses intact architectural or advanced engineering features reflecting a type, period, or method of construction associated with mining. Tramways may further be contributing elements of historic mining landscapes or larger districts.

Tramways may be eligible under Criterion D, especially when system hardware, structures, buildings, or their remnants may reveal aspects of tramway engineering. Single and double-rope systems may provide information about small-scale ad hoc engineering and the skills of untrained but experienced miners. Large systems may provide general information regarding professional mechanical engineering and its adaptation to local operations. Large systems may enhance current understanding of contemporary construction practices, coordination of materials, and operations in high-altitude conditions.

Integrity of design, setting, feeling, materials, and association is particularly relevant to the eligibility of these resources. For a resource to retain integrity of *design*, material evidence, including archaeological features, must convey the tramway's alignment and engineering. In many cases, tramways developed episodically, with new operators changing and adapting facilities as needed. In such cases, a resource reflects the evolution of surface facilities over time. To retain integrity of *setting*, the surrounding area must not have changed a great degree from its Period of Significance. In terms of *feeling*, the resource should convey the sense of historic mining operations. Integrity of *association* exists where buildings, structures, machinery, or other features convey a strong sense of connectedness between the property and a contemporary observer's ability to discern the historic mining operation.

Features Common to Aerial Tramways

Ore Bin: Top terminals had bins for the input of crude ore onto the system and more bins to receive it at the bottom terminals. The bins were sloped floor types described above with mines.
Ore Bin Platform or Foundation: See mine Property Types above for a description.
Sheave Frame: All tramway types except for single-rope reversible systems had sheave wheels in the terminals for the traction cables. The sheaves were large-diameter iron wheels that spun on axles bolted to stout timber frames. On double-rope and Bleichert systems, the frame encompassed the wheel, while it left clearance around wheels for Hallidie systems. The frames were usually rectangular, cubic, with several layers of stringers tied with vertical posts. Diagonal buttresses braced the frame against horizontal forces.
Terminal Frame: Formally designed terminals had independent frames that supported the building and its components, often separately from the sheave frame. The frames were vernacular in design in that they were adapted to the conditions, needs, and performance of the system, and its integration with the mine. Frames for Bleichert systems had hanging rails for the tram buckets bolted to the ceiling beams. The foundation was of concrete or timbers anchored to bedrock, and may have featured guides to direct the track cables to their anchors.
Terminal Building: The terminal building, usually custom-designed, encompassed the tram mechanism, braking station, and open floor where workers loaded or emptied tram buckets. Buildings were vernacular in construction, adapted to the environment, topography, and location at the mine. Form varied, but materials were usually lumber framing with corrugated sheet iron.

Tension Station: Lengthy Bleichert tramways consisted of multiple segments that operated independently. Tension stations joined the segments and served several functions. They allowed buckets to move uninterrupted from one segment to another, allowed the overall system to change pitch, and had anchors for the track cables. The stations consisted of timber frames on concrete or rock masonry foundations. Galleries through the structure provided passages for the buckets.
Tension Station Foundation: When dismantled, stations left symmetrical patterns of concrete, rock masonry, and timber footers for the frame. Tram hardware and debris usually lies scattered around.
Tram Tower: Towers supported cables between long spans.
Tram Tower Platform: Towers usually stood on earthen platforms cut out of a surrounding slope. Platforms for small towers were simple flat areas, while those for large towers may have featured rock retaining walls. Heavy structural materials and tram hardware may lie downslope.
Turning Station Foundation: Turning stations allowed lengthy tramways to curve around obstacles such as mountains. Also known angle stations, the structures were a union between two independent segments, and in this regard, were similar to tension stations. Turning stations, however, also required the supervision of workers, sometimes to manually switch buckets from one line to another. Thus, turning stations were usually enclosed by a frame superstructure. The stations were custom-designed.

PROPERTY TYPE: ORE CONCENTRATION FACILITY

One of the main objectives of mining is to reduce ore into its constituent metals. In historic mining operations in San Juan County, 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 sent to a smelter for roasting and melting in furnaces. The smelter yielded an unrefined blend of metals known as matte, and advanced plants 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 processing steps while complex, refractory ores required time-intensive treatment and numerous steps. In the county, a variety of facilities carried out these processes, operating either as independent mills or in conjunction with specific mines.

Some mining companies erected *concentration mills* to complete the crushing and concentration steps ordinarily carried out by smelters. This saved companies costs in two areas. First, the companies did not incur the high costs of shipping waste-laden ore, and second, they avoided paying fees charged by smelters for complete treatment. Concentration mills, also known as *reduction mills*, produced only concentrates and no refined metals. They processed ores featuring gold, silver, tungsten, and industrial metals. The mills ranged in scale from small facilities to sprawling industrial complexes, and metallurgists based treatment processes on specific types of ore. San Juan County hosted three general categories of concentration mills.

The first and most prominent was the concentration mill, the second was the amalgamation stamp mill, and the third, rarely used after the 1870s, was the arrastra.

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. The recovered material was known as concentrates and manifested as mineralized, metalliferous sand and rock dust. Concentration mills existed in a variety of scales and were usually built over a series of terraces incised into a hillslope so that gravity could draw 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 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, from where it passed 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 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 achieved separation in numerous steps. The lowest platforms usually featured the mill's power source and a drier to evaporate moisture from finished concentrates.

Often when a mill was abandoned, structures and machinery were 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 may manifest as substantial deposits of finely ground sand and rock flour. In San Juan County, many mills were no more than costly failures, which the absence of tailings often reflects. Every mining district in the county except for Poughkeepsie featured at least several mills. However, due to salvage efforts, tailings removal, alteration, and especially natural decay, very few mill sites remain intact. Archaeological sites may be particularly significant representations of the county's historic 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, a component of a concentration mill. However, unusually simple gold ore lent itself to pulverization in a stamp battery prior to being exposed to mercury to recover the metal. A jaw crusher usually provided primary crushing, the stamps carried out 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, leaving impure gold to refine. These treatment facilities are generally termed *amalgamation stamp mills*.

Because amalgamation stamp mills featured a fraction of the equipment installed at more complex concentration mills, they tended to be smaller and simpler. Regardless, amalgamation stamp mills shared with concentration mills a few fundamental characteristics. First, because they relied on gravity to draw 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-level or lower platform featured the power source, often a horizontal steam engine and boiler. Last, the mill required a water source. 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, but inefficient apparatus for recovering metals from ore. An arrastra consisted of a circular stone floor usually less than 30' 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 water power for draft animals.

Ore Concentration Facility Significance

Ore concentration mills played a key role in the long-term success of hardrock mining in the county because they reduced crude ore into a profitable commodity. Without a local means for treating ore, mining companies would have been limited only to those grades of payrock that were profitable enough to ship to distant smelters, and such material was in limited supply. From the 1880s through the 1920s, the industry repeatedly improved the methods for recovering metals from the county's notoriously difficult and complex ores. As a result, the mills rendered low grades of ore profitable and allowed mining companies to shift from producing silver and gold to lead, zinc, and copper. This greatly prolonged mining, helped the industry adapt to changing metals markets, and directly supported the county's international reputation as a center of innovation and technology. Without effective mills, the mining industry might have failed. Historic concentration processes were characterized by three principal categories of facilities.

Concentration Mill: Concentration mills can be associated with several Areas of Significance beginning in the late 1870s and continuing through the 1950s. Regarding Engineering, the county's complex ores defied conventional metallurgical methods proven to be effective in other regions. To render complex ore economically viable, local metallurgists made improvements to the Stoiber-McCartney vibrating table and Bastian flotation cell in addition to creating new inventions, such as Arthur Redman Wilfley's sand pump and multi-deck vibrating table. These advances proliferated throughout the west.

The county's troublesome ore also provided metallurgists opportunities to refine the entire treatment process. In 1883, David Brunton adapted current practices in the North Star Mill, the first fully successful concentration mill in the county. Edward Stoiber did likewise in 1890, pioneering the treatment of previously unprofitable grades of ore. The Silver Ledge and Sunnyside mills became sites for testing new zinc separation machinery, while flotation was adopted earlier in the county than elsewhere. Each time, metallurgists elsewhere successfully imitated concepts developed in San Juan County. Concentration was the forefront of a movement away from simple and labor-intensive methods to advanced and highly mechanized processes permitting the separation of multiple metals using economies of scale. This involved the coordination of testing and treatment methods, complex mechanical systems, and hundreds of workers in massive facilities. Evolution in economies of scale proved crucial for the state and national mining industry because it rendered previously uneconomical ores profitable, extending the viability of individual mines as well as entire mining districts. Properties associated with these advances may be further eligible in the areas of Industry or Science.

Other Areas of Significance involve themes of Economics, Commerce, and Social History. These areas are relevant to mills as to mines, since the two property types were integrally tied (see above Property Type: Hardrock Mine).

Amalgamation Stamp Mill: These ore treatment facilities were the earliest mechanized type of mill in the county, as well as in greater southwestern Colorado. The Little Giant Mill, the first in the San Juans, was an amalgamation stamp facility erected in 1873. A few other amalgamation stamp mills operated locally during the mid-1870s but few were built subsequently. Thus, the period of significance generally comprised 1873 through 1880. During the 1870s, miners exhausted most simple gold ore that could be easily processed in amalgamation stamp mills, such that they lost favor to concentration mills and smelters.

Regarding significance in the area of Industry, amalgamation stamp mills were instrumental to the success of the county's early hardrock mining industry, if not subsequently as local ore proved unsuitable for amalgamation. During the early 1870s, the county lacked ore treatment facilities, and shipping crude ore to extant mills, mostly on the Front Range, was prohibitively expensive. Local mills emerged as the only profitable means of treating gold ore mined locally. By treating ore at acceptable rates, the mills allowed mining to realize its potential as an industry. As such, amalgamation stamp mills were also significant in the area of Exploration/Settlement for their association with the mining frontier. The industry grew, fostering settlement and facilitating emergence of political, economic, and social systems.

Arrastra: These primitive facilities were the first type of ore treatment mill in the county, as well as in southwestern Colorado. The Little Giant arrastra, built in 1870, was the first in the deep San Juans, and it was followed by several more during the next several years. A few other arrastras operated in the county during the mid-1870s but were rarely built afterward. Thus, the timeframe of importance was from 1870 until 1880 (Periods of Significance two and three). During the 1870s, miners exhausted most of the simple gold ore that could be easily processed in arrastras, and they lost favor to concentration mills and smelters.

Arrastras share the same function and narrow timeframe of significance as amalgamation stamp mills. Their Areas of Significance are similar, as well, except for a fundamental difference. In the Area of *Exploration/Settlement*, arrastras allowed prospectors and small outfits to test ore and then produce gold in remote and unproven regions. When results were positive, investment, organized companies, and better mills followed, and they became the beginning of industry and settlement.

Ore Concentration Facility Registration Requirements

Ore concentration facilities form a spectrum ranging from small and simple arrastras to large and complex concentration mills. Small and simple mills tended not to participate in important engineering and technological advances, but often provided the vital service of ore treatment in particular districts. By contrast, large complex mills often hosted development of engineering and technology, in addition to providing essential local service. Because concentration mills, amalgamation stamp mills, and arrastras were very different facilities, registration requirements will be discussed individually below.

Ore Concentration Mills:

The eligibility of ore concentration mills is predicated on meeting at least one of the NRHP Criteria and adequate integrity to convey their significance. Ore concentration mills eligible under Criterion A must be associated with at least one Area of Significance noted above, events and trends important to the county. Ore concentration mills may be eligible under Criterion B provided they reflect the direct and active on-site contribution in the life of an important person or persons. Some mills, especially large complexes, can be traced to particular engineers and metallurgists. To be eligible under Criterion C, a resource must clearly represent a type of ore concentration mill. Because equipment and buildings may have removed when mills were abandoned, archaeological features may represent the complex. A site should posses material evidence clearly conveying the system design and engineering, such as terraces, aspects of infrastructure and support facilities. The general ore treatment process should be identifiable. Intact structures and equipment strengthen site eligibility. Buildings may represent the adaptation of design, materials, and construction methods to the conditions of a high-altitude environment. Treatment appliances, or direct evidence thereof, can reflect the adaptation of conventional metallurgy to the complex ore of the San Juan Mountains. In summary, mills may be eligible under Criterion C if the resource possesses intact architectural or advanced engineering features reflecting a type, period, or method of construction associated with mining. Mills may further be contributing elements of historic mining landscapes or larger districts. Mill sites may provide context or constitute discrete landscapes in themselves, especially when tailings dumps are present.

Concentration mills may be eligible under Criterion D, especially in the following cases. Buried archaeological deposits such as privy pits, thick boiler clinker dumps, and refuse layers in tailings dumps may include artifacts capable of yielding information that augments current understanding of workplace behavior and diet. If workers lived on site, residential deposits may further illuminate that social history. Secondly, an assemblage of structures, foundations, or machinery related to the ore treatment process may reveal how metallurgists designed or chose concentration processes for complex ore. Thirdly, extant infrastructure may demonstrate how engineers designed water, power, ore input, and tailings disposal systems. By contrast, small mill sites may lack buried deposits of substance.

Mills were prime targets for salvage of structural materials and machinery when abandoned. The general mill complex, its building locations, flow-path for ore, and infrastructure should be identifiable. The particular crushing and concentration processes can be extrapolated from common features, listed below. Integrity of design, setting, feeling, materials, and association is particularly relevant to the eligibility of these resources. For a resource to retain integrity of *design*, material evidence, including archaeological features, must convey the arrangement of buildings, infrastructure, and general flow-path for ore treatment. In many cases, companies retrofitted mills to improve processing. In such cases, a resource reflects the evolution of facilities over time. To retain integrity of *setting*, the surrounding area must not have changed a great degree from its Period of Significance. In terms of *feeling*, the resource should convey the sense of historic ore treatment operations. Integrity of *association* exists where a site's features convey a strong sense of connectedness between the property and a contemporary observer's ability to discern the historic milling operation.

Amalgamation Stamp Mills:

The eligibility of amalgamation stamp mills is predicated on meeting at least one of the NRHP Criteria and adequate integrity to convey their significance. Amalgamation stamp mills eligible under Criterion A must be associated with at least one Area of Significance noted above, events and trends important to the county. Amalgamation stamp mills may be eligible under Criterion B provided they reflect the direct and active on-site contribution in the life of an important person or persons. Some mills, especially large complexes, can be traced to particular engineers and metallurgists. To be eligible under Criterion C, a resource must clearly represent an amalgamation stamp mill. Because equipment and buildings may have removed when mills were abandoned, archaeological features may represent the complex. A site should posses material evidence clearly conveying the system design and engineering, such as terraces, aspects of infrastructure and support facilities. The primary crusher, stamp battery frame or foundation, and amalgamation tables should be identifiable. Intact structures and equipment strengthen site eligibility. Buildings may represent the adaptation of design, materials, and construction methods to the conditions of a high-altitude environment. Individual pieces of machinery, or their direct evidence, can reflect the adaptation of conventional amalgamation methods to the gold ore of the San Juan Mountains. In summary, mills may be eligible under Criterion C if the resource possesses intact architectural or advanced engineering features reflecting a type, period, or method of construction associated with mining. Mills may further be contributing elements of historic mining landscapes or larger districts. Mill sites may provide context or constitute discrete landscapes in themselves.

Amalgamation stamp mill sites may be eligible under Criterion D, especially in the following cases. Buried archaeological deposits such as privy pits, thick boiler clinker dumps, and refuse layers in tailings dumps may include artifacts capable of yielding information that augments current understanding of workplace behavior and diet. If workers lived on site, residential deposits may further illuminate that social history. Secondly, an assemblage of structures, foundations, or machinery related to the ore treatment process may reveal how metallurgists adapted conventional amalgamation methods to complex local ore. Thirdly, extant infrastructure may demonstrate how engineers designed water, power, ore input, and tailings disposal systems. Smaller mill sites may lack buried deposits of substance.

Eligible mills should possess physical integrity, most likely relative to the 1870s Periods of Significance. Mills were prime targets for salvage of structural materials and machinery when abandoned. The general mill complex, its building locations, flow-path for ore, and infrastructure should be identifiable. The particular crushing and concentration processes can be extrapolated from common features, listed below. Integrity of design, setting, feeling, materials, and association is particularly relevant to the eligibility of these resources. For a resource to retain integrity of *design*, material evidence, including archaeological features, should convey the arrangement of buildings, infrastructure, and general flow-path of crushing and amalgamation. In many cases, companies retrofitted mills to improve processing. In such cases, a resource reflects the evolution of facilities over time. To retain integrity of *setting*, the surrounding area must not have changed a great degree from its Period of Significance. In terms of *feeling*, the resource should convey the sense of historic ore treatment operations. Integrity of *association* exists where a site's features convey a strong sense of connectedness between the property and a contemporary observer's ability to discern the historic milling operation. Common features encountered at mill complexes are listed below.

<u>Arrastras:</u>

The eligibility of arrastras is predicated on meeting at least one of the NRHP Criteria and adequate integrity to convey their significance. Arrastras eligible under Criterion A must be associated with at least one Area of Significance noted above, events and trends important to the county. However, arrastra sites tend to possess few clearly dateable artifacts and were not thoroughly documented by contemporaries, rendering dates of operation difficult to confirm. As such, unless a timeframe can be established, few arrastras may be eligible under Criterion A. Arrastras may be eligible under Criterion B provided they reflect the direct and active on-site contribution in the life of an important person or persons. However, it may be difficult to document association with particular individuals for these properties. To be eligible under Criterion C, a resource must clearly represent an arrastra's character-defining features. Few if any complete arrastras remain extant, but the circular stone floor should be in situ. Other features including the sidewalls, capstan, mechanized power source, or support facilities strengthen site integrity. Arrastras may further be contributing elements of historic mining landscapes or larger districts.

Arrastras are likely to be eligible under Criterion D for their potential to yield information, as few arrastras have previously been documented in the Rocky Mountain states. Little is currently understood about how miners constructed and operated the facilities. Surface features and artifacts may enhance current knowledge, and, even when only the floor is visible, arrastras can possess buried archaeological deposits and features that may contribute important details.

Eligible arrastras should possess physical integrity, most likely relative to the 1870s Periods of Significance. Structural elements may have deteriorated or been removed, however, requiring analysis of remaining integrity. For instance, stone floors were often dismantled and surrounding ground excavated and processed for gold amalgam, leaving most resources with insufficient integrity for eligibility. Integrity of design, setting, location, and association are particularly relevant to the eligibility of these resources. For a resource to retain integrity of *design*, material evidence, including archaeological features, should represent the arrastra floor, portions of the power train, and waste disposal methods. To retain integrity of *setting*, the surrounding area must not have changed a great degree from its Period of Significance. In terms of *feeling*, the resource should convey the sense of historic ore treatment operations. Integrity of *association* exists where a site's features convey a strong sense of connectedness between the property and a contemporary observer's ability to discern the historic milling operation. Common features encountered at ore concentration facilities are listed below.

Features Common to Ore Concentration Facility Resources

Mill sites can possess an array of archaeological, engineering, and architectural features that were components of the crushing, concentration, power, and support facility systems. To help researchers understand ore treatment processes, 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: Mills usually featured assay shops to track the efficiency of metals recovery and concentration. A metallurgist periodically tested samples of unprocessed crude ore and compared the results with tests on tailings and concentrates. If he found that the metals recovered by the mill approximated the amount in the crude ore, the metallurgist knew the mill functioned efficiently. The assay shop may have been within the overall mill building at small facilities, or provided with its own building at large plants. The shops had distinct appliances such as a free-standing or masonry assay furnace, blower, coal bin, and stout workbenches. Assay shop buildings were usually constructed with the same materials and workmanship as the associated mill. Most were frame, had ample windows, a chimney for the furnace, and a heavy sub-frame or foundation for crushing machinery. The shops were vernacular in design in that they had no recognized architectural style and were custom-designed for function and economy. A tall brick chimney, machine foundations, and artifact assemblage of assay debris are often distinguishing characteristics.

Assay Shop Foundation/Platform: Assay shops often stood on earthen platforms or foundations of concrete and rock masonry. Distinct characteristics can define a platform as that for an assay shop. Foundations or other remnants of an assay furnace, its blower, and small crushers may remain. Artifact assemblages typically include furnace clinker, fire-bricks, broken assay crucibles, mineral samples, 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: Mills relied on gravity to draw ore through a sequence of crushing and concentration machinery installed on terraces. Many designs used conveyors to return the ore to the upper terraces for reprocessing or from one treatment stage to another. Early conveyors consisted of a bucket line or spiral feed, and later conveyors consisted of belts on rollers. A timber or steel frame was the chassis for the assembly.

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, or to transfer slurry from one process to another within the mill.

Flume Remnant: The collapsed or buried remnants of a flume.

Machine Foundation: A foundation that anchored an unknown mill machine.

Mill Building: Mill buildings were distinct buildings in the mining landscape. Most enclosed the ore treatment machinery, power source, and other facilities under one roof. The buildings tended to be large, sloped in profile to conform to stair-step terraces or foundations, and irregular in plan. Each mill was unique in design and incorporated elements of engineering. Most were based on a custom-designed frame that not only supported the walls and roof, but also appliances, bins, and the system of driveshafts and belts that ran the machinery. Given this function, most frames varied in design and construction within the mill, but were made of heavy timbers. The foundations for small mills consisted of log or timber footers direct-laid on the ground, while stone or concrete can be encountered at large plants. Well-designed mill buildings stood independently from interior structures such as bins and stamp batteries, allowing for replacement of components. Most, however, were integrated into the interior structures for economy of materials. These vernacular designs prior to the 1910s tended to include board-and-batten siding or walls of mere planks were common, while corrugated sheet iron and tarpaper dominated later.

Mill Building Foundation: Mills stood on stout foundations that not only supported the building, but also machinery and structures within. The foundations had footers around the circumference for the walls and additional footers on the terraces for the frame and machinery. At small mills, foundations were timber and log embedded in earth. At large mills, the foundations consisted of concrete or masonry and were often integrated with walls retaining the terraces.

Mill Building Ruin: A collapsed mill building.

Mill Platform/Terrace: Because mills relied on gravity to draw the ore through crushing and concentration, they were built over a series of terraces cut out of a slope. Often, the terraces are the principal features representing a mill. Each terrace supported a stage of treatment. When recorded, platforms should ideally 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: Evidence of a disassembled pipeline.

Privy: Most mill complexes included a privy for the crew's use.

Privy Pit: The pit that underlay a privy. Privy pits are often less than 5' in diameter and may feature artifacts visible in the walls and floor.

Pump Foundation: Often of concrete, pump foundations are rectangular, less than 2' x 4' in area, and may feature pipes.

Receiving Bin: Nearly all mills featured an ore bin at the head to receive crude ore for processing. The bins typically had sloped floors and discharge chutes in the front, which directed the ore into a stamp battery or primary crusher. The walls consisted of a timber frame sided on the interior with heavy planks.

Receiving Bin Platform or Foundation: Receiving bins stood on foundations and platforms similar to those for ore bins at mine sites. Timber or log footers embedded in the ground supported the frame, and cribbing or masonry may have supported the head and toe.

Receiving Bin Ruin: The collapsed remnants of a receiving bin, usually jumbled frame elements, plank siding, and foundation footers.

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 semicircular platform for a tank. The platform's floor may feature a pipe.

Crushing System Feature Types

Jaw Crusher: A jaw crusher reduced crude ore from the receiving bin into gravel, completing the first stage of physical reduction. The heavy machine, also known as a Blake crusher, was located on the mill's upper terrace. Crushers usually featured jaws and dual flywheels powered by a belt. Small units were around 2' x 4' in area and large units were up to 4' x 8' 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: Early mills relied on stamp batteries for primary crushing. After the mid-1880s, batteries often provided secondary crushing, reducing the gravel produced by a jaw crusher. A stamp battery consisted of a heavy timber gallows frame, heavy iron stamps that dropped into a battery box, and a cam shaft that raised and let the stamps fall. The cam rotated in the top of the frame, and it was fitted with a large bullwheel turned by a belt. The stamp shoes were fixed to steel rods that slid in guides. Batteries usually featured stamps in groups of five. The timber frame for a single group tended to be 7’ wide, up to 15’ high, and stood over a cast iron battery box bolted to a timber pedestal. Initially, workers shoveled ore into the battery box for crushing, and by the 1890s, automatic feeders introduced the ore.

Stamp Battery Frame: In many cases salvage efforts dismantled the iron hardware from a stamp battery, leaving the timber frame. Bolts for the cam shaft and semi-circular guides for the stamp rods are usually are evident.

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’ x 5’ in area and 2’ 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: Successful concentration and amalgamation required the crushed ore to be absolutely uniform in particle size after crushing. Screens in between each crushing stage allowed fine material to proceed while returning coarse particles for reprocessing. Trommels were preferred because they screened ore in a continuous flow. A trommel consisted of wire mesh cylinders nested together and bolted to a steel frame. As they rotated, fine material passed through while coarse particles rolled out and were returned.

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’ x 4’ in area while common units were 6’ x 6’ 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’ in diameter and 3’ to 4’ 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 rectangular timber footers 6’ x 9’ in total area. The machine stood on heavy posts forming a 6’ x 6’ cube at one end, and the other end featured a raised block with a brace for the drive shaft.

Ball Mill: A ball mill was a steel vessel similar to today's cement mixer. The vessel tapered at one or both ends, rotated in heavy bearings, and was powered by a canvas belt and shaft. As the vessel rotated, steel balls inside tumbled and pulverized the ore into a fine slurry. Small units were 4' in diameter and 6' long. Balls mills were used for tertiary crushing in concentration mills, and to recover gold with mercury in amalgamation plants.
Ball Mill Foundation: Ball mills were anchored to heavy concrete foundations distinct in footprint. The foundation featured three parallel pylons, usually 1' thick. Two pylons supported the vessel's ends. The one for the narrow end was usually 2' long and 4' high, and the pylon for the broad end was 3' long and slightly lower. The third pylon, often square, stood away and anchored the driveshaft.
Rod Mill: A rod mill operated according to same principles as a ball mill, with like applications. The vessel, however, was cylindrical, and steel rods inside ground the ore.
Rod Mill Foundation: Rod mill foundations were similar to those for ball mills. Parallel pylons, usually 1' thick, 3' long, and as high, supported the vessel, and another pylon smaller in size anchored the driveshaft.

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 and sloped away from the toe of a stamp battery. The tabletops were usually copper, coated with mercury, and around 6' x 12' in area. The slurry of pulverized ore produced by the stamp battery trickled over the copper plate, and the mercury caught the gold. In early mills, a flume diverted the spent slurry out of the mill as tailings. Later, the flume delivered the slurry to other amalgamation appliances such as Huntington mills.
Amalgamation Table Frame: Amalgamation tables were usually removed from mills when facilities were abandoned, leaving a heavy timber frame around 6' x 12' in area and at least 4' high.
Jig: A jig was a concentration 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. A frame over the cells supported a cam shaft powered by a canvas belt. The shaft gently moved plungers up and down, agitating the slurry in the cells. The action kept light waste in suspension while allowing heavy metalliferous material to drop out and settle in the floor. A water current flushed the waste away. Most jigs were around 4' x 9' in area and 4' high.
Vanner: A vanner was a concentration apparatus between 4' x 8' and 6' x 13' in area. The machine featured a broad rubber belt that passed around rollers at both ends of a mobile iron frame. An eccentric cam imparted a vibrating motion that caused heavy metalliferous particles to settle on the belt. The lighter waste remained on the surface, and a jet of water washed it into a flume. The waste may have flowed out of the mill as tailings or continued to another set of concentration appliances. Scrapers removed the metalliferous material into another flume for recovery.

Vanner Foundation: Vanners were usually bolted to timber foundations that featured cross-members at both ends, stringers linking the cross-members, and braces for the frame. A flume for the waste slurry usually passed by the vanner's toe.
Vibrating Table: The vibrating table, introduced during the late 1890s, was one of the most successful and widely used concentration apparatuses. Vibrating tables featured a slanted tabletop, often 5' x 15' in area, clad with rubber and narrow wooden riffles. The tabletops were often mounted at a slant on a mobile iron frame that oscillated. The motion caused heavy metalliferous material to settle against the riffles while a current of water washed the light waste into an adjacent flume.
Vibrating Table Foundation: Vibrating table foundations featured anchor bolts projecting out of three timber cross-members. Two cross-members were at the ends, and a third was parallel and near one of the ends. The foundations are typically around 12' to 15' in length.
Flotation Cells: Introduced during the early 1910s, flotation was a highly successful stage of concentration for complex ore. 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: Cyanidation was an alterative to amalgamation for recovering gold from complex ore. Finely ground slurry was introduced into cyanidation tanks, where a dilute cyanide solution leached out the gold. Slowly rotating agitation arms on the tank floor ensured a constant blend. Similar to a water tank, the vessels were usually located on a mill's lowest terrace and provided a last stage of ore treatment.
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: Prior to the 1910s, steam engines powered most mills. Return-tube boilers usually generated the steam. See Hardrock Mine Feature Types for a description of boilers.
Boiler Foundation: See Hardrock Mine Feature Types.
Boiler Setting Ruin: 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: Few mill appliances had their own independent power sources, and central engines or motors drove most. Sets of overhead driveshafts and canvas belts transferred motion from the engine or motor to the appliances. Overhead driveshafts, also known as line shafts, featured belt pulleys over each mill appliance and rotated in bearings 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' in width and 8' to 12' 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' in width and 8' to 12' 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: Those mills with electric power required transformer stations to convert and distribute the current. See Hardrock Mine Feature Types for a description.
Transformer Station Platform: See Hardrock Mine Feature Types.
Transformer Station Ruin: See Hardrock Mine Feature Types.

PROPERTY TYPE: SMELTER

Smelters were essential facilities for the mining industry. They were the final recipients for crude ore delivered from mines and the concentrates generated by mills. Smelters converted the ore and concentrates into metals. The Greene Smelter, built in 1874, was the first functional smelter in San Juan County and facilitated the county's mining industry for five years. Without the plant, the industry would have remained static, if not failed altogether. The Greene Smelter closed in 1879, dismantled, and incorporated into the Durango Smelter, which began treating ore in 1882. The Martha Rose Smelter, Silverton's second local plant, began at the same time but failed within the year. In 1894, Thomas F. Walsh opened Silverton's third local smelter, the only functional plant in nearly a decade. Walsh's plant filled an important niche until it closed around 1898. The county was without a local smelter until 1900, when the San Juan Smelting & Refining Company filled the void with the Kendrick-Gelder Smelter. This facility served the same market as the Walsh Smelter and operated until 1909. Declining ore production discouraged further smelting ventures, and the Durango and Standard smelters in Durango received the county's ore and concentrates.

San Juan County's smelters used a combination of mechanical, chemical, roasting, and smelting processes to convert ores and concentrates into metals. Most facilities required flat space, a source of abundant water, and well-graded roads, thus tending to be limited in scale and variety of components. The smelters usually featured several large buildings, high-volume coal and coke bins, and several free-standing steel furnaces. The companies usually designed the smelter complexes according to a standard plan, and as a result, various components shared common orientation. Slag, the waste produced by smelting ore, almost always lies around a smelter site and manifests as fine-grained or glassy cobbles dark gray to black in hue.

Smelter Significance

Between 1874 and 1879, the mining industry depended on the Greene Smelter to reduce ore to its constituent metals. With successful concentration mills, mining could have continued in the absence of the smelter, but companies would have shipped their concentrates to distant facilities at great cost. Given this, without the Greene Smelter, mining would have been severely stunted. By contrast, when the Walsh and Kendrick-Gelder smelters began operations, they were not the principal ore treatment plants. Instead, the Walsh and Kendrick-Gelder smelters offered supplemental ore treatment services and accepted specific types of ore for which the other Silverton and Durango facilities were not equipped. Thus, the Walsh and Kendrick-Gelder plants allowed certain mines to remain profitable from 1894 through 1909. The output of these mines represents a significant contribution to the county's overall production. The above trends fall within Industry as an Area of Significance.

Smelters may further be significant in the area of metallurgical Engineering. The county's complex ores defied conventional metallurgical practices and methods proven to recover metals in other regions. To render complex ores profitable, John Porter and other experts with the Greene Smelter combined their experience with calculation and devised effective processes. This became a foundation for the methods employed at the successive Durango Smelter, the most successful smelting plant in southwestern Colorado. The Walsh and Kendrick-Gelder plants offered similar advances for the complex ores of the Red Mountain district and northern portion of San Juan County.

Regarding Economics, the three smelting companies contributed to complex regional, statewide, and national economic and financial systems. Investment, banking, and acquisition and shipment of supplies occurred on interstate and intrastate levels. The smelting companies also diverted money into the local economy by paying wages to their workers, hiring consultants for services, and buying goods from local businesses. The companies also purchased machinery and other industrial goods from manufacturers mostly in Denver and outside of Colorado. Smelting companies supported primarily Colorado's and secondarily other economies. On a local level, smelting companies purchased their ore from mining outfits throughout the county. Such business disbursed money throughout the region.

Regarding Politics/Government, mining, and in turn smelting, was integrally tied to political systems on local, statewide, national, and international levels. After all, smelters relied on production of silver ore, a primary focus of policy decisions in the context developed here. Federal programs stimulated demand and inflated silver's values to levels that rendered mining profitable. The Bland-Allison Act of 1878 and the Sherman Silver Purchase Act of 1890 instituted price supports and acquisition quotas for silver. Repeal of the Sherman Silver Purchase Act and subsequent collapse of silver's value brought mining and smelting to an abrupt halt for several years. Industry workers, capitalists, and companies provided political support for elected officials who advocated for programs that kept the value of metals high. Further, Colorado mining elite, including Thomas Walsh and Thomas Porter, contributed financial support to legislators who influenced federal policy. Business activity at smelters at times reflected political developments.

Smelter Registration Requirements

The eligibility of smelters is predicated on meeting at least one of the NRHP Criteria and adequate integrity to convey their significance. Smelters eligible under Criterion A must be associated with at least one Area of Significance noted above, events and trends important to the county. The county's three smelter sites may be eligible under Criterion B provided they reflect the direct and active on-site contribution in the life of an important person or persons. If the significance is related to an important individual's design of the plant or complex, then Criterion C applies. To be eligible under Criterion C, a resource must clearly represent a smelter. Because equipment and buildings may have removed when smelters were abandoned, archaeological features may represent the complex. A site should possess material evidence clearly conveying the system design and engineering, such as the footprint, terraces, and aspects of infrastructure and support facilities. The general flow path of the ore from input to furnace should be identifiable, if not the process specifics. Intact structures and equipment strengthen site eligibility. A site retains high integrity when its features clearly represent each stage of ore treatment, as well as individual machines and appliances. Buildings, structures, and machinery may represent the adaptation of metallurgical engineering and technology to local ore and the conditions of a high-altitude environment. Slag dumps and flows may be another important character-defining feature. In summary, smelter sites may be eligible under Criterion C if the resource possesses intact architectural or advanced engineering features reflecting a type, period, or method of construction associated with mining. Smelters may further be contributing elements of historic mining landscapes or larger districts. Extensive smelter sites may provide context or constitute discrete landscapes in themselves.

Smelter sites may be eligible under Criterion D, due to the potential to yield information, especially in the following cases. Buried archaeological deposits such as privy pits, thick clinker dumps, and refuse layers in tailings dumps may include artifacts capable of augmenting current understanding of workplace behavior and diet. If workers lived on site, residential deposits may further illuminate that social history. Secondly, an assemblage of structures, foundations, or machinery related to smelting may reveal how metallurgists adapted the smelting process to complex local ore. Thirdly, extant infrastructure may demonstrate how engineers designed water, power, transportation, and slag disposal systems. Smaller mill sites may lack buried deposits of substance.

Eligible mills should possess physical integrity relative to its Period of Significance. Smelters were often targets for salvage when abandoned, but surface features and archaeological evidence can represent the complex's design, infrastructure, and waste disposal in order to approximate the smelting process. Integrity of design, setting, feeling, location, and association are particularly relevant to the eligibility of these resources. For a resource to retain integrity of *design*, material evidence, including archaeological features, should convey the smelting process, plant design, arrangement of buildings, and infrastructure. To retain integrity of *setting*, the surrounding area must not have changed a great degree from its Period of Significance, with the exception of some removal of structures and equipment. In terms of *feeling,* the resource should convey the sense of historic ore treatment operations. Integrity of *association* exists where structures, buildings, machinery, and archaeological features convey a strong sense of connectedness between the property and a contemporary observer's ability to discern the historic smelting operation. Common features encountered at smelter complexes are listed below as well as under the ore-concentration property type.

Features Common to Smelter Resources
The features below comprise an abbreviated list of those characterizing smelter sites. Most smelters relied on the same water and power systems as ore treatment mills and included preliminary stages of crushing, screening, and concentration. The researcher should review Ore Treatment Mill Feature Types for additional description.

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, often standing nearby. Blowers ranged from 3' to 8' in diameter.
Blower Foundation: A foundation that anchored a blower. Foundations were usually rectangular, less than 6' x 8' 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 Ruin: 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 the county relied on two general types of furnaces. The earliest and least efficient was a brick or masonry structure with multiple chambers lined by fire bricks. Combustion in lower chambers created superheated gases that melted ore in upper chambers. The masonry should feature evidence of intense heat and slag. The type of furnace used in the Greene and later smelters was a free-standing, cylindrical steel vessel lined with fire bricks. These furnaces tended to be from 6' to 20' 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: The early masonry furnaces stood on rectangular foundations of brick or rock integral to the chamber walls. The free-standing furnaces stood on brick or rock pads larger in footprint than the steel vessel. A foundation for a blower is usually nearby. Furnace foundations almost always feature slag and evidence of heat.
Furnace Platform/Terrace: Furnaces usually stood on dedicated platforms or terraces within the smelter building. Because the furnace provided one of the last stages of ore treatment, the platform was among the lowest at a smelter. Evidence of a furnace, such as slag flows or a

foundation, should remain. Free-standing steel furnaces often left little more than the foundation surrounded by slag flows, while masonry types may have left structural ruins.
Slag Dump: Slag is a vitreous waste left after ore melted and metal content was drawn off. Smelting companies disposed of their slag in dumps downslope from the smelting complex.
Slag Flow: Uncontrolled releases of slag from a furnace created flows on the furnace platform. The flows appear similar to lava or smooth concrete.
Smelter Building: Smelter buildings were similar to those for ore treatment mills. Where possible, they were built over a series of platforms or terraces so gravity could draw the ore through the stages of preparation and smelting. Each terrace was usually dedicated to a specific treatment stage. For a description of the general constitution of these buildings, see Ore Treatment Mills above.
Smelter Building Foundation: The foundations for smelters were similar to ore treatment mills.
Smelter Ruin: The collapsed remnants of a smelter building.

PROPERTY TYPE: MINING SETTLEMENT AND RESIDENCE

Because most county mines and prospects were distant from the principal town of Silverton, prospectors, miners, and other workers lived near their work. Prospectors established temporary camps, mining companies erected company housing, and other workers provided their own residences. All mining districts featured enough activity and people to support both organized and unincorporated settlements. Most forms of residence and settlement exist as individual resources. They are sometimes components of other sites, in which case they should be included with their parent resources.

Mining Settlement and Residence Subtypes

Prospector's Camp: When examining an area or developing a claim, prospectors usually established impermanent camps abandoned after brief occupation. Prospectors' camps were simple, may have lacked formal buildings, and were located in the most favorable environment an area had to offer. In terms of residence, individual and pairs of prospectors often lived in wall tents because of their low cost and portability. Occasionally, prospectors intensely examining an area erected primitive log cabins as longer term bases of operations. Camps also may have included a well-built hearth for outdoor cooking, and a field forge for blacksmithing. Because prospect camps were intended to be impermanent, they often left little material evidence. The residence tends to manifest as a small earthen platform, log cabins, if any, are in ruins, and a sparse scatter of food cans and hardware reflect occupation. For such assemblages of features and artifacts to qualify as a prospector's camp, they must be either directly associated with nearby prospect workings or located in an area that was subject to prospecting. If a camp is directly associated with a specific prospect complex, shaft, or adit, then it would be part of that larger Property Subtype.

Workers' Housing: Workers' housing is a resource subtype category encompassing various types of buildings where mining industry workers lived. Buildings ranged from primitive cabins to single-family houses to boardinghouses. The unifying element is that residents who lived in these buildings were confirmed mining industry workers. Houses and boardinghouses near mines and mills are likely to meet the definition because of their proximity to these industrial operations. Similarly, houses in unincorporated settlements usually qualify because most men were employed at nearby mines. Residences in towns such as Silverton, however, require archival documentation to substantiate the occupation of inhabitants. Often, mining companies built cabins and boardinghouses for their employees. Although these residences are workers' housing, they should be recorded as components of larger mine or mill sites when possible.

Workers' housing can be recorded as an independent resource under several conditions: first, when workers' housing cannot be directly attributed to a specific industrial complex or single employer. For example, residences may lie near a cluster of mines, and yet be far enough away from any one so that the residences cannot be attributed to a specific operation. Second, when residences are within an unincorporated settlement dependent on mines or mills and inhabited by a population dominated by industry workers, it may be registered independently. Finally, when residential features are a component of a larger industrial site, but the industrial aspects have been destroyed or have little integrity, the residential features may be recorded independently. They indeed may be the only surviving intact portion of the site. In this case, the residential features would constitute a site unto itself, but the lost industrial complex should be noted.

As a resource, workers' housing includes all features associated with inhabitation and other domestic activities. The sites were usually complexes centered on at least one residential building, and often several. Buildings may have been cabins or formal houses occupied by a miner and family, or shared by a handful of unmarried workers. Boardinghouses provided accommodations for unmarried workers who dined and spent leisure time in a communal setting. Isolated mines and mills commonly had boardinghouses for workers and separate cabins or houses for the superintendent and family. Typically, archaeological features such as building platforms, foundations, and ruins represent residential buildings today. Some workers' housing still exist as standing buildings. Small houses and boardinghouses may be of log or frame construction, while large boardinghouses are almost always frame. Nearly all are vernacular in function, construction, and form. Vernacular buildings adapted conventional designs and construction methods to the environment and building materials available locally. The builder's economic resources, skills, preferences, and needs influenced the built form.

Workers' housing complexes almost always possess site features in addition to the residences, many of which are primarily archaeological in nature. Privy pits and refuse dumps reflect primitive waste disposal practices. The dumps usually extend downslope from the residence doorway and consist of domestic refuse, and materials generated by food preparation. Residents usually cleared an area by the building for chopping firewood, cleaning laundry, and other outdoor activities. Complexes for numerous workers often included root cellars for the storage of perishable food.

Isolated Residence: Isolated residences are places of developed inhabitation that cannot be clearly tied to an industrial operation due to insufficient evidence. Such resources lack characteristics or artifacts that can associate the resource with prospecting, mining, logging, transportation, or agriculture. Determining whether a resource in a mining district is an isolated residence can be subjective since it may have served as base of operations for prospectors, hunters, or homesteaders. Isolated residences are simple resources and usually consist of a few residential features, generic artifact assemblages, and no industrial or commercial attributes. If buildings stand, they are likely to be small cabins or frame houses vernacular in appearance and form, as defined above.

Unincorporated Settlement: Popularly known as mining camps, unincorporated settlements were informal communities established in response to several factors, but often a mineral boom. When prospectors and miners joined a local rush, they tended to erect residences in a common area that offered flat ground, open space, and water. In San Juan County, Poughkeepsie and Mineral Point are examples. Informal settlements also grew as communities to house the workforce of a primary industry, such as a group of mines. Gladstone was one such settlement.

Unincorporated settlements were rarely planned in advance and instead evolved organically according to local housing needs. The communities usually possessed no formal organization or infrastructure, and buildings tended to be disbursed among the most favorable micro-environments. Mining companies and individual workers built residences near their employment, which assumed form as a settlement when concentrated in one area. When the population became large enough, entrepreneurs and community activists established basic services and businesses such as a post office, mercantile, saloon, and restaurant-hotel. The businesses then formed the settlement center, even if residences were few and scattered.

As a center for a working population, an unincorporated settlement usually was the hub of a local transportation network. Several wagon roads linked settlement with the nearest nodes of commerce as pack trails fanned out to places of employment. Because draft animals were a principal transportation method, residences for multiple people often featured corrals. Sanitation was limited to privies, and water came from streams, springs, and wells. By the mid-1890s, some settlements enjoyed electricity for lighting, wired from nearby mines or mills.

The architecture in unincorporated settlements tended to be vernacular in appearance and form. The buildings were rarely designed by architects, and were instead planned in the field for function and economy. Residents imitated familiar methods and forms as best they could, adapting them to the local environment and incorporating available materials. Milled lumber was preferred for its regularity, but residents substituted local building materials such as logs and stone masonry. When a settlement was in infancy, almost all its buildings were wall tents, small cabins, and buildings combining logs, lumber, and canvas. Mature settlements often featured at least several substantial frame buildings, as well as log cabins with plank or board-and-batten siding. By the 1900s, residents made increased use of corrugated sheet metal. Some business buildings had false-fronts and nearly all possessed gable roofs.

Today, few if any unincorporated settlements survive in a well-preserved state. Although some settlements still possess intact buildings, most have been reduced to archaeological sites. Features such as earthen platforms, foundations, and ruins represent buildings. Such ruins are usually center to associated features such as yards, refuse dumps, privy pits, root cellars, and wells. At sites completely overgrown, differentials in vegetation may outline features. If a researcher suspects a site to be an unincorporated settlement, he or she should survey a large area for outlying residences, primitive infrastructure such as community springs, and industrial complexes. Companies frequently built ore treatment mills and sawmills in drainages near settlements.

Townsite: When a mineral boom matured from the prospecting phase toward development and production, the nascent industry drew a working population. The shift ushered in a stage of growth, and a common result was the evolution of unincorporated settlements into organized towns. In many cases, the towns remained small and were abandoned within a short time, but if the industry was successful, some became large and sophisticated. Small townsites may be recorded and evaluated as individual sites or districts as discussed above. The town of Silverton, as a major regional center, requires additional context beyond that generalized to the mining industry.

Small or large, both forms of community shared basic physical characteristics and organization patterns. An identifiable business district was the most elementary, offering goods and services proportional in volume and diversity to the population. Towns in early stages of growth usually featured a few mercantiles, saloons, restaurants, and hotels, as well as a butcher, bakery, assayer, laundry, livery, and blacksmith. As the population increased in number and sophistication, entrepreneurs began additional businesses such as newspapers, law practices, surveying, confectioneries, clothing retailers, stationary and book stores, medical and dental, and hygiene. Although not heavily documented, women and families were an essential demographic of mining town and reflected a stable working population. They demanded social institutions such as schools, churches, social organizations, and public meeting halls. Gaming houses and prostitution were rare in the county's small towns, with Silverton as one exception.

Business districts, however small, served as town centers surrounded by formal residences usually occupied by members of an upper socioeconomic status. In many towns, proprietors lived in their commercial buildings on an upper story. The town core conformed to a surveyed grid of lots and blocks, while outlying residences may have been scattered. These were usually inhabited by workers and members of a lower socioeconomic status. Workers also rented space in boardinghouses or took a room in a house. As the town grew and population diversified, both the business and residential districts divided further along socioeconomic or ethnic lines.

Town architecture was a function of community development, success of the mining industry, timeframe, distance from shipping and manufacturing centers, and available materials. In a town's early period, the architecture tended to be vernacular in appearance and form.

Builders preferred milled lumber and manufactured elements, but made extensive use of local materials when these were costly or unavailable. Logs were the most common local material for walls and roof beams, with stone for foundations.

The earliest buildings in a town were wall tents and log cabins. Within several years of establishment, residents assembled buildings from combinations of lumber, log, canvas, and sheet metal. Frame construction was preferred, but expensive until the town had a sawmill or wagon road to outside commercial centers. In form, most buildings were simple with gabled roofs and one or two stories. Commercial buildings may have featured false-fronts and plank walks or stoops. Buildings usually stood on informal foundations, had roofs sided with shingles or log strips, and featured walls clad with boards and batten, plank, or clapboard. Wealthier individuals at times added some ornamentation, such as trim to display status or imitate architecture in established cities.

Architectural improvements were hallmarks of community maturation and economic stability. New buildings tended to be more substantial and standardized construction materials dominated. An increase in value of building lots, the perceived obsolescence of log construction, and social preference for frame construction contributed to gradual architectural evolution. Elements of architectural style began to appear as early as the 1880s, including ornamentation suggestive of Greek Revival, Italianate, and Queen Anne styles and pattern books. 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. Vernacular form and appearance, however, continued to be universal. Although brick and stone replaced lumber for some of the most important buildings in Silverton, the county's small towns saw little masonry construction. The residents did, however, use sheet metal stamped with imitation brick and stone patterns, which suggested masonry from a distance.

Most mining towns possessed infrastructures proportional in sophistication to the success of the mining industry, population, and expectation of permanency. On a base level, most infrastructure related to transportation, communication, and limited public utilities. Transportation infrastructure usually featured trunk roads that carried freight and passenger traffic to town, and feeder roads extended to the surrounding mines and mills. Streets and footpaths directed traffic within the town, and even though many towns were arranged according to a grid, roads and paths did not always conform. The ultimate transportation system was the railroad, which served Silverton, Howardsville, Eureka, Animas Forks, and Silver Ledge.

Communication systems were initially limited to the postal service and newspapers. By the early 1880s, Silverton, Howardsville, and Eureka were linked by telegraph, followed by a telephone system within several years. By around 1900, many towns of lesser importance also subscribed to telephone service. Water systems existed in both towns and workers' housing erected by mining companies. Water systems appeared in Silverton during the 1880s, and some other principal towns followed during the subsequent thirty years, although most small towns never saw service. The introduction of flush toilets, bathtubs, and sinks during the 1890s fostered a demand for sewer systems in the large towns and advanced workers' housing complexes. Common systems consisted of little more than pipes and culverts that drained into local waterways. One of the most important forms of public utility was electricity, available when the town of Silverton and the Silver Lake Mines Company built local power plants during the early 1890s. The ability to subscribe to domestic and commercial service was based on socioeconomic status, which excluded many residents until the 1940s.

Mining Settlement and Residence Significance

Settlement and residence property subtypes provided shelter and granted 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 participants in the mining industry and in turn facilitated permanent settlement. Individual subtypes are associated with narrower Areas of Significance outlined below.

Prospectors' Camps: Because prospectors' camps were a function of prospecting, they share the same Periods and Areas of Significance as Hardrock Prospect Property Types. The timeframe spans 1870, when prospectors arrived in significant numbers, until 1885 when mining subsumed prospecting. Regarding Exploration/Settlement, temporary encampments were bases of operations for prospectors at the forefront of the mining frontier. Camps allowed prospectors to search for ore, characterize a region's geology, and conduct general exploration. These important steps preceded the establishment of the mining industry. Prospectors and organized outfits were the first Euro-American settlers to inhabit the county, especially when the rush developed.

Regarding Social History, camps inhabited by groups of prospectors served as frontier communication centers where individuals exchanged information and news. The camps also served as primitive social centers for a segment of the industry that often went without human contact for long periods of time. To search and labor in the wilderness, prospectors had to be adventuresome, independent, curious, physically robust, and skilled at survival. Most possessed at least some formal education. Seeking wealth often attracted individuals who did not conform to the traditional values of an agrarian lifestyle.

Regarding Politics/Government, prospectors organized the earliest mining districts in the San Juan Mountains, setting a precedent for districts elsewhere in the 1870s. In general, mining districts were tantamount to a frontier government that brought order to mining. This trend is relevant to camps as places of district administration. By supporting the presence of prospectors, camps can in turn be associated with the division of southwestern Colorado into counties. In particular, the territorial legislature originally designated La Plata County in 1874 in response to the surge of prospecting and mining in the Animas River drainage. Because of continued growth, the legislature then carved San Juan County out of La Plata.

Workers' Housing: Among the Areas of Significance relevant to workers' housing, Architecture applies to cabins, houses, and boardinghouses. Usually vernacular in form and construction, residential buildings reflect the adaptation of building methods and design to the physical environment and available materials of the San Juan Mountains. Boardinghouses can represent how mining companies adapted conventional engineering and architectural practices to meet the needs of housing large crews in the environment of the San Juans. Well-capitalized organizations erected handsomely appointed accommodations for their workers to attract skilled workers and entice them to remain. Less commonly companies sought to provide comfortable housing out of humanitarian concern and social progressiveness. Between around 1890 and 1920, companies installed plumbing and electric lighting, and a few even provided showers, flush toilets, steam heat, dining halls, and commercial kitchens. Such appointments set an example followed by companies elsewhere.

Regarding Community Planning and Development, workers' housing complexes were often apart from larger communities, thus constituting a distinct settlement pattern. Workers' housing supported population distant from concentrated settlements, contributing to permanent settlement.

Regarding Economics, workers' housing, especially boardinghouses and bunkhouses, were microcosms of intrapersonal financial transactions. Cumulatively, workers' housing participated in regional economic systems, including agriculture and commerce. Merchants in the major towns handled food and goods and the acquisition of such contributed to local economies.

Regarding Social History, communal residences were important centers of communication and socialization. They were also the place of cultural diffusion among employees of different ethnicities. Residences sheltered much of the mining industry's workforce, saw it fed, and allowed people to attend to the necessities of life outside of the workplace.

Isolated Residences: By definition, isolated residences cannot be directly attributed to an industry or other pattern of subsistence. For this reason, their historical associations and Areas of Significance remain unknown until detailed research or archaeological investigation provides clarifying information.

Townsites and Unincorporated Settlements: Both forms of settlement are associated with similar Areas of Significance. Regarding Architecture, settlements were places where both companies and residents adapted conventional design and construction to the physical environment and materials available in the San Juan Mountains. Most buildings were vernacular, influenced by the builder's financial resources, needs, skills, and experience. Townsites also were later a vehicle for the introduction of defined architectural stylistic elements.

Townsites and unincorporated settlements were significant in the area of Community Planning and Development. Townsites, and to a lesser degree unincorporated settlements, introduced platting, community organization, infrastructure, municipal ordinances, and business development. Townsites and unincorporated settlements also influenced the distribution of population, social classes, gender, businesses, and some industrial facilities. Townsites and unincorporated settlements were transportation nodes and transfer points for the movement of goods and people. The supplies, equipment, and services required by mining companies and the population often flowed into settlements prior to their distribution to consumers, and ore and mill products flowed out. Such a function influenced where communities grew and how large they became.

Regarding Economics, settlements participated in the same complex local, statewide, and national economic systems as noted above in relation to workers' housing. Regarding Commerce, townsites and unincorporated settlement were local centers of banking, business, and trade. They also served as anchors and conduits for capital and investment. The presence of established settlements, especially towns, lent legitimacy to a local mining industry, fostering confidence among potential investors. When these investors provided capital, the settlements became the points through which that capital flowed to associated mines and mills.

Regarding Social History, townsites and unincorporated settlements were centers of social relationships as well as passive and active cultural development. Passive development occurred when cultural traditions practiced by different ethnicities diffused among the population. Active development occurred when inhabitants purposefully sought out cultural performances, lectures, salons, organizations, and community events. In addition, employment the mining industry impacted social patterns. Further, 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. Their arrival fostered a demand for cultural and social institutions, both constructive and recreational. Institutions that communities accepted were schools, churches, civic associations, unions, and meeting halls. Institutions less condoned included venues catering to substance abuse and saloons.

Regarding Industry, towns and unincorporated settlements supported the mining industry by housing the workforce, providing goods and services, and hosting mines and mills. Towns and unincorporated settlements were also nodes of infrastructure, including transportation, communication, and utility systems.

Regarding Politics/Government, townsites and unincorporated settlements were centers of law enforcement and judicial systems created in response to social and mining disputes and crime. Administrative and regulatory bodies developed in towns to oversee local government activities, claim registration and regulation, and records keeping. Settlements also served as polling stations, where populations proved instrumental in the election of government officials.

Mining Settlement and Residence Registration Requirements

Prospectors' Camps:

The eligibility of prospectors' camps is predicated on meeting at least one of the NRHP Criteria and adequate integrity to convey their significance. Camps eligible under Criterion A must be associated with at least one Area of Significance noted above, events and trends important to the county. Prospectors'' camps may be eligible under Criterion B provided they reflect the direct and active on-site contribution in the life of an important person or persons. For instance, an important person lived in the camp. However, few camps possess sufficient archival documentation to demonstrate the presence of an important person. To be eligible under Criterion C, a resource must clearly represent short-term residence associated with mineral discovery, mineral boom, or general exploration. Because prospectors' camps were purposely impermanent, most lack buildings and manifest as archaeological features. Clearly definable resources with integrity are uncommon because brief occupation left minimal evidence. Tent or cabin platforms, sparse artifact assemblages, and corral remnants are important character-defining features. Prospectors' camps may also be eligible under Criterion C if the resource possesses intact architectural features or facilities necessary for prospecting, such as cabins and field forges. These are significant and rare manifestations of historic prospecting efforts.

Under Criterion D, in the relatively rare cases where camp sites 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 demographics of prospectors, as well as the presence of families and women. Such information has not been extensively documented. However, because camps were occupied briefly, material evidence tends to be ephemeral. Prospectors' camps featured few built elements, most of which were usually removed when the site was abandoned.

Resources that can be confirmed as prospectors' camps and possess physical integrity relative to a stated Period of Significance are significant. Integrity of setting, feeling, location, and association are particularly relevant to the eligibility of these resources. To retain integrity of *setting*, the surrounding area must not have changed a great degree from its Period of Significance. In terms of *feeling*, the resource should convey the sense of historic prospecting and residence. Integrity of *association* exists where archaeological artifacts and features convey a strong sense of connectedness between the property and a contemporary observer's ability to discern historic occupation.

Workers' Housing: This subtype comprises a spectrum ranging from simple cabins to large complexes with multiple boardinghouses. Because most workers' housing was a function of the mining industry, it shares similar Periods of Significance. The eligibility of workers' housing is predicated on meeting at least one of the NRHP Criteria and adequate integrity to convey its significance. Housing eligible under Criterion A must be associated with at least one Area of Significance noted above, events and trends important to the county. Housing may be eligible under Criterion B when occupation by an important person or persons can be confirmed. The important individual must have lived or worked at the complex or been directly present during its construction. If the important individual designed the complex or building but did not live there or was otherwise associated with the site, then Criterion C applies.

Workers' housing may be eligible under Criterion C under certain conditions. Here, it is best to distinguish between resources with standing buildings from those that have been reduced to archaeological features. Currently, workers' housing in the forms of cabins, houses, and boardinghouses stand intact in the county. Small and simple houses and cabins can represent the austere, vernacular architecture typical of wage workers in the San Juan Mountains. Boardinghouses are uncommon and can also reflect architectural adaptation to the needs of a mining operation and its workforce. Character-defining features may include adaptations to environment and geography, such as function, construction method, and materials use.

Archaeological integrity requires intact assemblages of surface artifacts and features clearly conveying the organization and infrastructure of the housing and information about the residents and their lifestyles. Evidence of how the residents inhabited the complex, conducted domestic activities, and added support facilities are additional information a site may yield. Workers' housing may be eligible under Criterion D for its potential to yield meaningful information. An analysis of a complex and its features may augment existing understanding of the design of complexes, architectural practices and methods, and the residential environment associated with the mining industry. Workers' housing often possesses building platforms, privy pits, and refuse dumps that represent buried archaeological deposits. Testing and excavation may reveal information regarding the lifestyles, social structures, and demographics of workers, as well as the presence of families and women. Such information is significant because these subjects have not been extensively documented.

Resources that can be confirmed as workers' housing and possess physical integrity relative to a stated Period of Significance are significant. Integrity of setting, feeling, location, design, and association are particularly relevant to the eligibility of these resources. To retain integrity of *setting*, the surrounding area must not have changed a great degree from its Period of Significance. In terms of *feeling*, the resource should convey the sense of historic residence. Integrity of *association* exists where archaeological artifacts and features convey a strong sense of connectedness between the property and a contemporary observer's ability to discern historic occupation. For housing to retain integrity of *design*, material evidence, including archaeological features, must convey organization and planning of the complex. For individual buildings to possess integrity of design, their floorplan, form, and construction must be readily discernable. Resources may include standing buildings that were re-occupied periodically. Integrity of *materials* and *workmanship* requires most materials to be original, and any repairs completed with materials and workmanship similar to the original.

Isolated Residences: Since isolated residences often cannot be tied to a specific industry without substantial research, but the presence of buried archaeological deposits may yield information related to what industry residents were associated with. In this case, the site may be eligible under Criterion D.

Townsites and Unincorporated Settlements: This subtype comprises a spectrum ranging from small unincorporated settlements with a handful of buildings to formally organized towns. The eligibility of townsites and unincorporated settlements is predicated on meeting at least one of the NRHP Criteria and adequate integrity to convey its significance. In general, each settlement was important at least on a local level, and some were tied to historical trends and patterns significant on statewide and sometimes national levels. Settlements eligible under Criterion A must be associated with at least one Area of Significance noted above, events and trends important to the county. Settlements may be eligible under Criterion B when occupation by an important person or persons can be confirmed. For instance, the individual's specific residence or place of employment must be identified, and in such cases, the place with the greater association will qualify.

Settlements may be eligible under Criterion C under certain conditions. Although some townsites currently possess standing buildings, all include a majority of archaeological features. Integrity at least on an archaeological level is required for eligibility. Townsites and settlements may be eligible in their entirety if the archaeological, architectural or engineering features and artifacts clearly convey broad patterns of the community. The settlement's organization and design is one example. Although most designs were based on grids, some communities grew spontaneously in response to local conditions. Road intersections, railroads, and local topography greatly influenced a settlement's final form. The distribution of residences, businesses, and industrial facilities constitutes another broad pattern. The transportation infrastructure, water sources, and waste disposal practices, however primitive, are additional patterns of potential significance.

Archaeological integrity requires intact assemblages of surface artifacts with the potential to yield important information. Artifacts are necessary to interpret timeframe and function in the community, as well as its individual buildings. Boardinghouses, cabins inhabited by families, and different businesses left distinct types of artifacts. By analyzing the artifacts, the researcher may be able to determine the function of some buildings, even when represented solely by archaeological remnants. A researcher may further be able to interpret socioeconomic status, gender, ethnicity, and modes of employment of residents through artifacts; characterizing aspects of lifestyle such as diet, health, and consumerism.

Standing buildings possessing integrity relative to a Period of Significance may be eligible individually or as contributing elements of a larger site. Settlements still inhabited today often possess more recent construction. If the number of such buildings overly disrupts the townsite's historic fabric, then the townsite as an entity may no longer possess the necessary level of integrity. Even if a townsite lacks integrity as a whole, standing buildings may be individually eligible under Criterion C. If the building retains architectural integrity relative to its Period of Significance, it may represent a type common to that era. Buildings altered over time may represent serial occupation and changes in preferred materials, styles, and spatial requirements. Some buildings possess innovative designs, construction methods, and materials uses in response to the conditions of a specific area. Such buildings may be eligible as adaptations of architecture to the environment, climate, and geography of the San Juan Mountains. In a few cases, buildings can be attributed to important architects and builders. If the building retains integrity relative to the original design, it may be eligible as the work of a master architect or builder, known or unidentified. Even when largely reduced to archaeological features, townsites may further be eligible under Criterion C as historic mining landscapes.

Settlements and townsites may be eligible under Criterion D for their potential to yield meaningful information. An analysis of architectural features may augment existing understanding of the commercial and residential environment associated with the mining industry. Broad-scale studies of settlements often reveal aspects of community development, distribution of gender, modes of employment, socioeconomic status, and business practice. 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, lifestyles, social structures, and demographics of residents, as well as the presence of families and women. Such information is significant because these subjects were not extensively documented.

Eligible townsites and unincorporated settlements must possess physical integrity relative to their Period of Significance. Features commonly encountered at settlements are listed under the feature types below. Most of the seven aspects of integrity defined by the NRHP apply to settlements. For a settlement to retain integrity of *design*, material evidence, including archaeological features, must convey community organization and planning. Individual buildings can retain integrity of design in two principal ways. Unaltered buildings can exhibit their original form, floorplan, and construction. Buildings altered through serial occupation retain integrity of design if they reflect evolution within the historic period. Integrity of *materials* and *workmanship* is retained when a building exhibits predominantly original materials and construction methods. Modern repairs must be made with compatible materials and workmanship. To retain integrity of *setting*, the area around the resource must not have changed a great degree from its Period of Significance, with allowance for removal of buildings and structures. To retain integrity of *feeling*, the resource should convey the sense of historic community. Integrity of *association* exists where features convey a strong sense of connectedness between the settlement and a contemporary observer's ability to discern historic occupation.

Features Common to Mining Settlement and Residence Resources

As historic resources, settlement subtypes possess a diverse array of architectural and structural features and their archaeological manifestations. Only the most common features are defined below.

Prospectors' Camp Features

Corral Remnant: Prospectors usually relied on pack-animals to carry their goods and penned the animals in informal corrals near their camps. Corral boundaries maximized natural obstructions, and had fences of branches, stumps, and wire.

Dugout: A dugout was among the most impermanent and primitive forms of residence. They were created by prospectors who lacked wall tents but were unwilling to invest time and resources in other accommodations. A dugout consisted of an excavation in a slope, 8' x 10' or larger in area, roofed with logs or branches covered with earth. The front often had a log or rock masonry façade, window, and doorway. A chimney or stovepipe extended from the roof. Dugouts were not limited to residential use. Root cellars, hay storage, and explosive magazines can resemble these resources. To recognize a resource as a dugout, it may be center to an assemblage of domestic refuse, which reflects inhabitation.

Dugout Ruin: Dugouts usually collapsed when abandoned. Ruins manifest as ovoid depressions embedded with structural materials. A sparse artifact assemblage of domestic refuse should be present.
Fire Hearth: Prospectors often built large outdoor rings or rock structures for cooking and heating fires. The ring should be near the tent or cabin platform and exhibit signs of aging such as collapse and revegetation.
Pack Trail: Pack trails often radiated outward from prospectors' camps to the areas under examination and to the nearest commercial centers. Most were created by foot and pack animal traffic, while others were intentionally graded to fulfill claim assessment requirements. Pack trails are no wider than 8'.
Tent Platform: Prospectors often graded small platforms, usually less than 20' x 20' 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: Mining companies erected boardinghouses for crews of four or more workers. The residents lived in a communal atmosphere, may have shared sleeping quarters, and usually consumed meals prepared in the building. Privies, outdoor work areas, and domestic refuse dumps or scatters are usually associated with boardinghouses. In form, the buildings were often greater than 20' x 25' in area, one or two stories in height, and rectangular, L-shaped, or irregular in plan. Roofs were usually gabled with a loft underneath, and foundations were informal on earthen platforms. Although builders preferred lumber, they used locally available materials to save capital. Boardinghouses were typically vernacular, in that the builder adapted conventional form and construction methods to local conditions, available materials, and interpreted needs.
Boardinghouse Platform: Boardinghouses usually stood on earthen platforms, which may feature rock or log footers and a collapsed a root cellar. The platform often represents the building's size and footprint.
Boardinghouse Ruin: The structural remnants of a boardinghouse.
Bunkhouse: Bunkhouses were a type of company housing where workers slept and spent leisure time, but did not regularly prepare food. Instead, they ate in a boardinghouse or company dining hall. Given this, bunkhouses often feature few food-related artifacts relative to the size of the building and the number of inhabitants. In form, construction, and style, bunkhouses were similar to boardinghouses.
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 Ruin: The structural remnants of a bunkhouse.
Cabin: A cabin was a self-contained residence for several workers or a family. In form, cabins were less than 20' x 25' in area, rectangular or L-shaped in plan, and one story high. Workers built cabins with any combination of logs, lumber, canvas, and sheet iron. Cabins were typically

vernacular, in that the builder adapted conventional form and construction methods to local conditions, available materials, and need. Because cabins were self-contained households, they usually offer a wide array of domestic artifacts. Privies and refuse scatters are often associated.
Cabin Ruin: The collapsed remains of a cabin.
Cellar Pit: Cellars, at times mistaken for dugout residences, were subterranean structures that provided cold storage for perishable food. They usually had plank walls retaining an earthen pit, a plank or log roof covered with earth, and a sunken doorway. In some cases, cellars were underneath cabins and boardinghouses. When the walls and roof collapsed, the cellars tend to manifest as pits with notches marking the entry. A lack of domestic refuse is a common attribute.
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 for fresh water. Cisterns were plank, concrete, or stone masonry chambers sunk into the ground, usually with inlet and outflow pipes.
Corral: Pack animals provided transportation in the mining industry before 1940, when automobiles became common. Company housing complexes, unincorporated settlements, and towns almost always had corrals to impound multiple animals. The corrals varied widely in size, plan, and constitution, depending on the number of animals and type of operation. Livery businesses tended to build large corrals geometric in plan with wooden or wire fences, feed troughs, and stables. Mining and logging companies, on the other hand, built smaller corrals that utilized natural features as barriers to save construction costs. Such corrals were built in open areas bordered by streams, rock outcrops, thickets, and slope changes, and incorporated combinations of branches, upended stumps, and wire as fencing.
Corral Remnant: After abandonment, corrals may feature evidence of their boundaries such as wires, branches, upended stumps, individual fence posts, and cobble alignments marking a fence line. The interior should either be open or feature vegetation younger than in the surrounding area.
Developed Spring: Settlements depended on water for existence, and residents were able to subsist on surface sources when a community was still in its early stages of growth. Springs were preferred because of their purity. When water was difficult to collect, the residents developed the spring by excavating a chamber, lining it with planks or masonry, and diverting drainage around the excavation.
Domestic Refuse Dump: People usually threw their solid refuse downslope from their residences, forming deposits of domestic artifacts. Large deposits that were high in volume qualify as dumps. Artifacts are usually domestic in nature, primarily food-related, and include food cans, fragmented bottles and tableware, and personal articles.
Domestic Refuse Scatter: A refuse scatter is a light amount of domestic artifacts disbursed over a broad area. Domestic scatters usually extend downslope from a residential feature.
Privy: Until flush toilets became common during the 1940s, most people outside of principal towns relied on privies for their personal use. Privy buildings enclosed toilet benches with cut-out holes as the seats. Most buildings were vernacular with shed or gabled roofs, plank floors,

and a plank door. The residents often preassembled the walls, leaned them together, and nailed the corners. The buildings stood over a pit on posts or rocks.

Privy Pit: Privy pits were excavated in the ground underneath privies to receive waste. When a pit became full, the residents relocated the privy building, topped the depression off with domestic refuse, and shoveled over a soil cap. The cap subsided as the pit contents leached away and decayed, creating a depression usually less than 6' in diameter. Pits often feature backdirt downslope, some domestic refuse in the interior, and ashy soil. The pit may be surrounded by more refuse and footers for the privy building.

Residential Building: Settlement sites may feature buildings that material evidence defines as residential, but the buildings do not clearly possess the characteristics of boardinghouses, bunkhouses, or small cabins. Such buildings can be recorded as general residences.

Residential Building Platform: A platform, confirmed by artifacts, which supported an unspecified residential building.

Residential Building Ruin: The structural remnants of a residential building.

Road: Residential complexes usually required roads to accommodate traffic. Roads are at least 8' wide.

Root Cellar: Residences and businesses that handled high volumes of perishable food had root cellars for storage. Such enterprises were commonly boardinghouses, restaurants, hotels, and markets. Root cellars, often mistaken for dugouts, were excavated near their associated buildings. Walls usually made of rocks, logs, or lumber retained the earthen sides and a roof covered with more earth. Because root cellars were not residences, they usually offer few domestic artifacts and lack stovepipe ports.

Spring Box: A spring box was a small enclosure built over a developed spring. The structures had plank walls, often a masonry or concrete chamber, a roof, and an entry door.

Stable: Mining companies and livery operators erected stables to house draft animals used for wagon drayage. Stables were vernacular, poorly constructed, and assembled from inferior materials to save costs. In form, stables were square to rectangular, and one-story high with shed or gabled roofs. Logs were used for the foundation and walls, and lumber and sheet metal for the roof. Defining characteristics include wide doorways, low ceilings, broad gaps in the walls, and mangers and stalls in the interior.

Stable Ruin: A collapsed stable.

Well: Because many settlements lacked reliable and clean sources of water, residents turned to wells. Three types were common in mining districts. The earliest was a hand-dug shaft lined with dry-laid masonry and crowned by a platform at the collar. Once hardware was available, residents sank pipes into the ground and fitted them with hand-pumps. In some cases, communities or mining companies installed steam- or gasoline-powered pumping stations over large-diameter wells.

Townsite and Unincorporated Settlement Features

Townsites and unincorporated settlements usually included similar features described above with Workers' Housing.

Assay Shop: An assay shop was a facility where a trained metallurgist tested ore samples for their mineral content. In function, content, and form, the shops were like those described with the Ore Treatment Mill property subtype above. The shops in unincorporated settlements may have been an independent business or run by a mining company, while those in towns were usually businesses.

Assay Shop Foundation/Platform: Assay shops often stood on earthen platforms or foundations of concrete and rock masonry. Distinct characteristics can define a platform as that for an assay shop. Foundations or other remnants of an assay furnace, its blower, and small crushers may remain. Artifact assemblages typically include furnace clinker, fire-bricks, broken assay crucibles, mineral samples, and laboratory artifacts.

Blacksmith Shop: Blacksmiths were vital to mining communities because they manufactured hardware, maintained tools, and shoed draft animals. Nearly every community had a blacksmith, who kept shop on the fringes of the business district. Community blacksmith shops were equipped like those at mines, and the buildings were vernacular and simple in form. They were square, rectangular, or L-shaped, one-story, and gabled. In construction, they consisted of combinations of logs, lumber, and sheet iron, and were rough. The floor was the underlying earthen platform and the foundation usually of logs or rocks. The interior was open and featured workbenches, a coal bin, forge, anvil block, and blower to force air into the forge.

Blacksmith Shop Platform: Blacksmith shops usually stood on earthen platforms larger than the building for storage of materials and large items. Rock alignments and deposits of forge clinker usually define the building's footprint. The artifact assemblage is distinct and includes much forge clinker, forge-cut iron scraps, hardware, and sheet iron.

Blacksmith Shop Ruin: The collapsed remnants of a blacksmith shop.

Commercial Building: Commercial building is a general term applied to a building that housed a business. Commercial buildings were usually located in or near a town's business district. The buildings assumed a variety of plans, were as high as two stories, and usually featured gabled roofs. Commercial buildings in most settlements were vernacular and consisted of any combination of log and lumber construction.

Commercial Building Foundation/Platform: Primitive commercial buildings stood on logs or rocks laid on earthen platforms. Large buildings may have stood on formal foundations of masonry or concrete. Artifacts and buried archaeological deposits are often few because most service and retail businesses generated little refuse.

Commercial Building Ruin: The collapsed remnants of a commercial building.

Ditch: Many unincorporated settlements and towns featured ditches that delivered fresh water for consumption and other uses. The ditch, an early public utility, tapped the nearest reliable source and carried the water through the settlement.

Hotel: A hotel was a business that housed guests on a short-term basis. A boardinghouse, in contrast, provided long-term accommodations. In the early years of unincorporated settlements and towns, hotels were small and featured only several rooms. In mature settlements, the hotels were more substantial and complimented by a dining and drinking establishment. In form, hotels had varying floorplans, were often two stories in height, and usually featured gabled roofs. In construction, small buildings were usually made of logs and stood on foundations of logs or rocks, while large hotels were constructed of lumber with formal foundations. Most were vernacular in appearance and had may have featured false-fronts, boardwalks, and ornamental trim.

Hotel Foundation/Platform: Small hotels stood on rock alignments and logs laid on earthen platforms, while larger hotels may have had formal masonry or concrete foundations. The platforms tend to be large and may feature a cellar pit if the hotel had a kitchen. The artifact assemblages are often distinct and can include a high proportion of small personal items, clothing hardware, decorative domestic wares, furniture parts, and lamp parts. Large and numerous privy pits are often associated.

Livery: A livery was a business that temporarily boarded draft animals. Defining characteristics include corrals, collapsed fences, evidence of stables, earth packed by animal traffic, and manure deposits. Because of noisome pests and odors, liveries were usually located on the fringes of a settlement. The artifact assemblage should include a high proportion of tack straps and hardware.

Mercantile: A mercantile was a retail establishment that sold a variety of goods. In form and construction, mercantiles were similar to the commercial buildings described above.

Mercantile Foundation/Platform: Mercantiles may be identified by a substantial platform or foundation, an associated privy pit, and little evidence of residence, such as food-related items.

Restaurant: A restaurant was a food service business that may have also sold baked goods. Similar in form and construction to commercial buildings, restaurants featured a dining room, a kitchen, a storage area, and a root cellar. Work areas also usually existed behind the restaurant building. The artifact assemblage is distinct and includes high proportions of cans, broken tableware, butchered bones, and stove clinker. Large and numerous privy pits were behind the buildings.

Restaurant Foundation/Platform: Restaurant platforms are similar to those for commercial buildings, except they almost always offer 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 frame buildings in developed towns. They usually featured a bar room, storage area, and root cellar.

Saloon Foundation/Platform: Saloons stood on platforms similar to those for commercial buildings. The artifact assemblage is distinct and includes high proportions of fragmented bottles relative to other items.

Property Type: Rural Historic Mining Landscape

Rural Historic Landscapes are a large-scale property type representing the history of an area’s human occupation, life ways, and land use. The National Park Service recognizes other types of landscapes for National Register nomination, such as designed historic landscapes and cemeteries. The National Park Service describes Rural Historic Landscapes in detail in its *National Register Bulletin: Guidelines for Evaluating and Documenting Rural Historic Landscapes*. In overview, the Bulletin states:

> A rural historic landscape is defined as a geographical area that historically has been used by people, or shaped or modified by human activity, occupancy, or intervention, and that possesses a significant concentration, linkage, or continuity of areas of land use, vegetation, buildings and structures, roads and waterways, and natural features.[10]

Areas that experienced intensive mining form a subset, Rural Historic Mining Landscapes. Such landscapes provide a physical context for individual resources, and when viewed in total, the resources and their setting constitute a greater whole. Extensive tracts of land, its natural features, and individual historic resources represent the history, people, and traditions of mining in San Juan County.

The National Park Service organized the defining characteristics of Rural Historic Landscapes into eleven categories: land uses and activities; patterns of spatial organization; response to the natural environment; cultural traditions; circulation networks; boundary demarcations; vegetation related to land use; buildings, structures, and objects; clusters; archaeological sites; and small-scale elements. The first four are the result of processes, while the latter seven are physical attributes.[11] A rural historic mining landscape can also be described as a "landscape of work."[12] Mining outfits molded the landscape for the efficiency, organization, and economics of finding ore, extracting it, and processing the material. Mining landscapes of work include features characteristic of hardrock mining. Prospects are concentrated in areas where ore was likely to be found, while mines lie on land where ore formations were confirmed, regardless of topography. Ore treatment mills were sited either at the mines or in drainages where water and open ground were available. Companies erected workers' housing at mines and mills that were distant from established communities. Unincorporated settlements and formal towns grew in the most suitable environments near the centers of mining and milling. Circulation systems in the form of pack trails linked prospects with communities, and roads connected mines, mills, and transportation centers. Ditch systems diverted water from streams to reservoirs for industrial and community consumption. The forests around the mines and communities were cut over to provide wood for heating, steam power, and lumber. Sawmills were located close to the mature stands to minimize the distance workers hauled the cut logs. All are variations on the working landscape as related to the San Juan County mining industry.

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[10] Linda Flint McClelland, et al.,. *National Register Bulletin: Guidelines for Evaluating and Documenting Rural Historic Landscapes* (National Park Service, 1999) 1.
[11] McClelland, et al., 1999:3.
[12] Denise P. Messick, J.W. Joseph, and Natalie P. Adams, *Tilling the Earth: Georgia's Historic Agricultural Heritage, A Context* (Stone Mountain, GA, New South Associates, 2001) 62.

Rural Historic Mining Landscape Significance

Because multiple historic resources and natural features make up rural historic mining landscapes, significance can be assessed in terms of the broad historical theme of the mining industry, associated settlement, and infrastructure development. Potential Areas of Significance include Architecture, Community Planning and Development, Engineering, Industry, and Landscape Architecture. Because of the complexity and diversity of constituent historic resources, coupled with ongoing and evolving use, most landscapes may be significant under multiple areas and criteria. Extended Periods of Significance must be considered when determining the significance of rural historic mining landscapes.

Regarding Architecture and Engineering, mining industry participants adapted conventional designs and construction methods to the environment of the San Juan Mountains. Conditions included topography, natural landscape features, local climate, and available buildings materials. In the context of a landscape, a spectrum of buildings can represent the evolution of architecture specific to the mining industry. Similarly, structures may be significant representations of mining engineering, and multiple structures within a single landscape may reflect the evolution of function, design, methods, workmanship, and materials.

Regarding Community Planning and Development, landscapes may reveal settlement patterns pertaining to hardrock mining. Unlike traditional settlement patterns, mining industry participants established residential complexes near centers of mining or related industry regardless of environmental conditions. Proximity to mines and industry was a first priority, and the best micro-environment for residence or community was secondary. Landscapes may reflect the development patterns of industrial aspects of mining and natural resource influence on settlement. It should be noted that settlement is not limited to concentrations of residences, such as townsites. Workers' housing and prospectors' camps scattered throughout the county comprise an alternate another settlement pattern.

Regarding Economics and Commerce, assemblages of sites including mines, mills, roads, and railroads reflect the overall process of converting natural resources into wealth. The mines produced ore that was carried over the roads to mills. The ore was processed at the mills, metals recovered, and concentrates shipped by road or rail to a smelter for the final processing. Each stage furthered the ore-to-wealth cycle. Each stage also represents a divestment of money into the region through workers' wages and consumption of goods. Communities in the landscape were local economic centers where the divested funds supported commerce.

The area of Industry is fundamental. Mining landscapes are tied to and representations of the mining industry, which was the most important factor in the exploration and development of the county. The industry was the principal force behind the county's economy, infrastructure, permanent settlement, and development. The industry and its impacts on the land made San Juan County one of Colorado's most productive sources of mineral wealth, a center known in greater mining circles. Prospectors and mining outfits adapted known methods and technology to the physical environment, geology, and mineralogy of the San Juan Mountains. Through their efforts, prospectors and companies contributed to the development of mining technology and engineering in numerous ways. Many innovations were adopted widely and forwarded mining and infrastructure elsewhere. Some innovations were smaller in scale, such as individual pieces of machinery or structures. Others were macro in scale, such as tramways and enormous mines and mills.

The area of Landscape Architecture pertains to landscapes purposefully manipulated. Infrastructure such as water systems and railroads are forms of purposeful large-scale land uses. Townsites, with grids of buildings and scattered outlying industries, are another. Large mine and mill complexes, where portions of the land were designated and altered for specific functions, are a third. On a large scale, designed systems associated with mining changed the appearance of landscapes.

Rural Historic Mining Landscape Registration Requirements

To qualify for nomination, a landscape must meet at least one of the NRHP Criteria and possess related physical integrity. Under Criterion A, a landscape and its contributing resources must date to one of the mining industry's Periods of Significance and one of the associated Areas of Significance, trends and events important to the county. Landscapes such as individual mines or milling complexes may be eligible under Criterion B through residence, employment, or other involvement by a significant person or persons. The associated resource must retain physical integrity relative to that person's occupation during their productive period of time. A prominent mineral surveyor may have platted numerous claims in a region, for example. Larger scale landscapes are less easily documented under Criterion B generally, as they evolved organically through the actions of numerous people.

Mining landscapes may be eligible under Criterion C if any buildings, structures, archaeological features, or natural features represent mining, its subsidiary industries, or related settlement patterns. Landscapes occupied for extended periods of time can reflect evolution in land use, while those occupied for a narrow period might reflect land use patterns of that era. Intact buildings and structures can be significant and often rare contributing elements of mining landscapes. Most contributing resources comprising the landscape should retain integrity at least on an archaeological level. Modern intrusions should either be minimal or compatible with the historic land use. The researcher must discuss how the landscape's characteristics and contributing elements represent an aspect of the mining industry.

Landscapes may be eligible under Criterion D when they hold a high potential to yield information based on a holistic representation of buildings, structures, or archaeological features. The arenas of inquiry may be broad and rely on information offered by the landscape as a whole. If residential complexes within the landscape possess building platforms, privy pits, and refuse dumps with buried archaeological deposits, testing and excavation may reveal important information regarding lifestyle and demographics of occupants. When information from multiple complexes is compared, regional patterns may become apparent. Important areas of inquiry include but are not limited to diet, health, distribution of gender, families, ethnicities, professional occupation, and socioeconomic status. Comparative studies of industrial sites may reveal patterns of the application of systems engineering, ore treatment processes, and equipment. Other patterns regarding construction methods, materials, structural design, and architecture may become apparent. Such information can be compared to geology, mineralogy, and the successful or failed operations for a full understanding of a region's industry. Intact underground mine workings is another area of inquiry under Criterion D. Groups of mines may feature connected workings that can contribute to the understanding of broad-scale mine engineering, planning, and operations.

Eligible rural historic mining landscapes must possess physical integrity relative to one of the county's Periods of Significance. Landscapes in the county changed to varying degrees through continuity in use, as well as degradation of resources following abandonment. Overt modern intrusions can compromise integrity if out of keeping with land use patterns characteristic of historic mining. Such intrusions should be few and unobtrusive. The presence of some characteristics is more important to integrity than others. Historic settlement patterns, vegetation patterns, circulation systems, and small-scale features typical of mining should be present. Because the natural environment was a prominent backdrop for mining during the county's Periods of Significance, a preserved natural setting is important to integrity.

Many of the seven aspects of integrity defined by the NRHP may apply to rural historic landscapes, although not all need be present. *Location* is the place where the significant activities that shaped land took place and remain apparent. To retain integrity of *design*, landscape features, both manmade and natural, must convey organization and planning relative to mining land use. *Setting* is the physical environment surrounding a historic property. Both large-scale and small-scale features form a setting that conveys mining land use and settlement patterns. To retain integrity of setting, a landscape and bordering area must not have changed a great degree in overall character. To retain integrity of *feeling*, the landscape should convey mining and associated settlement. Integrity of *association* exists where a combination of natural and manmade features conveys a strong sense of connectedness between the landscape and a contemporary observer's ability to discern the historic mining industry or settlement.

SECTION G: GEOGRAPHICAL DATA

The geographical area covered by this document consists of San Juan County, near the center of the San Juan Mountains in southwestern Colorado.

SECTION H: IDENTIFICATION AND EVALUATION METHODS

Two general research tracks proved to be effective in providing accurate contextual information and informing Property Types. The collections of six important research facilities in the Denver area provided primary archival and secondary source material. The institutions in order of relevance are Denver Public Library Western History Collection, Colorado School of Mines, Colorado State Archives, University of Colorado at Boulder library system, and History Colorado (the Colorado Historical Society). Of these, Colorado School of Mines, Colorado State Archives, and Denver Public Library possessed the richest collections relevant to mining. Key events and trends were synthesized from contemporary publications, including mining periodicals, newspapers, mine inspectors' and engineers' reports, manuscript collections, and other archival materials. Secondary sources, primarily popular literature, were used to clarify some information, synthesize historical overviews, and provide contextual information for broad trends.

Two approaches were useful for identifying discrete Periods of Significance: examination of the materials identified above and statistical analysis of population, ore production figures, and numbers of active prospects, mines, and mills between 1860 and 1980. This information was tabulated in five year increments when possible, and mines divided among small, medium, and large scale operations. Colorado Mining Directories (1870-1915), newspapers, Colorado Mine Inspectors' Reports (1915-1980) and other archival materials were used to reconstruct the number of mines and mills active between 1870 and 1980. Susanne Schulz's census compilation, *A Century of the Colorado Census*, provided population figures. Charles Henderson's *Mining in Colorado* provided production figures between 1874 and 1923, while the Bureau of Mines' *Minerals Yearbook* provided figures for 1931 to 1980. The above-described statistical analysis revealed some inherent challenges. Production figures for some periods may be inaccurate, while active mines and mills may have gone unreported. The period 1885 to 1897 in particular was poorly documented in archival resources. Overall, however, statistical analysis proved effective for identifying Periods of Significance and their associated trends. For example, sudden rises in both population and numbers of prospects can be interpreted as a period of discovery, mineral exploration, and boom. Gradual population growth combined with high production figures and an increase in small and medium-sized mines reflected the early phase of productive mining. A slight contraction in population, decrease in small mines, increase in large operations, and increase in production figures suggested the maturation of mining.

Regarding further comparison and contrast, several Multiple Property Documentation Forms document the mining industry in Colorado. The author co-authored *The Mining Industry in Colorado* with Jay Fell, Ph.D., in addition to solely authoring the *Amendment to Tourist Era and Metal Mining Resources in Boulder County*. These documents served as models for *Historic Mining Resources of San Juan County*. Descriptions of mining technology in Section E 2 of this context as well as the property types described in Section F were reproduced and adapted from *The Mining Industry in Colorado* with author permission.[1] The author's treatise on mining technology, *Riches to Rust*, and his work on the Las Animas Mining District, *Basins of Silver* also served for heavy reference. Text from the latter publication is also reproduced here. However, *Historic Mining Resources of San Juan County* differs from the above publications in its emphasis on the adaptation of mining and ore treatment to the difficult environmental, geological, and mineralogical conditions of San Juan County.

[1] Steve Baker, *Cement Creek West Study Unit-AML Historic Site Survey* (Montrose, CO, Centuries Research, 1998); Steve Baker, *The 1999 Abandoned Mine Land Reclamation Program Recording of Historic Mining Sites in the Treasure Mountain Study Unit of the Upper Animas Drainage, San Juan County, Colorado* (Montrose, CO: Centuries Research, 2000); .Ross S. Curtis, *Recording of Historic Mining Properties in the Galena Mountain Study Unit, San Juan County, Colorado* (Durango: Durango Archaeological Consultants, 2001); Julie Singer, Jonathan Horn, and Eric Twitty, *Martha Rose/Walsh Smelter (5SA1177) Archaeological Assessment, San Juan County* (Silverton:, Silverton Restoration Consulting, 2006); .Eric Twitty, *Mining Cement Creek: A Selective Inventory of Historic Mine Sites on the East Side of the Cement Creek Drainage, San Juan County, Colorado* (Boulder: Mountain States Historical, 2000); Eric Twitty, *The Silverton Mining District k: A Selective Inventory of Principal Historic Sites, San Juan County, Colorado* (Boulder: Mountain States Historical, 2002); Eric Twitty, *Kittimac Mine, Site 5SA181A, Level II Documentation* (Boulder: Mountain States Historical, 2005); Eric Twitty, *Legal Tender Tunnel, Site 5SA795, Level II Documentation* (Boulder: Mountain States Historical, 2005); Eric Twitty, *Level II Documentation of the Contention Tramway, Site 5SA1184.1* (2006,), forms on file at the Colorado Office of Archaeology and Historic Preservation; Eric Twitty and Jonathan Horn, *Level II Documentation of the Gold Prince Tramway, Site 5SA585* (2006), forms on file at the Colorado Office of Archaeology and Historic Preservation.

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Section E 1: San Juan County's Mining Districts

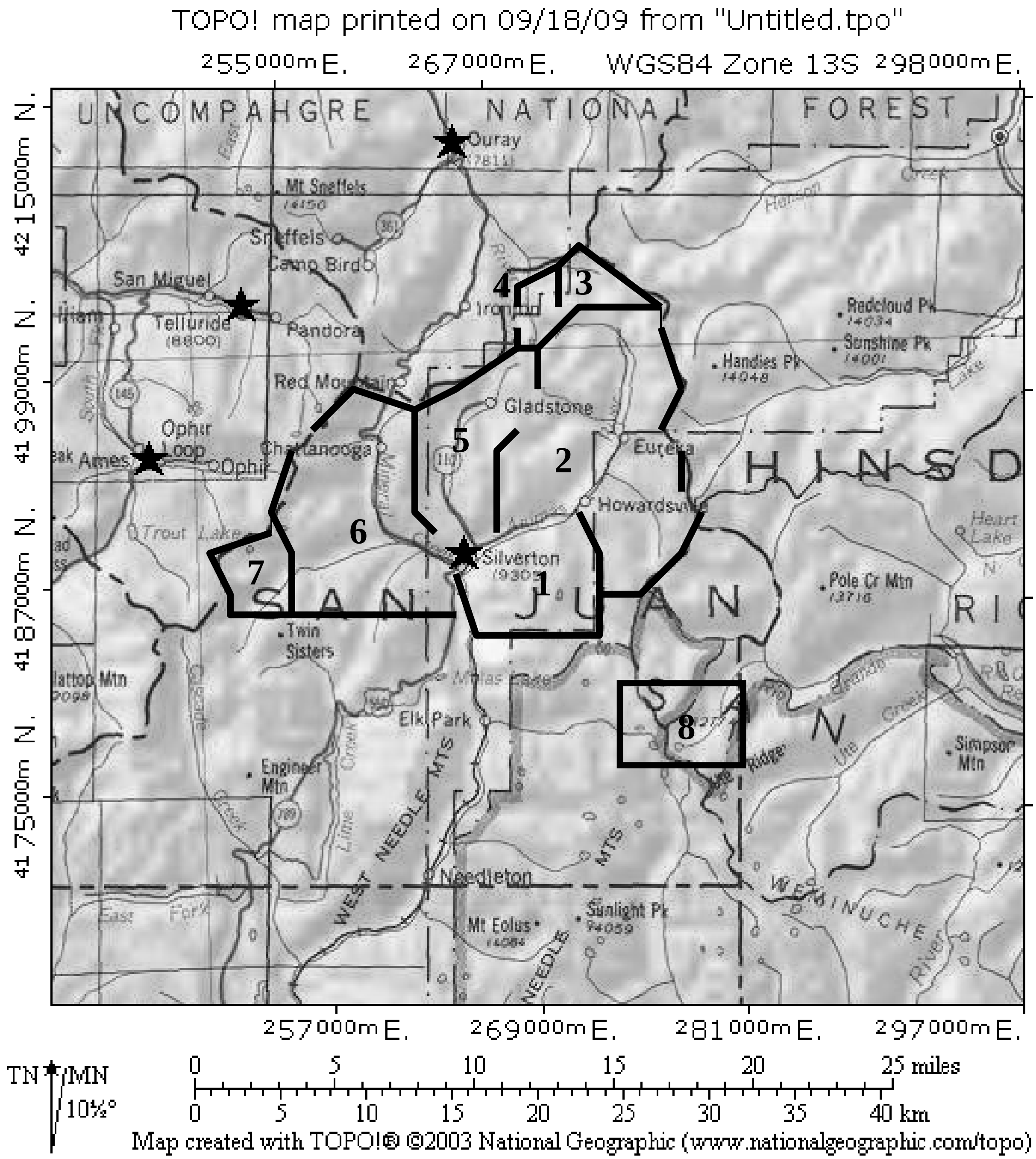


Figure E 1: The map is an index of San Juan County's mining districts. 1 = Las Animas; 2 = Eureka; 3 = Mineral Point; 4 = Poughkeepsie; 5 = Cement Creek; 6 = Mineral Creek; 7 = Ice Lake; 8 = Bear Creek.

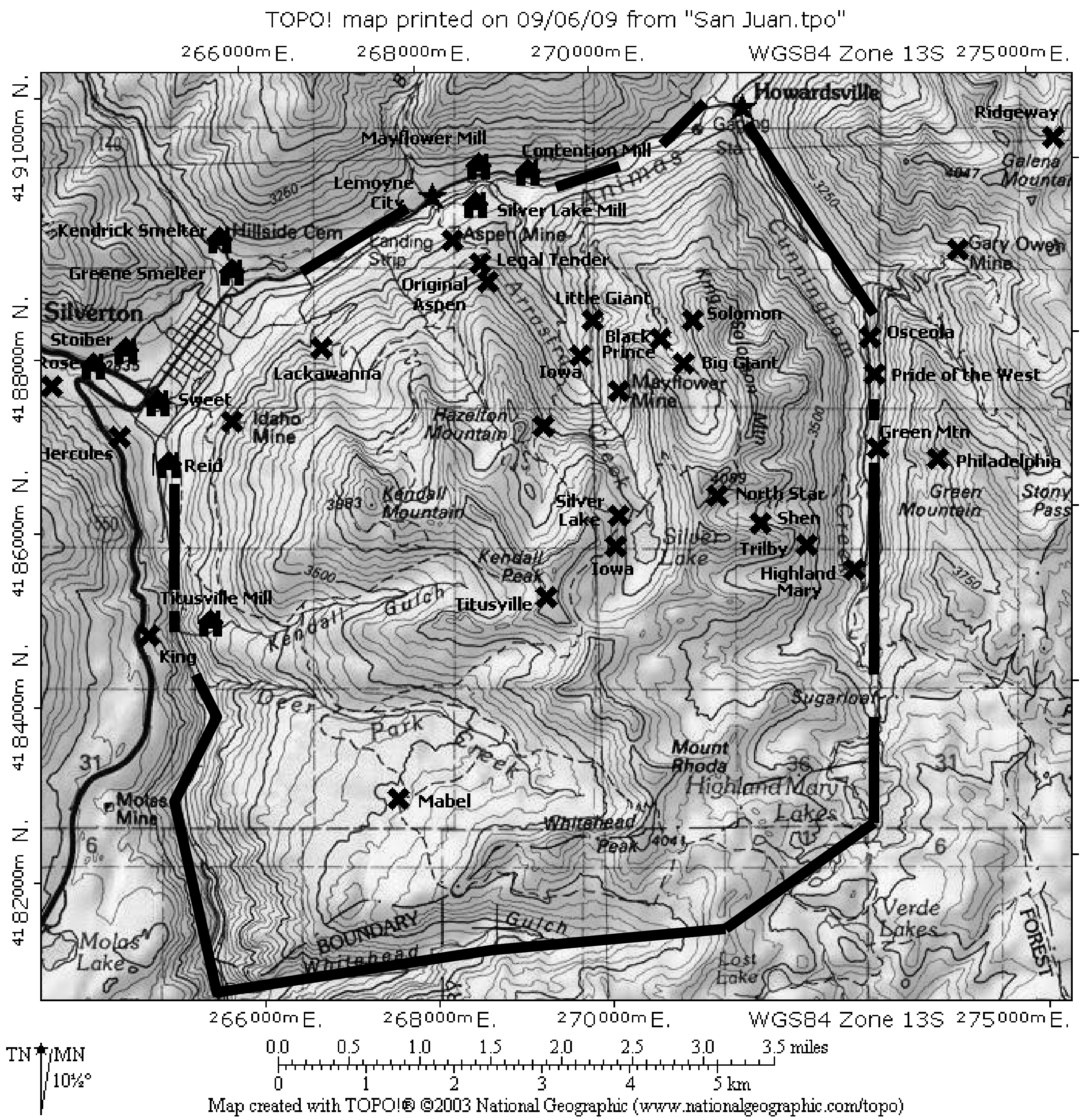


Figure E 2: The map depicts the principal mines, mills, and boundaries of the Las Animas Mining District.

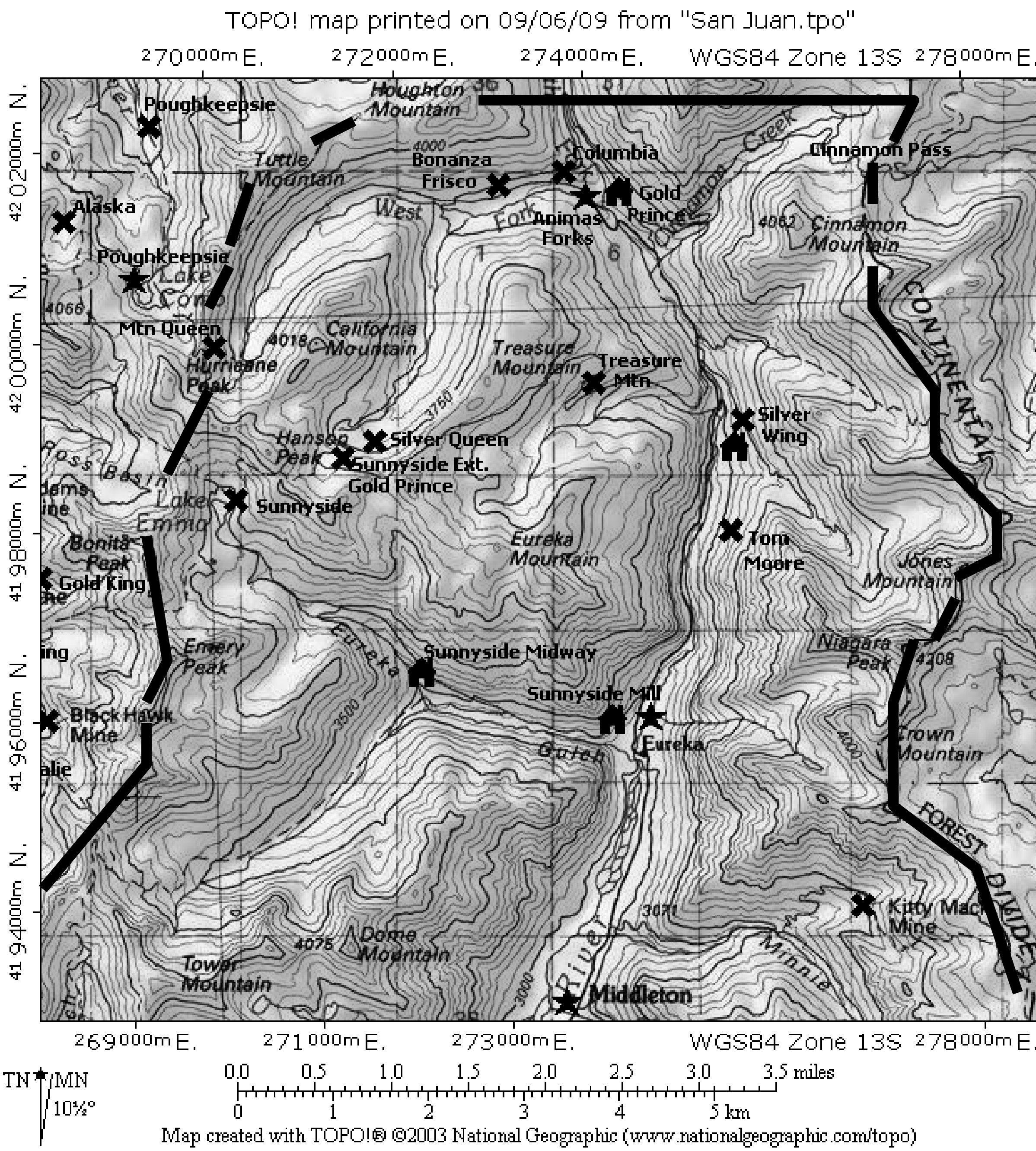


Figure E 3: The map depicts the principal mines, mills, and boundaries of the Eureka Mining District's northern portion. The settlements are Middleton at bottom, Eureka above, and Animas Forks at top.

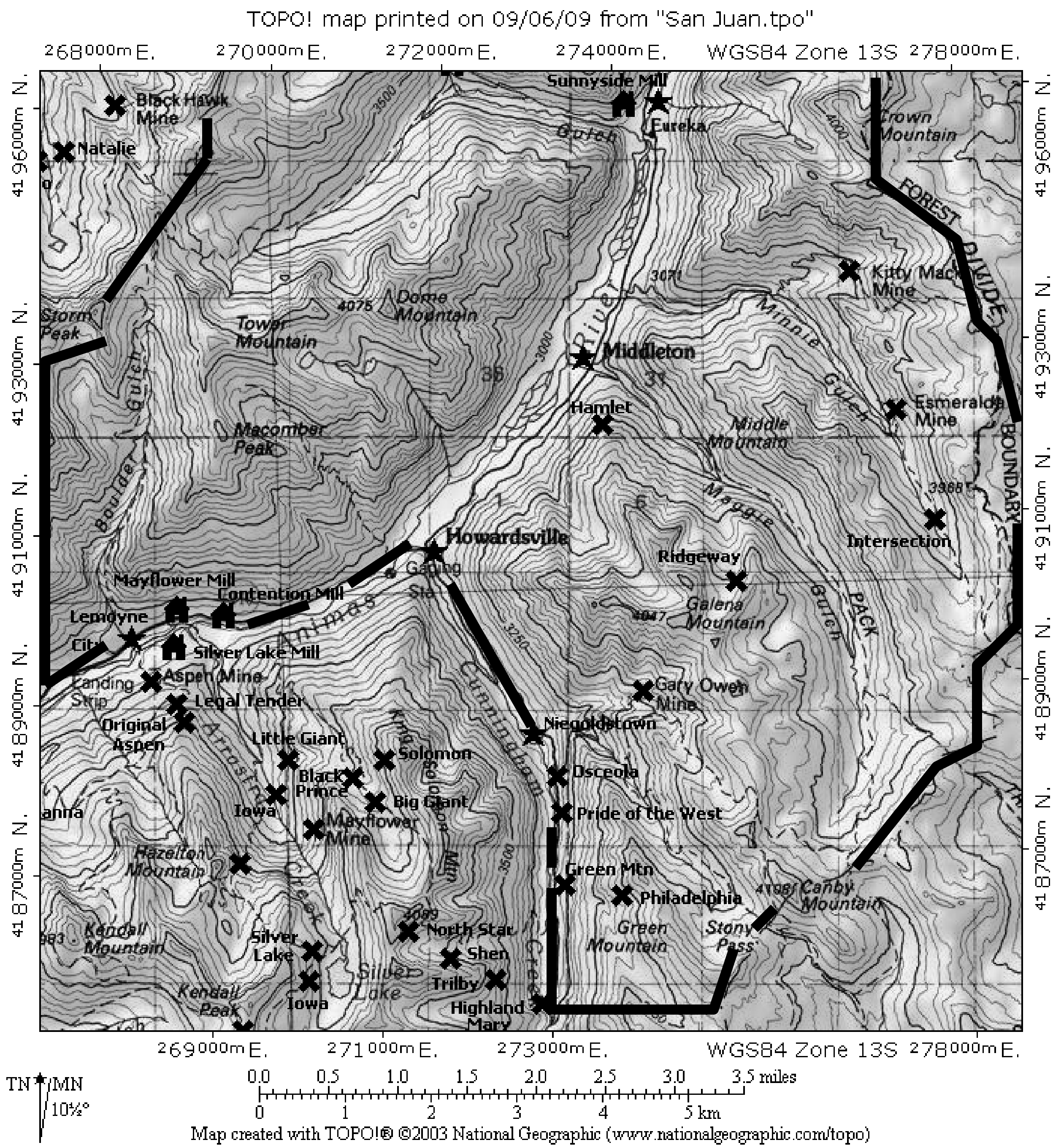


Figure E 4: The map depicts the principal mines, mills, and boundaries of the Eureka Mining District's southern portion. The Las Animas Mining District extends southwest.

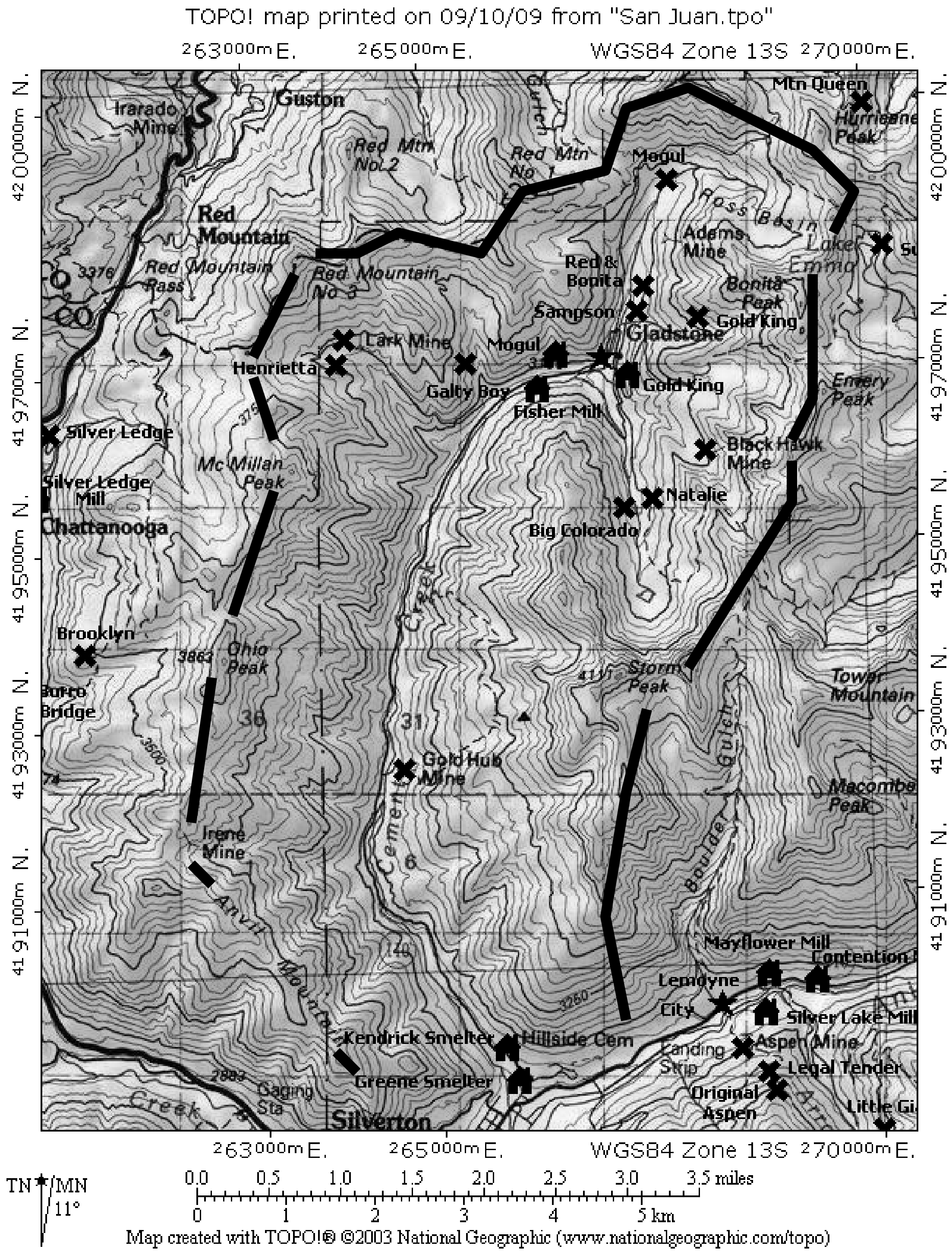


Figure E 5: The map illustrates the principal mines, mills, and boundaries of the Cement Creek sub-district.

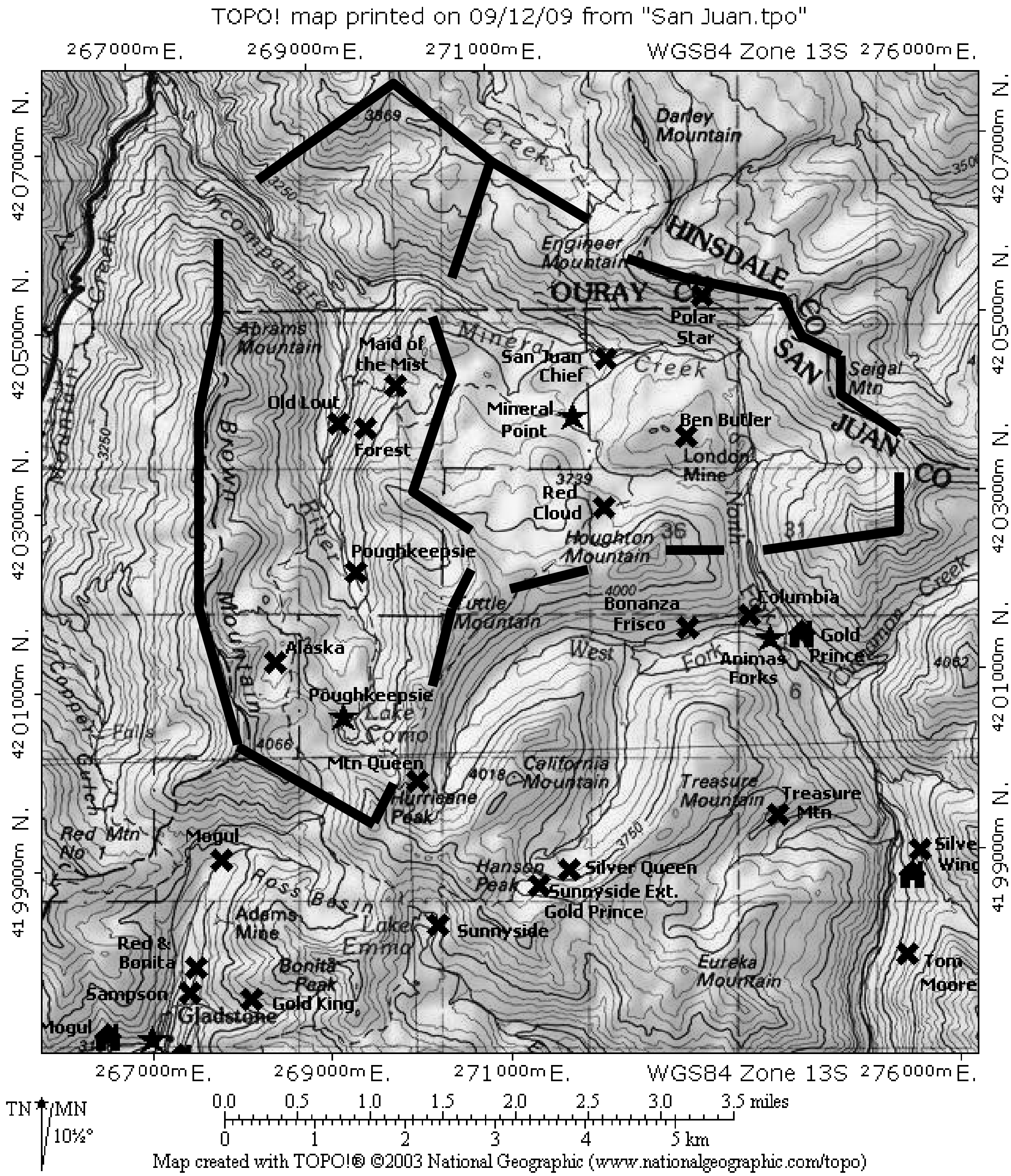


Figure E 6: The map depicts the principal mines of the Poughkeepsie Mining District, left, and Mineral Point Mining District, right. The Eureka district extends south, and the Red Mountain valley is west.

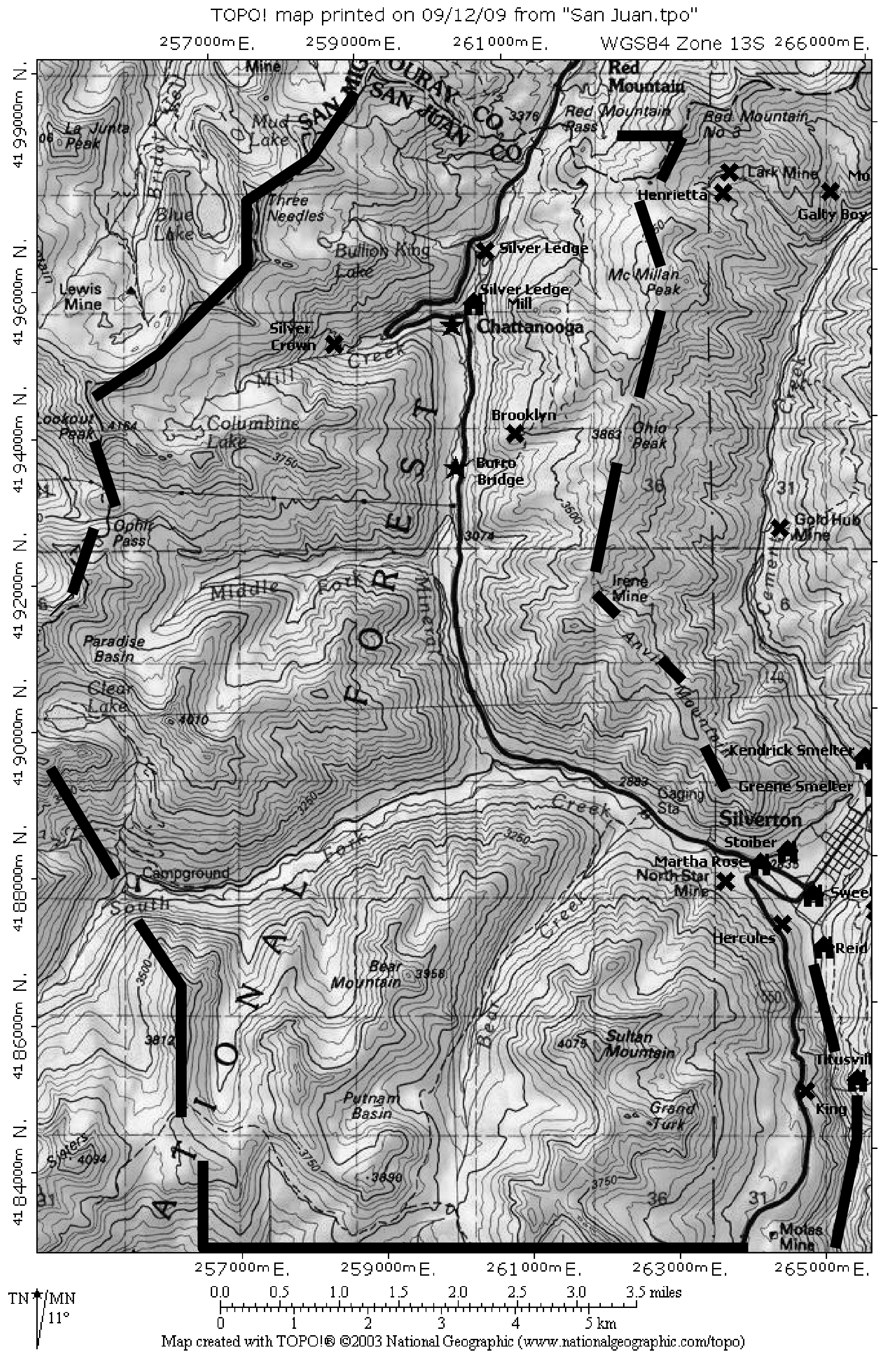


Figure E 7: The map depicts the principal mines, mills, and boundaries of the Mineral Creek Mining District.

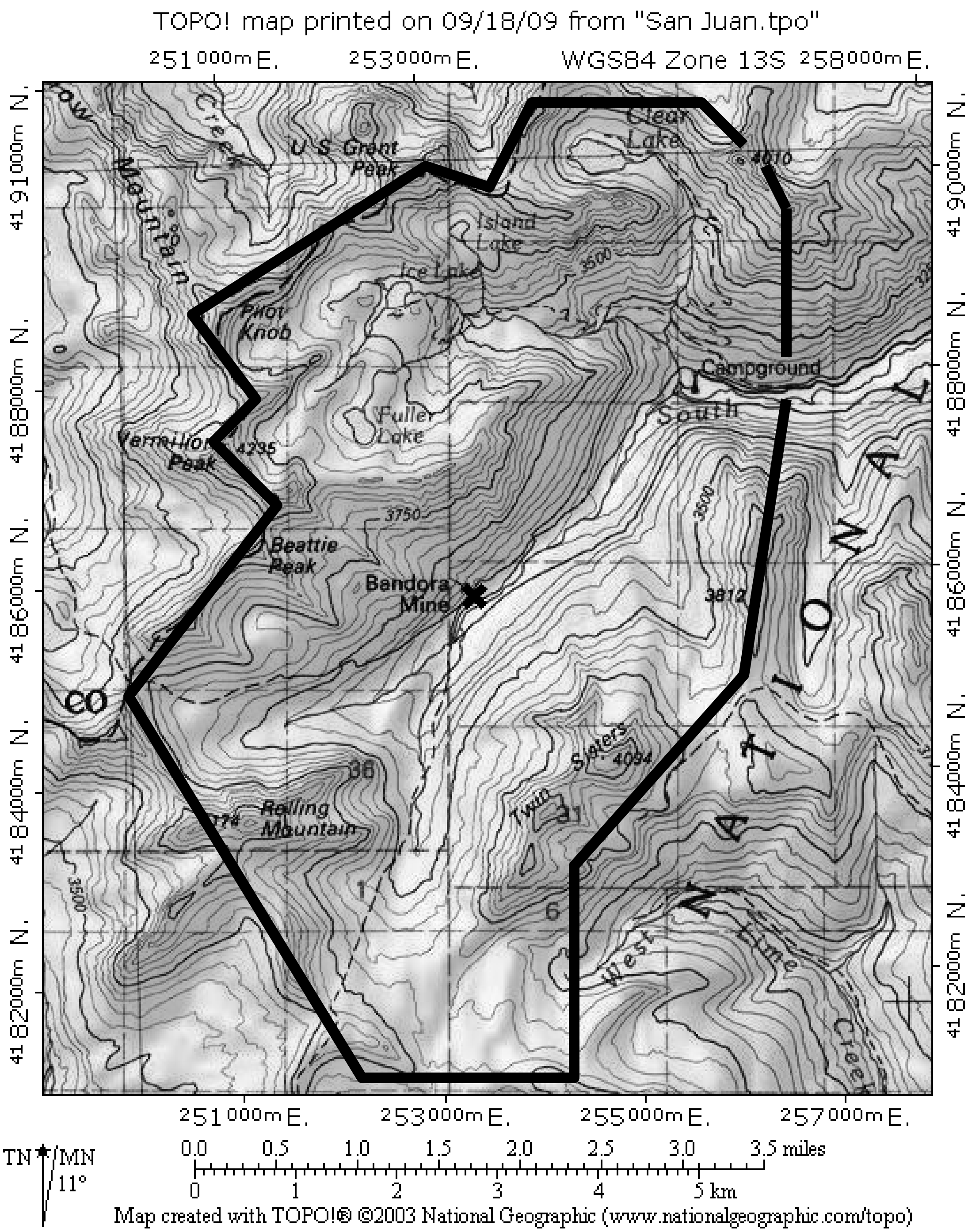


Figure E 8: The boundaries generalize the Ice Lake Mining District. The district's eastern portion overlaps the western edge of the Mineral Creek district.

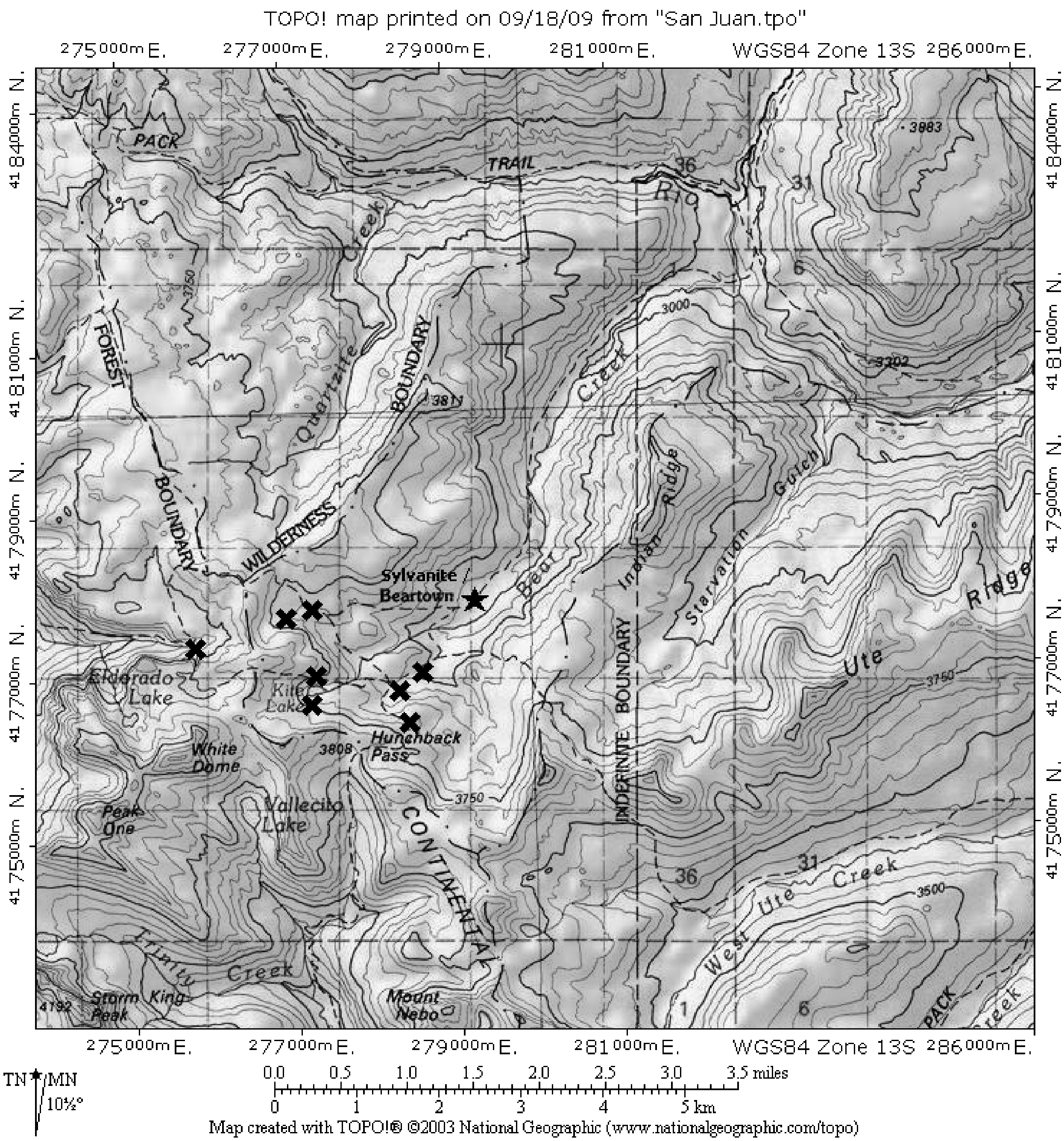


Figure E 9: The Bear Creek Mining District encompassed the collection of mines southwest of Beartown. The district's exact boundaries are uncertain and are therefore not shown. The Rio Grande River valley traverses upper right and, historically, provided easy access to the town of Creede in Mineral County.

Section E 1: The Gold Rush, 1860-1861

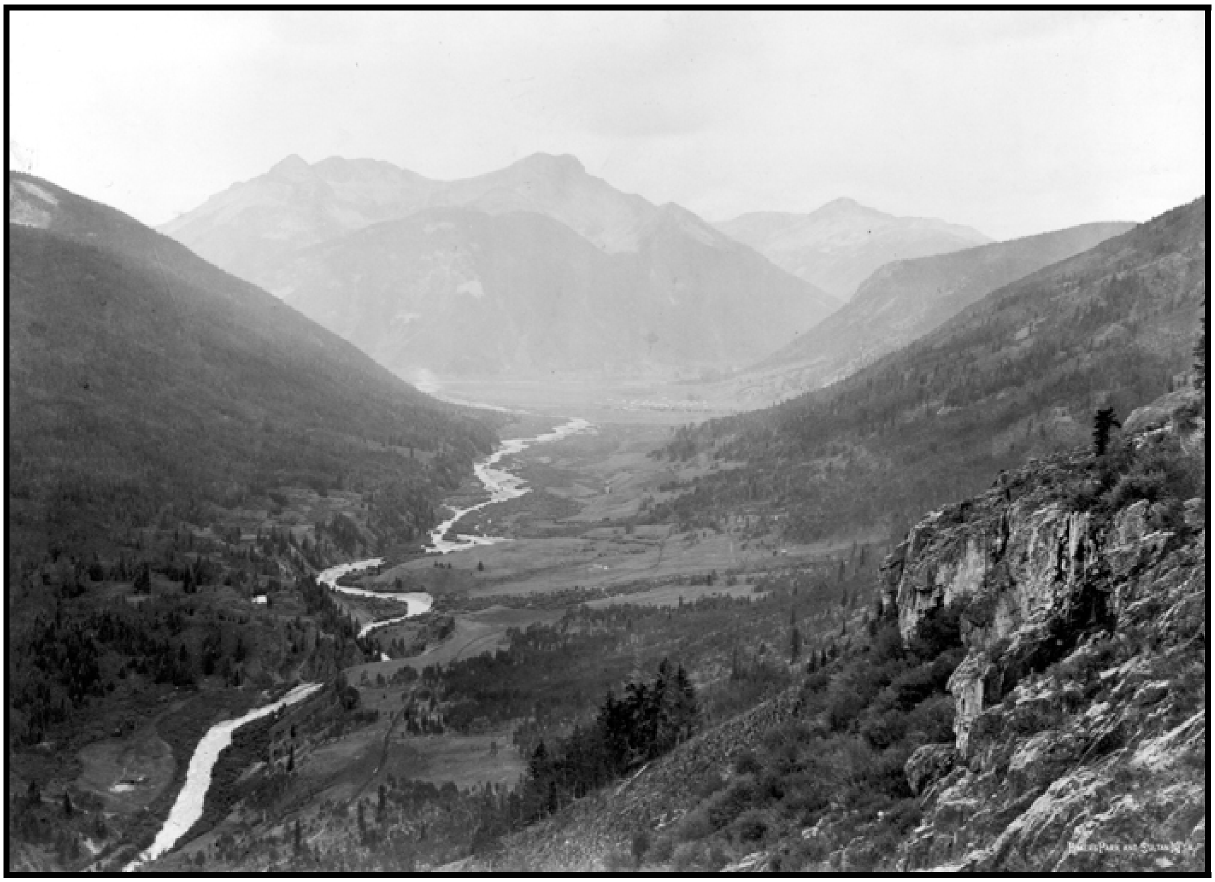


Figure E 10: Baker's Park was a prospectors' paradise, at least between May and October when the ground was thawed. The area offered enough drainages, rock outcrops, and peaks to keep prospectors busy for decades. William Henry Jackson took the southwesterly view in 1875. Source: U.S. Geological Survey, Jackson, W.H. 1689.

Figure E 11: Arrastra Gulch, originally known as Mason Gulch, seemed like an unlikely place to find gold, but the Baker Party found economical placer deposits on the floor in 1860. The French party traced leftover gold flakes to the Little Giant lode in 1870, which became the first hardrock mine in the San Juans. The Little Giant was located on the left side of the gulch behind the forested slope. Silver Lake Basin lies behind the imposing headwall, and William Henry Jackson captured the south view in September, when lower regions still enjoyed the warmth of summer. Source: U.S. Geological Survey, Jackson, W.H. 482.

Section E 1: Settlement and Establishment of Industry, 1875-1881

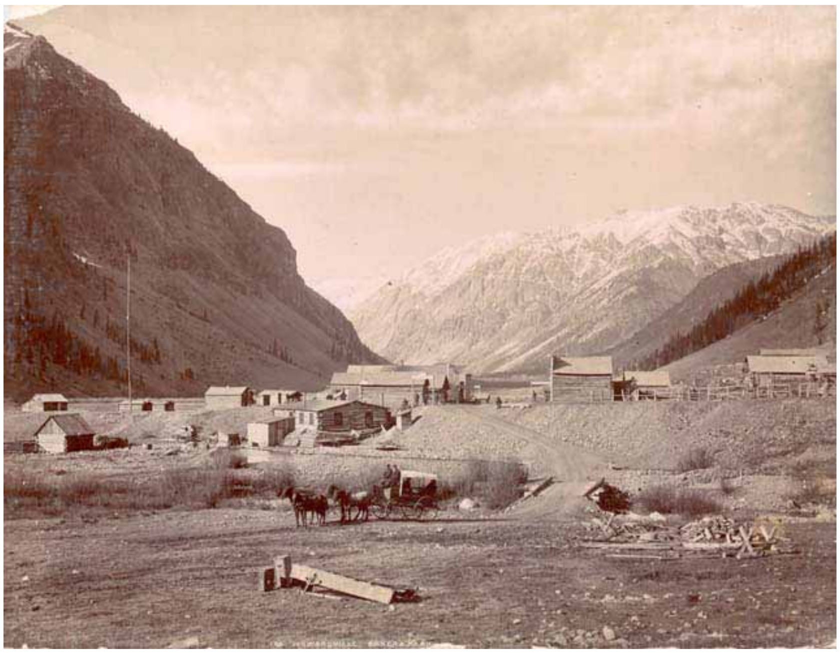


Figure E 12: William Henry Jackson took this northeast view of Howardsville in 1874. Howardsville was the county's most important town for several years, and it epitomized the county's formally organized settlements. The business district is at center and a few residences are scattered around. Source: Denver Public Library, Western History Collection, WHJ 1582.

Figure E 13: The south view depicts Eureka during the late 1870s. The town was the commercial center of the Eureka Mining District's southern portion. The town has been formally laid out in a grid of lots and blocks. Source: Denver Public Library, Western History Collection, C-131.

Figure E 14: The Greene Smelter, the county's first functional ore treatment facility, was fundamental to the success of the mining industry. In this late 1870s view, the facility is in full blast. Source: Denver Public Library, Western History Collection, X 61438.

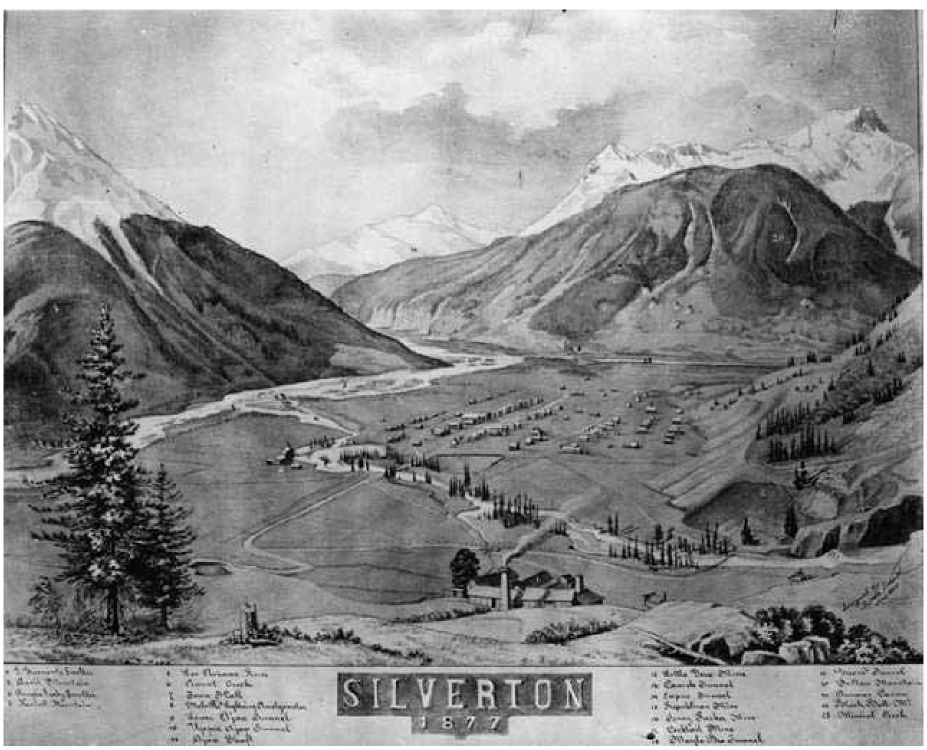


Figure E 15: South overview of Silverton in 1877. By this time, Silverton assumed the role as the county's principal center of commerce, communication, and ore treatment. The Greene Smelter stands at bottom, the Animas River courses beyond town, Kendall Mountain towers on the left, and Sultan Mountain looms at right. Source: Denver Public Library, Western History Collection, X 11384.

Section E 1: Early 1880s Boom: 1882 – 1885

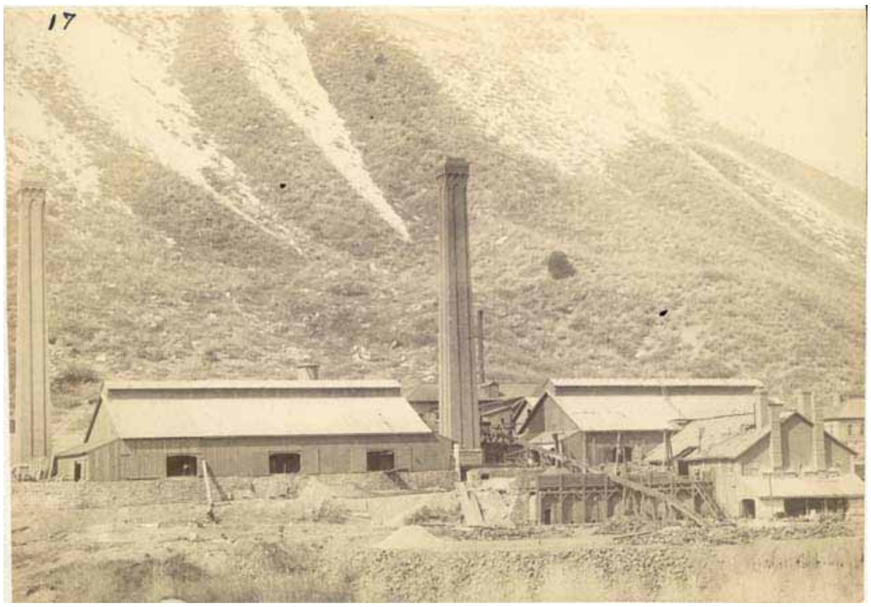


Figure E 16: The New York & San Juan Smelter, also known as the Durango Smelter, offered competitive rates and provided high returns, which rendered marginal grades of ore economical to produce. The facility also undercut Silverton's local smelting industry. Source: Denver Public Library, Western History Collection, Z 4858.

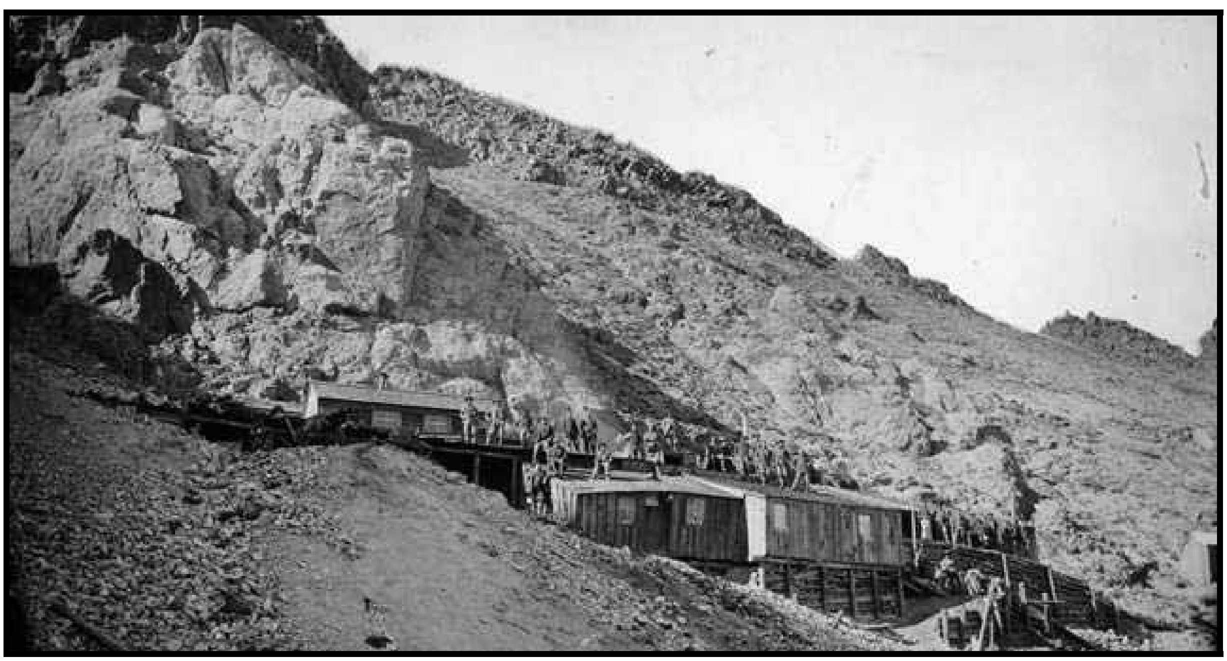


Figure E 17: Although this north view of the North Star Mine's tunnel house was taken around 1900, the building changed little from when engineer Eben Olcott erected it in 1881. The building housed the mine's tunnel portal, blacksmith shop, ore sorting station, and living quarters under one cramped and drafty roof. Source: Denver Public Library, Western History Collection, X 62714.

Figure E 18: For decades, most mining companies relied on pack trains such as this one in Silverton to carry ore down from the mines and haul supplies up. Shipping materials by pack train was costly and consumed much of a mining operation's profits, which provided incentive for the development of a network of wagon roads. Source: Denver Public Library, Western History Collection, X 1769.

Figure E 19: During the early 1880s, a boom in the Red Mountain Mining District, Ouray County, gave rise to Chattanooga. The town was not only gateway to the new district, but also center to a small collection of mines in San Juan County's northwest portion. Source: Denver Public Library, Western History Collection, c-156.

Figure E 20: During the early 1880s, Animas Forks was the eastern gateway into San Juan County, and a commercial and residential center for mines in the northern portion of the Eureka Mining District. The southern view depicts the main street. Source: Denver Public Library, Western History Collection, WHJ-758.

Figure E 21: For much of the county's history, Eureka was the commercial center for the Eureka district's southern portion. In the north view, the two-story building is Henry Helmboldt's mercantile. Helmboldt also ran one of the county's largest meat suppliers. Source: Denver Public Library, Western History Collection, X-6948.

Section E 1: The Value of Silver is Restored: 1890 – 1893

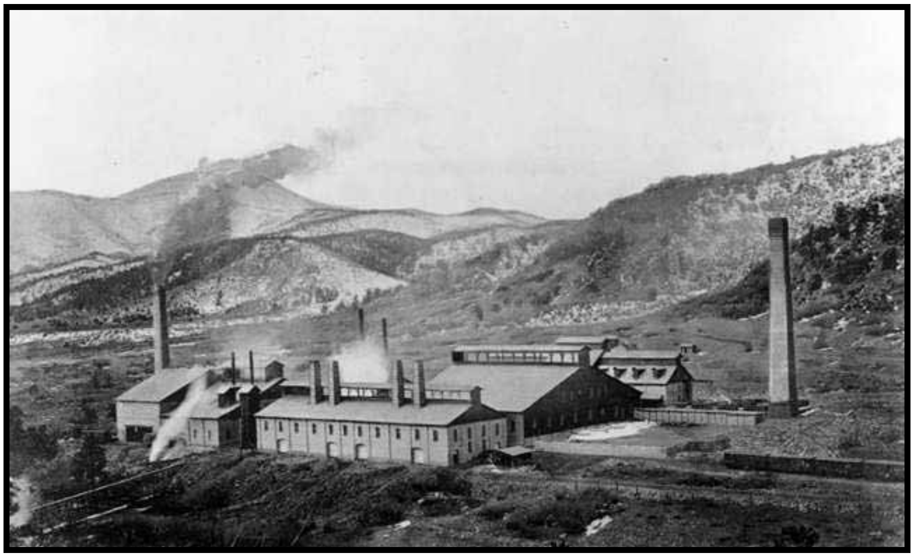


Figure E 22: Otto Mears opened the Standard Smelter in Durango in 1892 primarily to treat pyretic ore from the Red Mountain district in Ouray County. The smelter also accepted similar ore from San Juan County, providing competition for the Durango Smelter. Source: Denver Public Library, Western History Collection, X-61433.

Figure E 23: This northwest view depicts Edward Stoiber's Silver Lake Mine in 1890 or 1891. Stoiber recently finished the mill, center, a boardinghouse adjacent and right, and two shaft houses at upper left. The long chute at left delivered ore from a mid-level tunnel. The skiff floats on Silver Lake, which was a glacial tarn in an austere basin above treeline. The man on the bow is probably Edward Stoiber, and he is accompanied by engineers. Source: Colorado Historical Society, CHS X 7880.

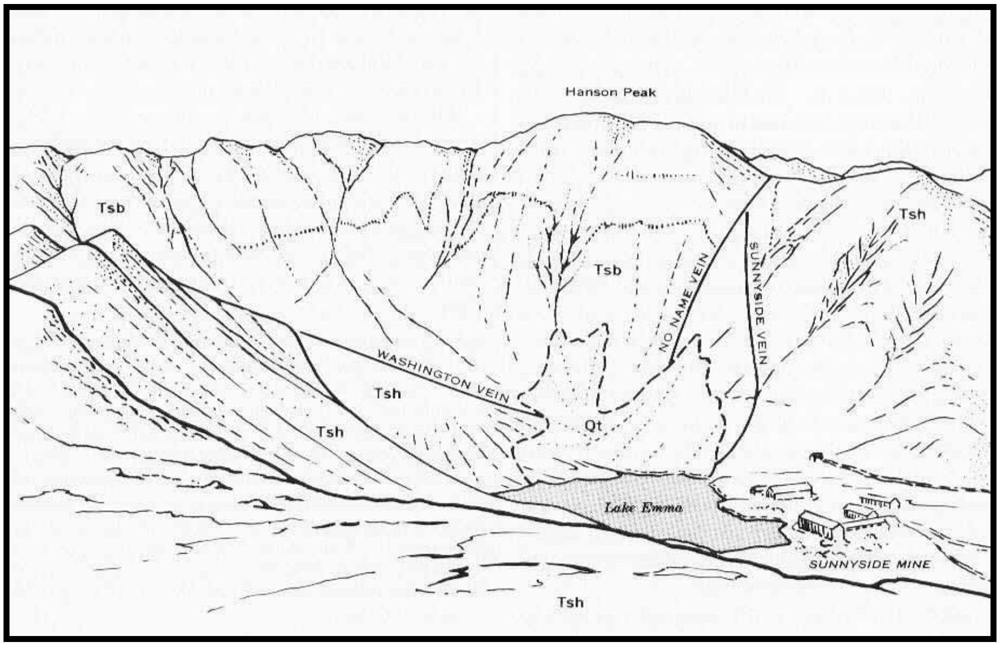


Figure E 24: The line drawing is a north view of Lake Emma, the Sunnyside Mine, and the principal veins that interested owner John H. Terry. Over time, Terry acquired rights to the veins and developed the Sunnyside into one of the county's most important producers. Source, Burbank, 1947:57.

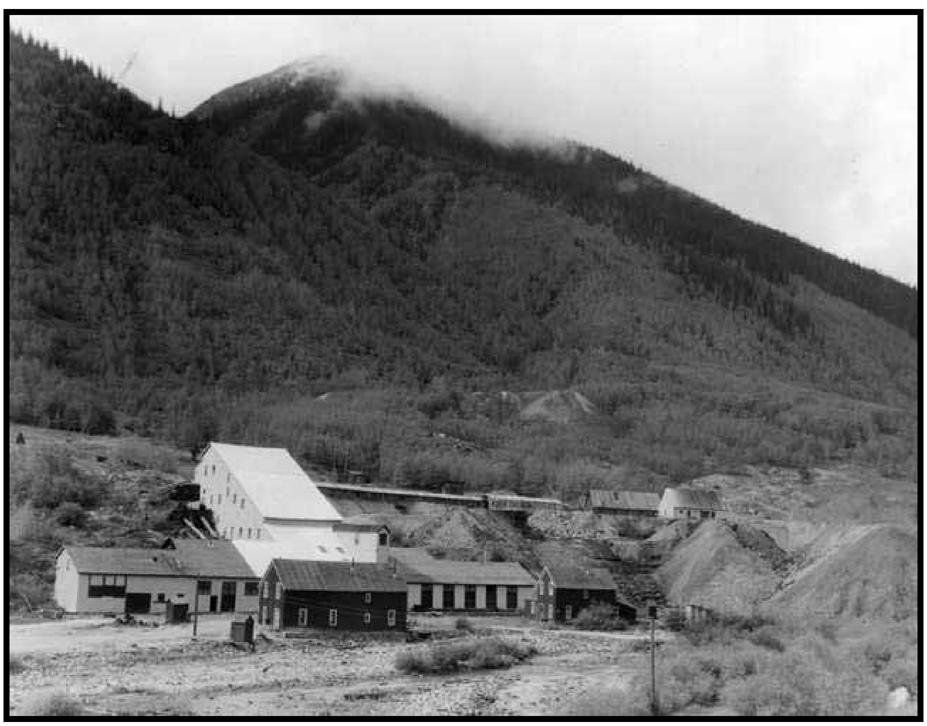


Figure E 25: The North Star Mine, at the base of Sultan Mountain, was among the county's most important producers during the early 1890s. The operation was one of three major mines on the west edge of Silverton. Source: Denver Public Library, Western History Collection, X-62266.

Section E 1: The Silver Crash: 1894 – 1897

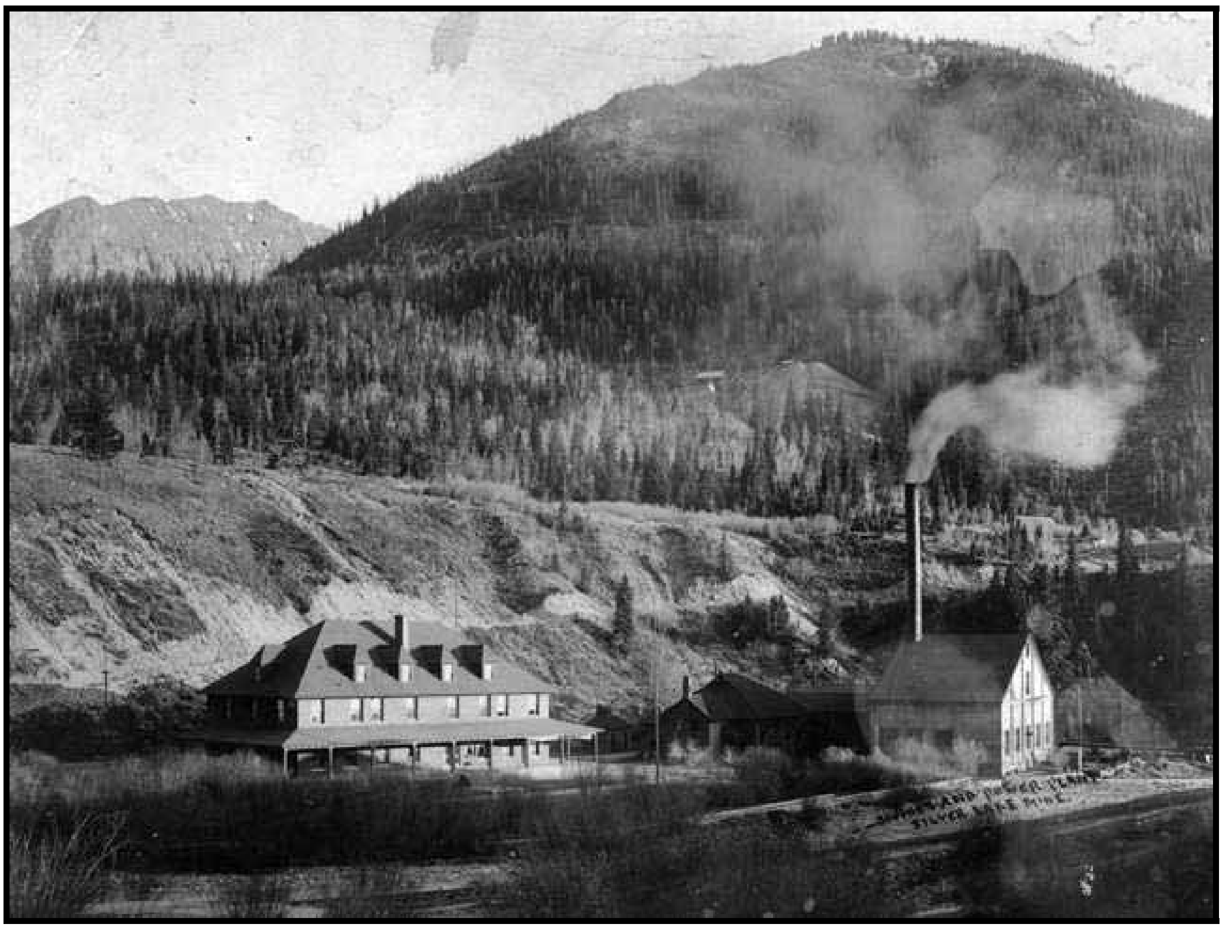


Figure E 26: In 1895, Edward Stoiber built Waldheim as the nerve center for his Silver Lake Mines Company. The buildings at right are what some engineers claimed was the most advanced private AC current powerhouse of its time, and Stoiber's mansion at left was among the largest in the San Juans. Although AC current technology was still in an experimental state, Stoiber chose AC because, unlike DC current, it could be transmitted up to the Silver Lake and Iowa mines in Silver Lake Basin. Source: Denver Public Library, Western History Collection, X-62272.

Figure E 27: The south view depicts the Iowa Mine in 1898 during a rare calm day in Silver Lake Basin. At this time, the Iowa ranked among the county's most important mines. The buildings at left were a compressor house and tram terminal, and the long structure at the upper right enclosed shops and the portal of the Iowa Tunnel. Source: Denver Public Library, Western History Collection, X 62274.

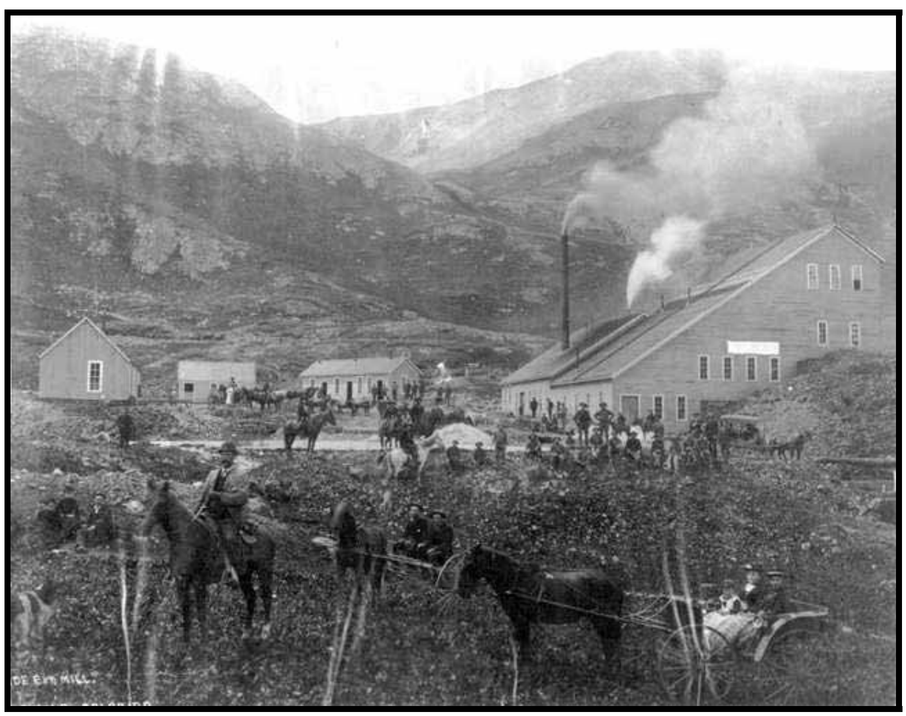


Figure E 28: In this southwest view of the Sunnyside Extension Mine, the main tunnel is at left and the mill built in 1890 stands at right. The operation was above treeline at the head of Placer Gulch. Source: Denver Public Library, Western History Collection, X 62199.

<u>Section E 1: The Great Mining Revival: 1898 – 1910</u>

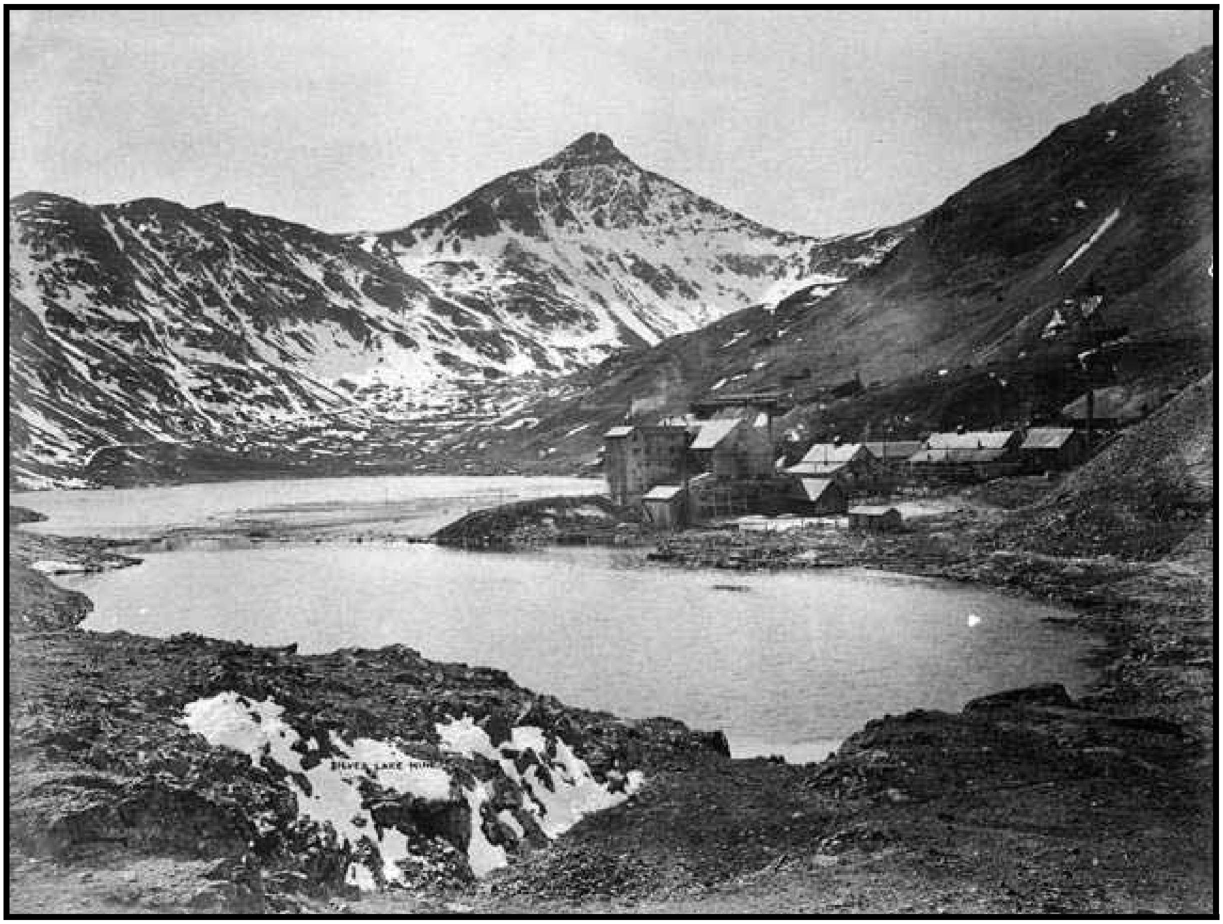


Figure E 29: By the late 1890s, Edward and Gustavus Stoiber transformed Silver Lake Basin into an industrial landscape. The Silver Lake Mine is right of center, the Iowa Mine is on the mountainside behind, and the roofs of boardinghouses for a workforce in the hundreds are prominent. The edifice near center was a five-story boardinghouse with steam heat, hot showers, and toilets, which was rare for the era. Source: Denver Public Library, Western History Collection, X 62273.

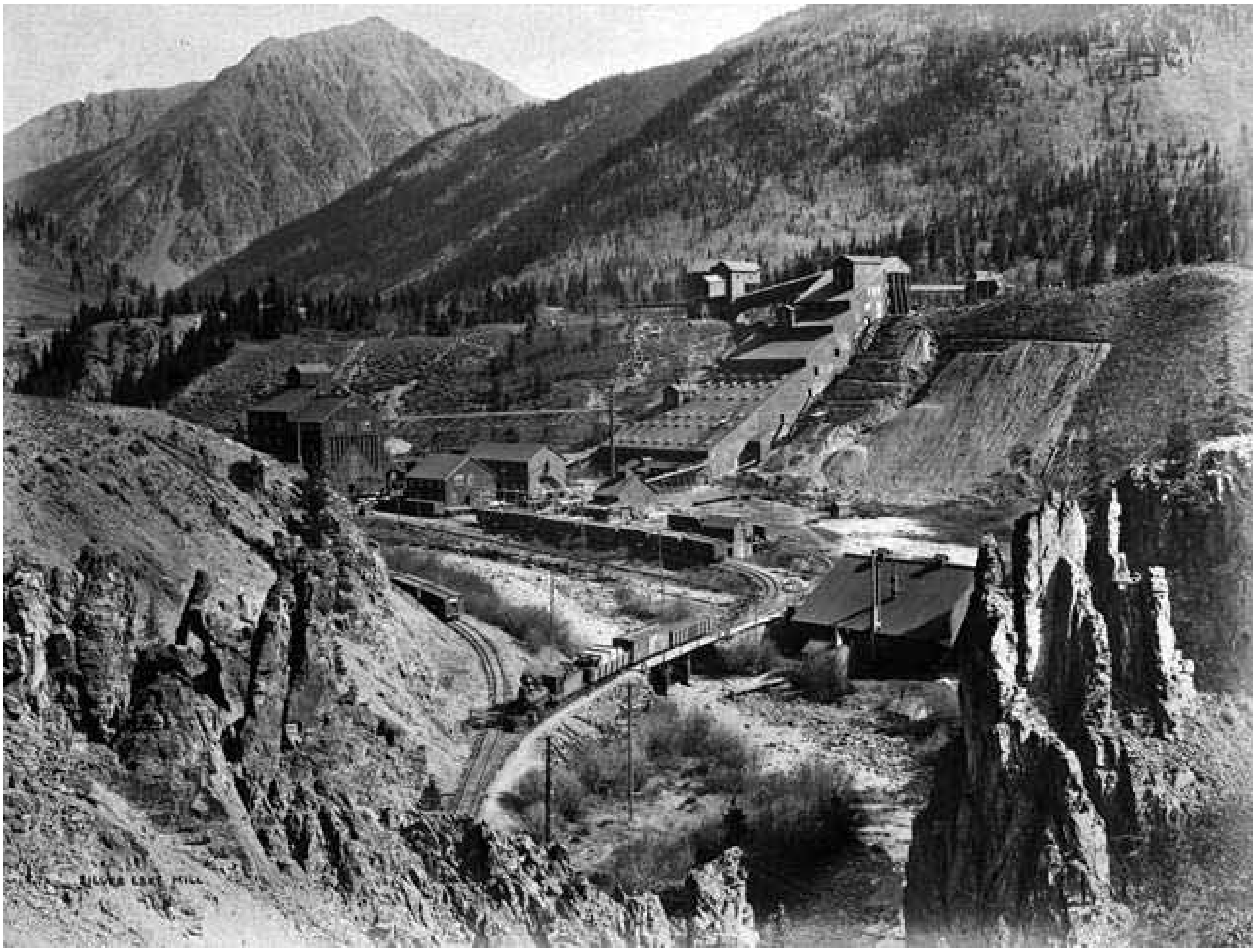


Figure E 30: Edward Stoiber designed the sprawling Silver Lake Mill, built on the Animas River in 1900. Because Stoiber was one of Otto Mears' best customers and invested in Mears' Silverton Northern Railroad, Mears provided the mill with direct rail service. At far left stands the ore bins and tram terminal of a loading station erected during the 1890s, prior to the mill. The small building with tall smokestack at photo-center was an electrical powerhouse, and the complex building to the left of the mill's head was a new tram terminal that received and crushed ore. Note how the mill building fans out to accommodate the increased number of concentration machines for each processing stage. The facility had a capacity of 1,000 tons of ore per day and ranked among the state's largest. In later years, the mill played an important role in the county because it accepted custom ores from independent mines. Source: Denver Public Library, Western History Collection, X 62275.

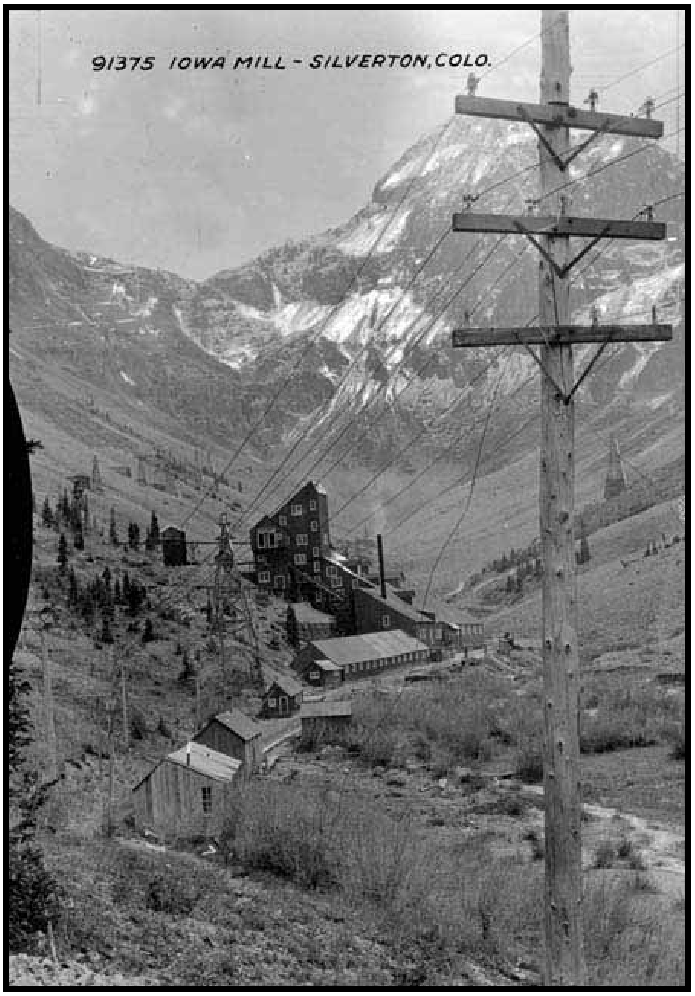


Figure E 31: The Iowa Mill was not as complex as the Silver Lake facility, but it was vital to the mines in Silver Lake Basin. The south view depicts the Iowa Mill, Arrastra Gulch's imposing headwall, and the confusion of tram towers in the gulch around 1900. The towers in the left background descended from the Iowa and Silver Lake mines, located above and beyond the headwall, and the tower at right carried the Unity Tunnel tramway. The cupola on top of the mill was a terminal for yet another tramway that carried finished concentrates down to a station on the Animas River. Source: Denver Public Library, Western History Collection, Z 2560.

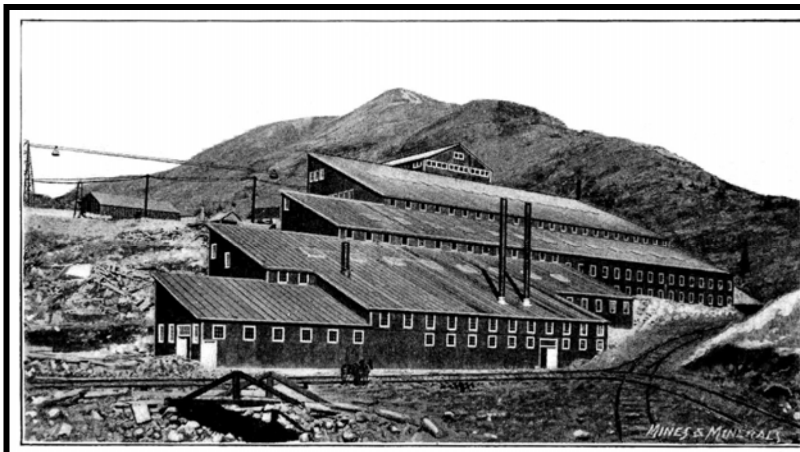


FIG. 5. GOLD PRINCE MILL

Figure E 32: In 1904, the Gold Prince Mines Company erected one of Colorado's largest and most advanced mills at Animas Forks. The mill featured structural innovations and could treat 500 tons of ore per day. Although the process was based on science, the mill was unable to recover enough metals to remain economical. As a result of this and bankruptcy of its owners, the mill was a costly failure. Source: *Mining Reporter* 54:386-389.

Figure E 33: During the early 1900s, the Little Dora complex was a component of the Hercules Consolidated Mining Company, which also operated the Hercules Mine and Mill, not shown. The complex includes the Little Dora Mill, shops, and tunnel above the mill. The operation was on the west outskirts of Silverton and one of the most successful in the Mineral Creek district. Source: Denver Public Library, Western History Collection, X 62191.

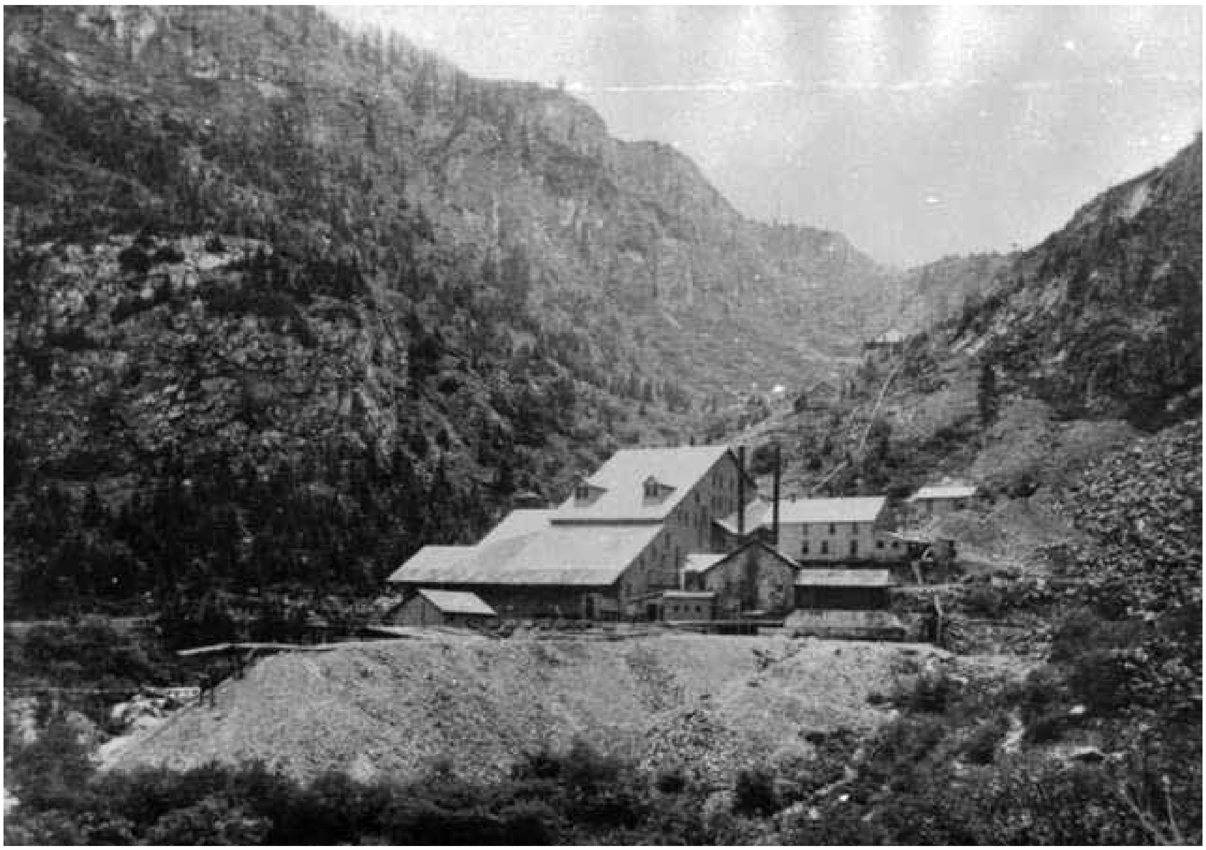


Figure E 34: Primarily through Denver mining investor Mary B. Murrell, the Gold Tunnel & Railway Company brought the Highland Mary Mine into its first meaningful production and built this mill in 1902. The large waste rock dump came out of the Innis Tunnel, located at right. The head of Cunningham Gulch rises in the background, and the roof of Edward Innis old Whitehouse can be seen at the end of the water pipe. Source: Denver Public Library, Western History Collection, X 62209.

Section E 1: World War I Revival: 1915 – 1920

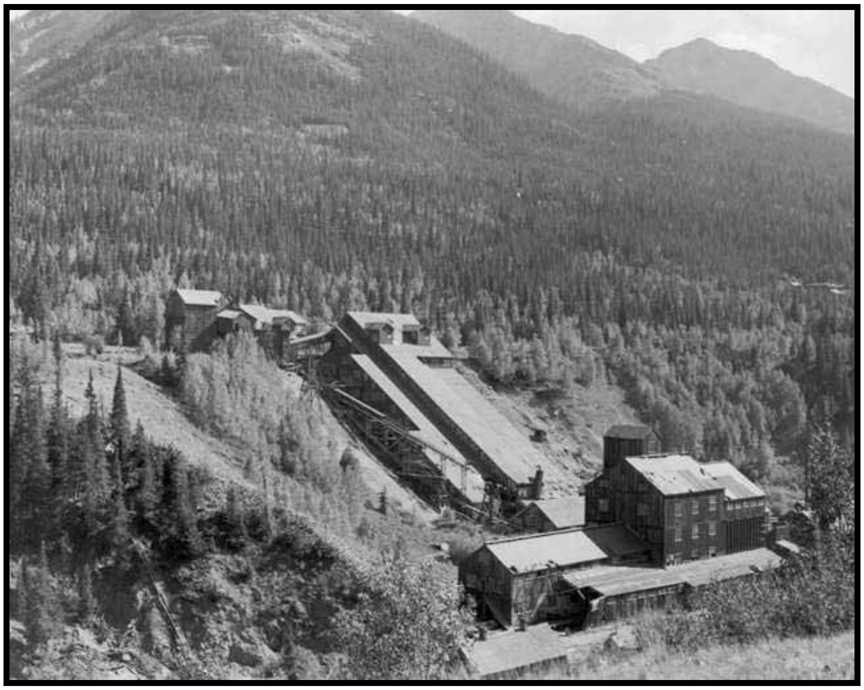


Figure E 35: When the Silver Lake Mill burned in 1906, the American Smelting & Refining Company built a replacement. The fire spared the 1898 ore storage structure at lower right, visible in Figure E 30. The new mill was smaller than Edward Stoiber's 1900 version. The Silver Lake Mine no longer provided ore by the mid-1910s, forcing the mill to run custom payrock from local companies. The mill played an important role in this capacity. Source: Denver Public Library, Western History Collection, X 62198.

Figure E 36: Peter Orella's tram terminal at the Big Giant Mine still stands. Miners input payrock into the structure from the trestle at left. A second tramway carried North Star Mill tailings down from Little Giant Basin and entered the double doorway in the cupola. The tram mechanism was located in the large room at the structure's bottom. Source: Author.

Section E 1: Great Depression Era Revival: 1933 – 1939

Figure E 37: By the early 1930s, the Highland Mary Mill appeared worn and battered. The structure, erected over the ruins of the original mining operation, was typical of such facilities during the Great Depression. And yet, the Highland Mary and similar mines were important for their economic contributions and employment. Source: Denver Public Library, Western History Collection, X 62206.

Figure E 38: The Mayflower Mine, at the base of the cliff at center, was the leading mine in San Juan County from the late 1920s until closure in 1954. The surface facilities included a five-story boardinghouse, the upper terminal for a tramway, and shops. The tramway carried ore down to the Mayflower Mill on the Animas River. The operation was the county's economic cornerstone and largest employer. Source: Denver Public Library, Western History Collection, X 62245.

Section E 2: Mining and Milling Methods, Technology, and Equipment

The Mine Shop

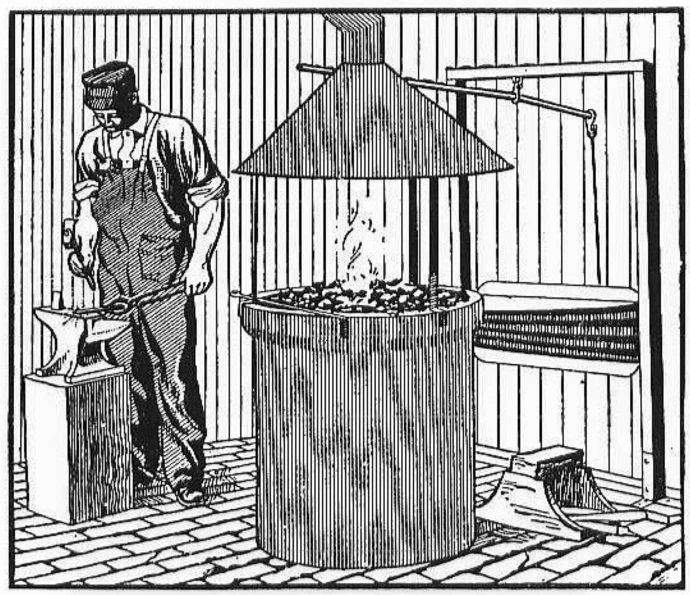


Figure E 39: The illustrated shop is representative of those at prospects and small mines. Such shops usually consisted of little more than a forge, an anvil, and hand-tools, which restricted work to drill-steel sharpening and the manufacture of light hardware. Source: Drew, 1910:1.

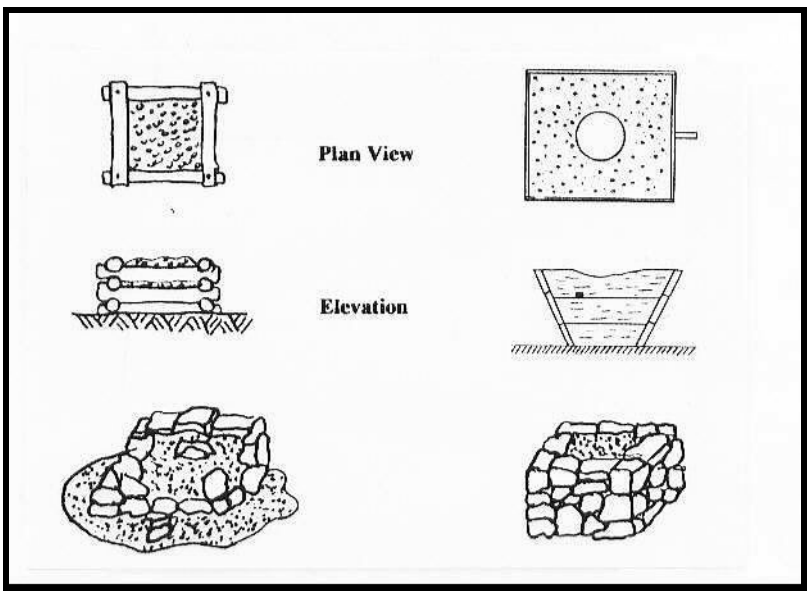
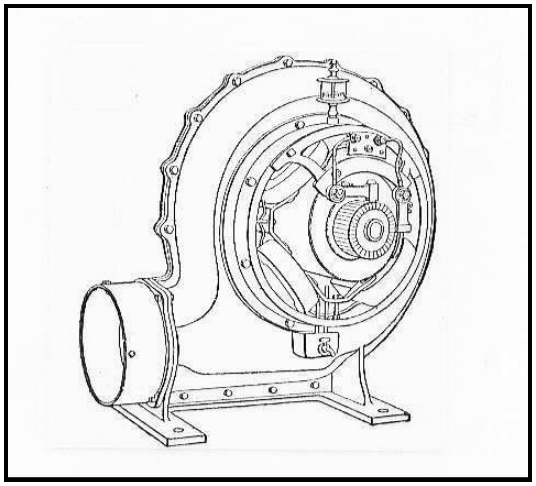


Figure E 40: Above are examples of the common forges used in blacksmith shops. At upper left is a gravel-filled log forge, at right is a wood box forge, and at lower right is a dry-laid rock forge. Over time, rock forges decay and collapse, and manifest as the remnant at lower left. Source: Eric Twitty.

Mine Ventilation

Figure E 41: At right is a common ventilation blower used to force fresh air underground. Ducting was fastened to the nozzle, and a belt turned the machine. Source: International Text Book Company, 1899, A41:146.



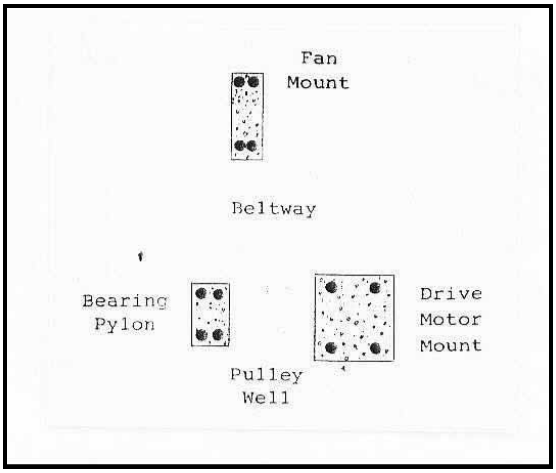


Figure E 42: The plan view at left depicts a typical concrete foundation for a ventilation blower and its drive motor. Source: Eric Twitty.

Shaft Form and Hoisting Vehicles

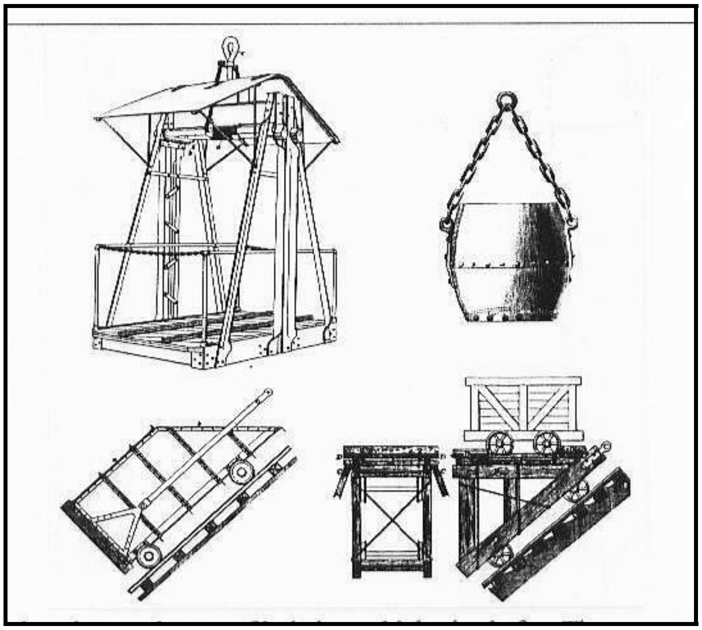


Figure E 43: Mining companies employed several types of hoisting vehicles in shafts. The cage at upper left, popular from the 1870s through the 1930s, ran on guide rails and carried miners or an ore car. The sinking bucket at upper right required no rails and was common among small operations. The skip at lower left was popular in both vertical and inclined shafts by 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.

Figure E 44: When intact, shafts often are divided into several compartments for hoisting and egress. The collars are usually timbered to retain loose material, and are flush with the surrounding ground. Intact examples are rare and important engineering resources. Source: Eric Twitty.

Hoists

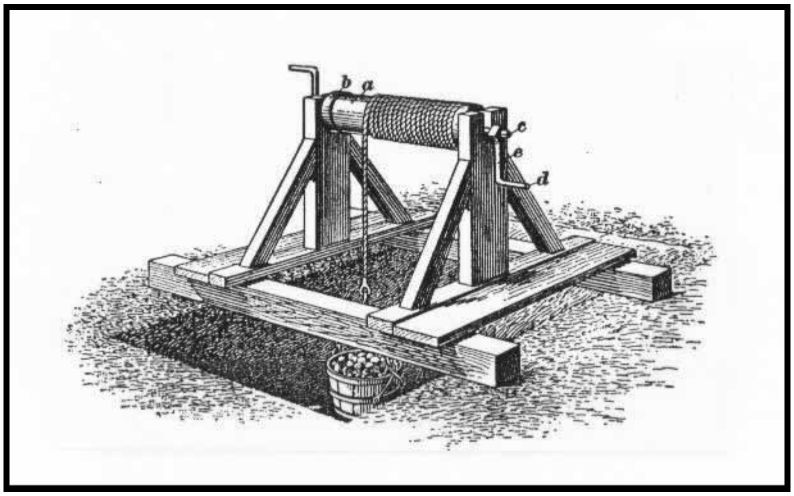


Figure E 45: The windlass was an institution among prospectors, and nearly all shafts less than 100 feet deep were equipped with this simple, inexpensive, and portable type of hoist. Source: Twitty, 2002:145.

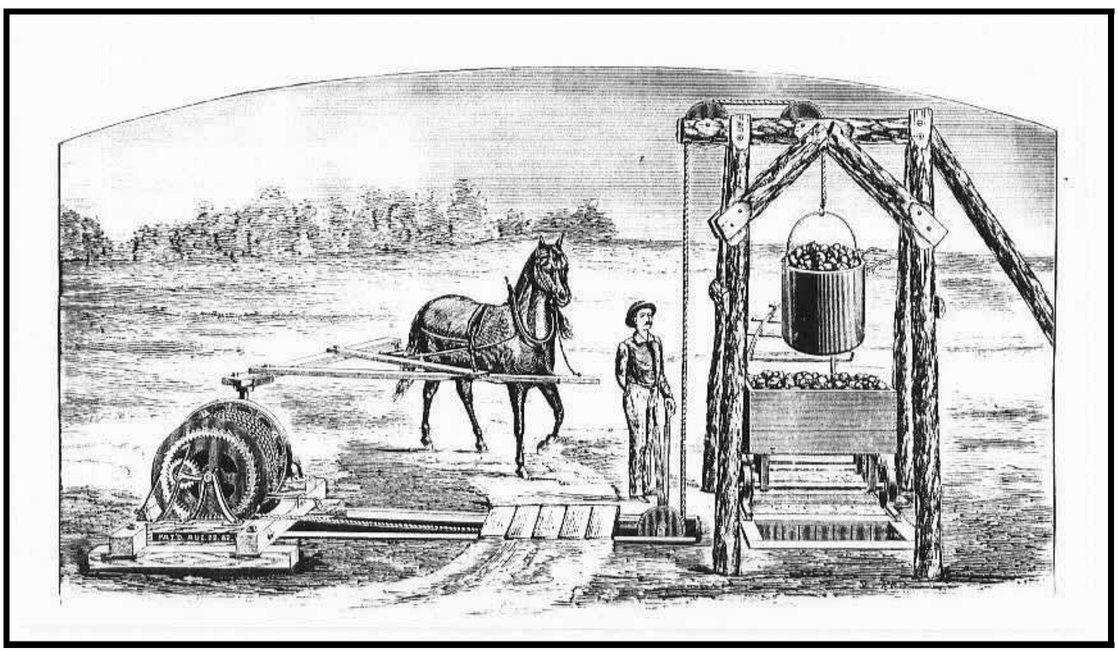


Figure E 46: Horse whims were the most primitive type of mechanical hoist, and were a favorite among prospectors because of their simplicity and portability. The unit shown is a geared whim, which was popular from the 1880s through the 1910s. The hoist operator controlled a brake and clutch via levers mounted to the shaft collar. The control linkages and hoist cable passed through the trench. Source: Ingersoll Rock Drill Company, 1887:60.

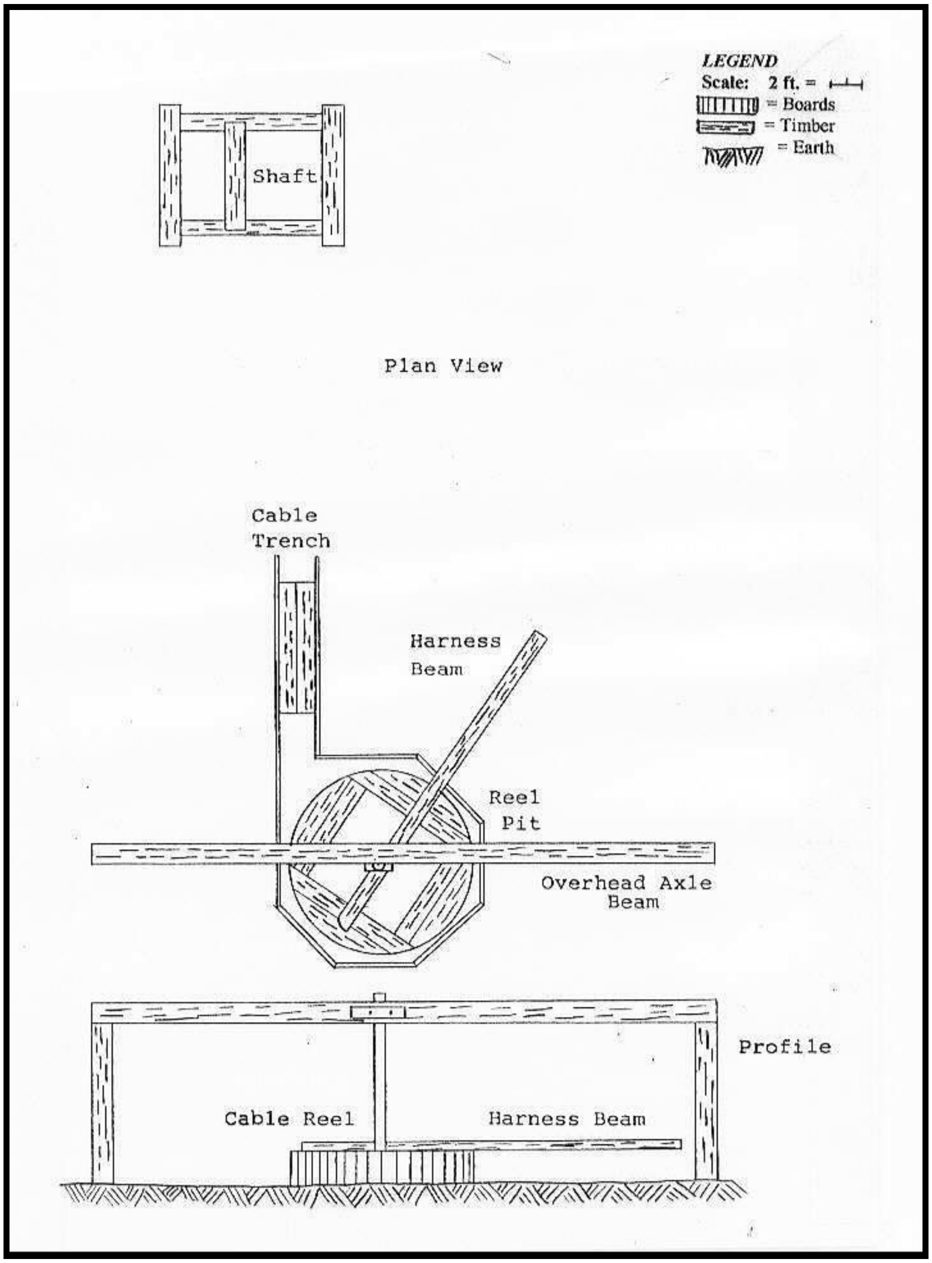


Figure E 47: The plan view, top, and elevation, bottom, depict a horizontal reel horse whim, which was a universal prospecting hoist prior to the 1880s. The reel was mounted to an axle on a timber footer buried in the floor of a plank-lined pit. Usually, only the pit and cable trench remain at prospect shaft sites today. Source: Eric Twitty.

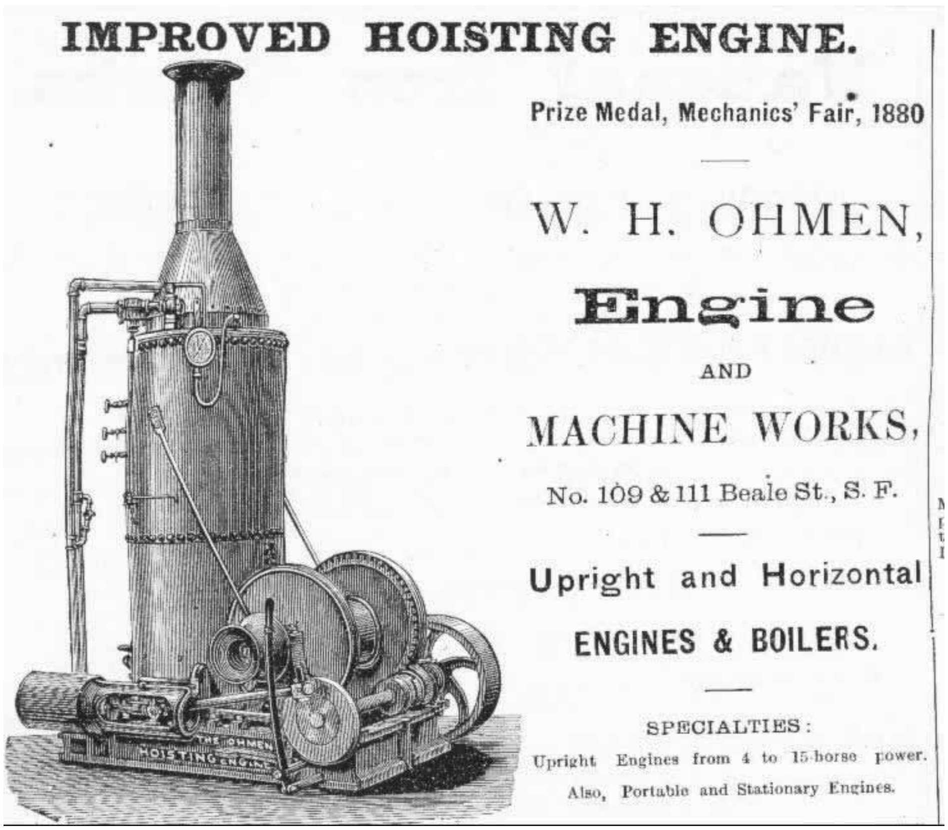


Figure E 48: Donkey hoists were popular for deep prospecting after the 1880s because they were self-contained and required little site preparation other than a flat area. Source: *Mining & Scientific Press* 1881.

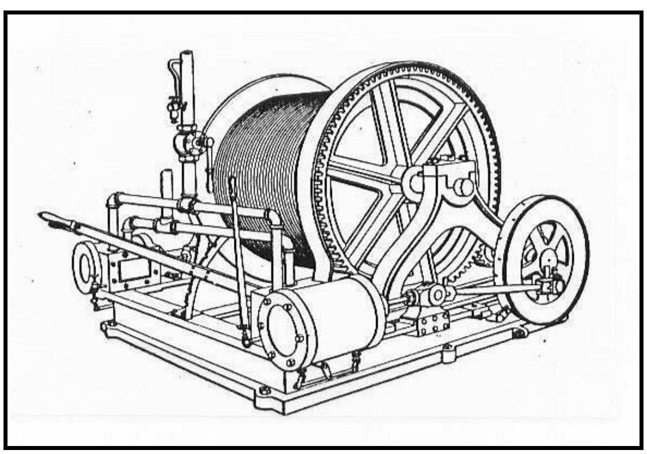


Figure E 49: Single-drum geared steam hoists were the most common power type between the 1870s and 1910s. Gasoline and electric models became popular afterward. Source: International Text Book Company, 1906, A50:8.

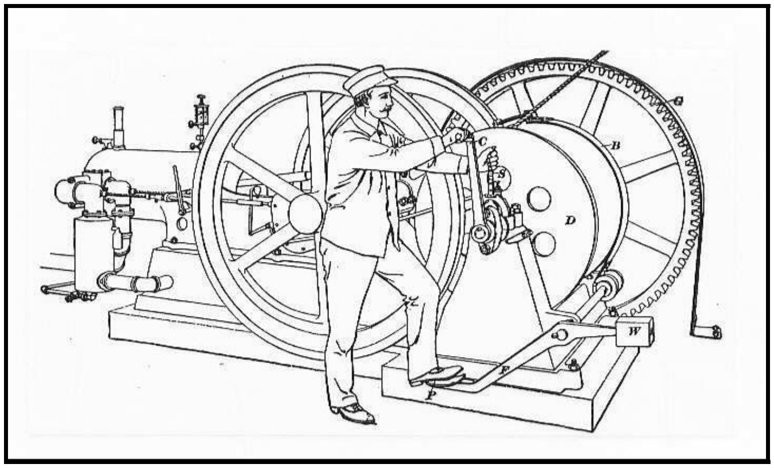


Figure E 50: This type of gasoline hoist was employed for deep prospecting and minor ore production between around 1900 and 1930. A single-cylinder engine is at left, dual flywheels are at center, and the cable drum is at right. Source: International Textbook Company, 1906, A50:31.

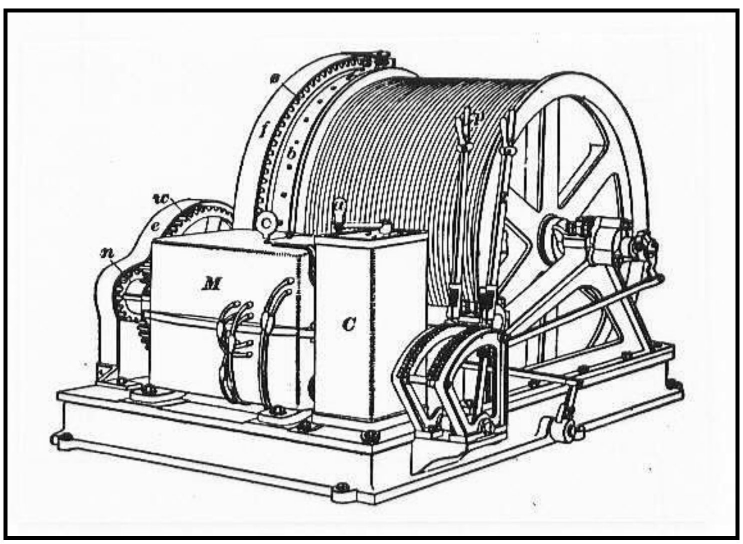


Figure E 51: The single-drum electric hoist grew in popularity during the 1910s where power was available. The motor is in the case in front, drive gearing is at left, and the upright box is a speed controller. Source: Twitty, 2002:224.

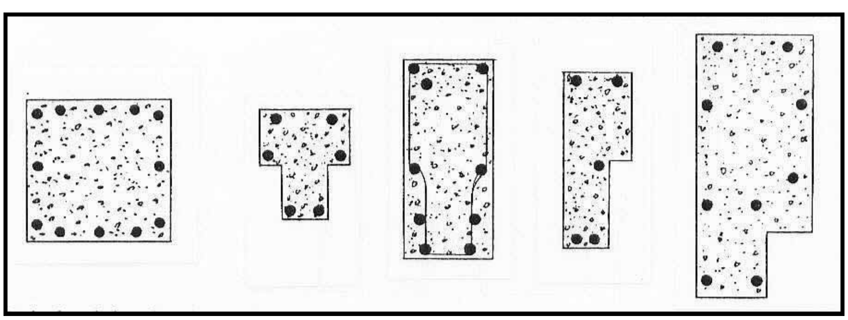


Figure E 52: Hoist foundation plan views. Single-drum steam and electric hoists were bolted to foundations like the one at left, and the other foundations were for various types of gasoline hoists. Source: Twitty, 2002:187, 241.

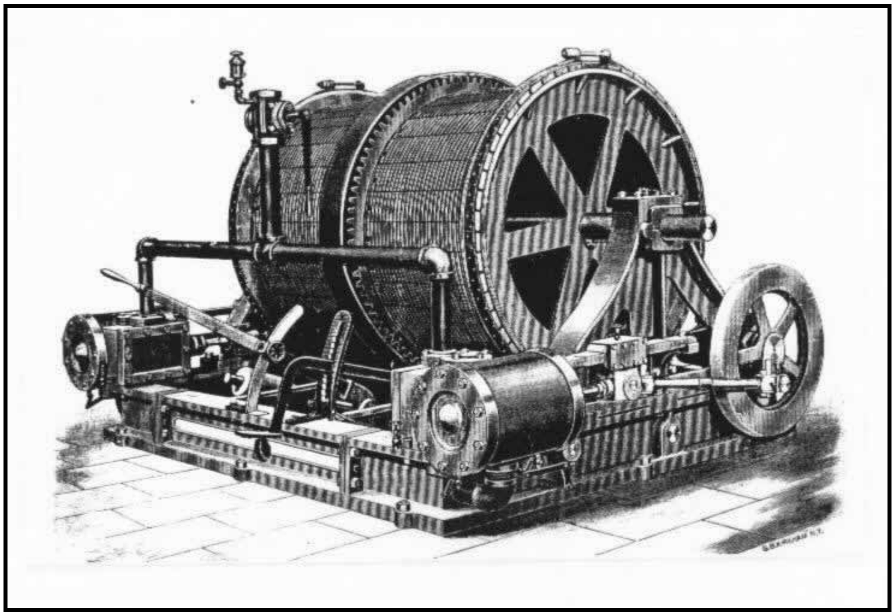


Figure E 53: Rear quarterview of a geared double-drum steam hoist. Double-drum hoists, hallmarks of significant ore production, achieved balanced hoisting with two vehicles. Source: Ingersoll Rock Drill Company, 1887:65.

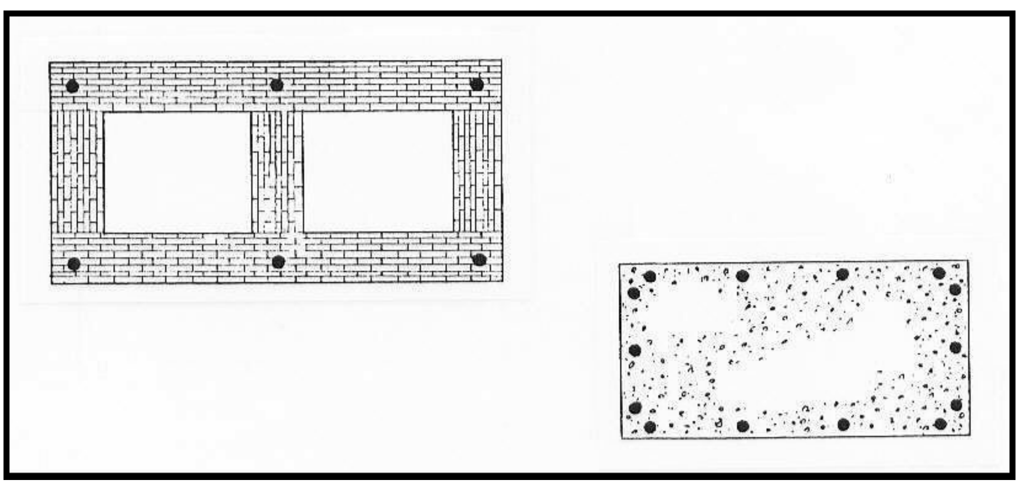


Figure E 54: The plan views depict foundations for geared double-drum steam hoists. The foundation at left features wells for the hoist's cable drums. Source: Eric Twitty.

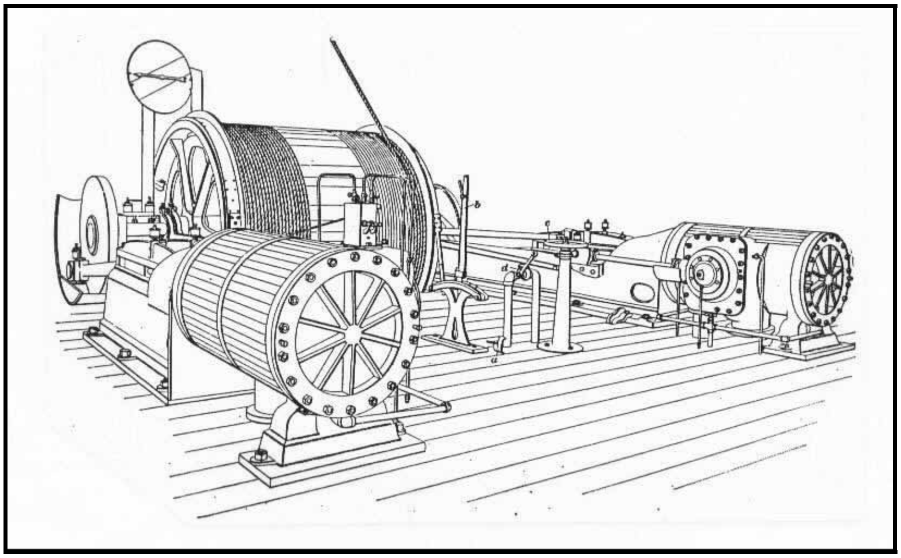


Figure E 55: Rear quarterview of a direct-drive single-drum steam hoist. Powerful steam cylinders flank the hoist's controls, and the drive-rods are directly coupled to the cable drum. Source: International Text Book Company, 1906, A50:16.

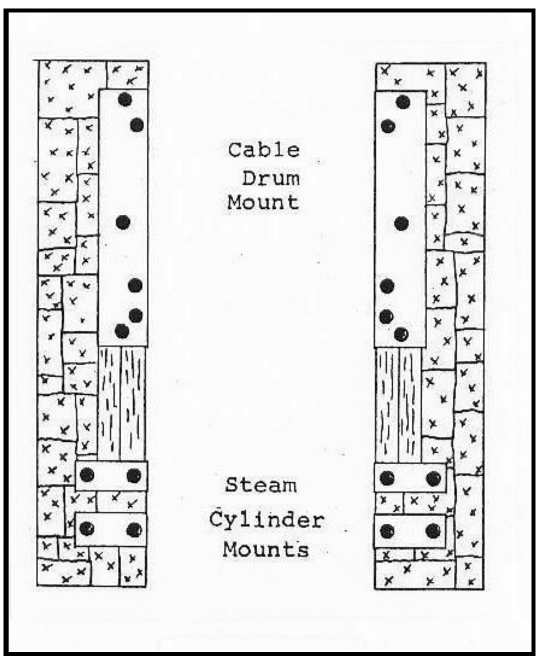


Figure E 56: The plan view depicts a typical foundation for a direct-drive single-drum steam hoist. Such foundations are usually less than 14 by 17 feet in area. Source: Eric Twitty.

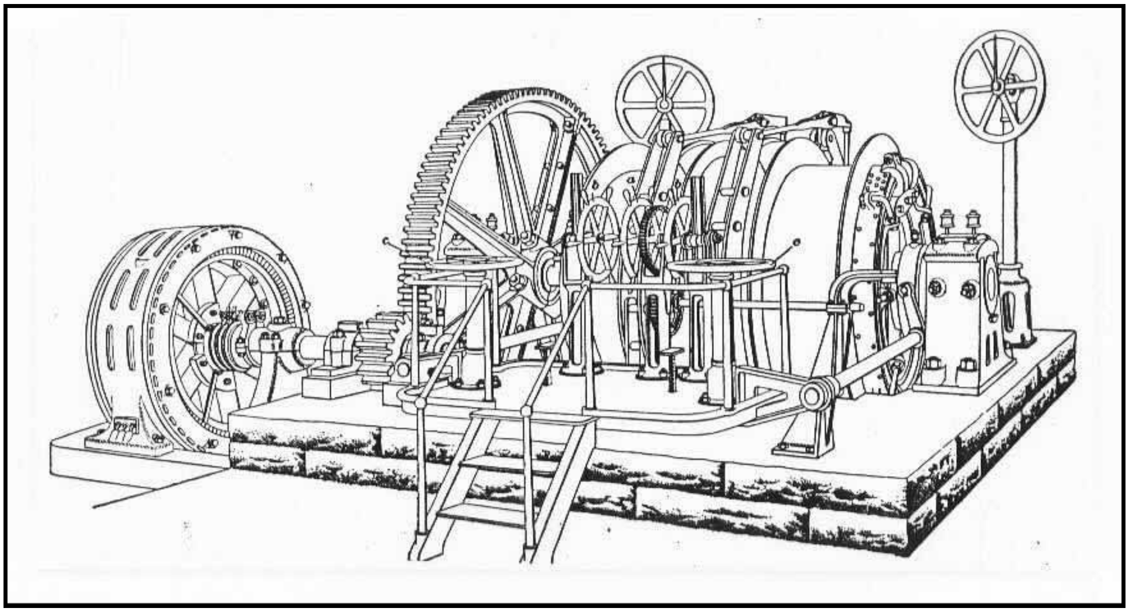
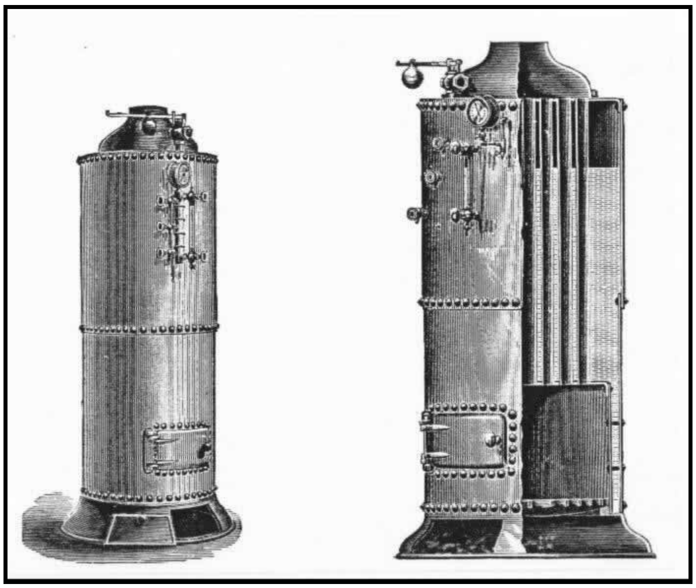


Figure E 57: Rear quarterview of a double-drum electric hoist. The motor at left drove the dual cable drums via the large bull gear. Such hoists facilitated heavy production, saw use after the 1910s, and were popular among well-capitalized companies by the 1930s. Note the foundation. Source: International Textbook Company, 1906, A50:40.

Steam Boilers

Figure E 58: Upright boilers were the least expensive and most portable type of boiler, but 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.



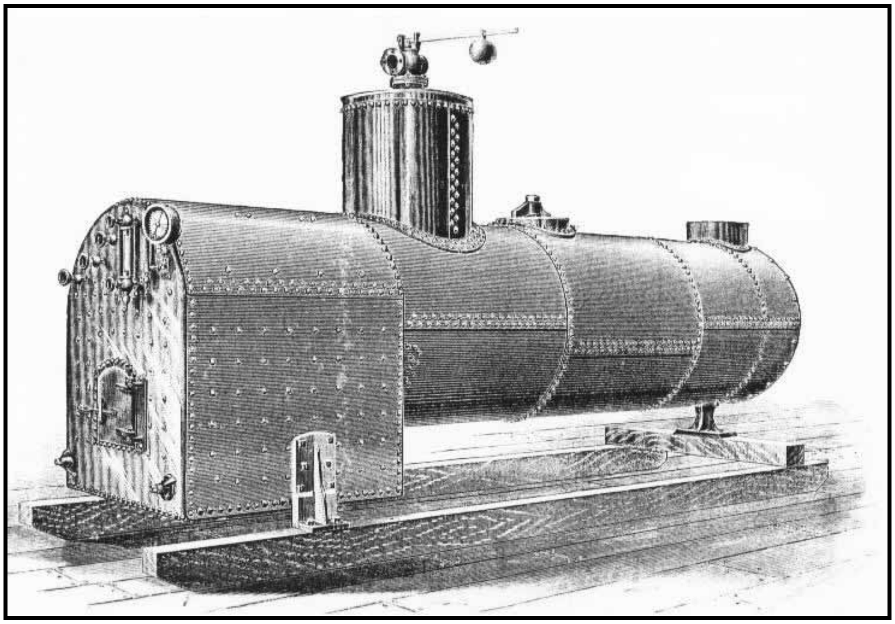


Figure E 59: The locomotive boiler was one of the most popular steam generators. Flue gases traveled from the firebox at left through flue tubes in the tank and out a smokestack at right. Source: Rand Drill Company, 1886:45.

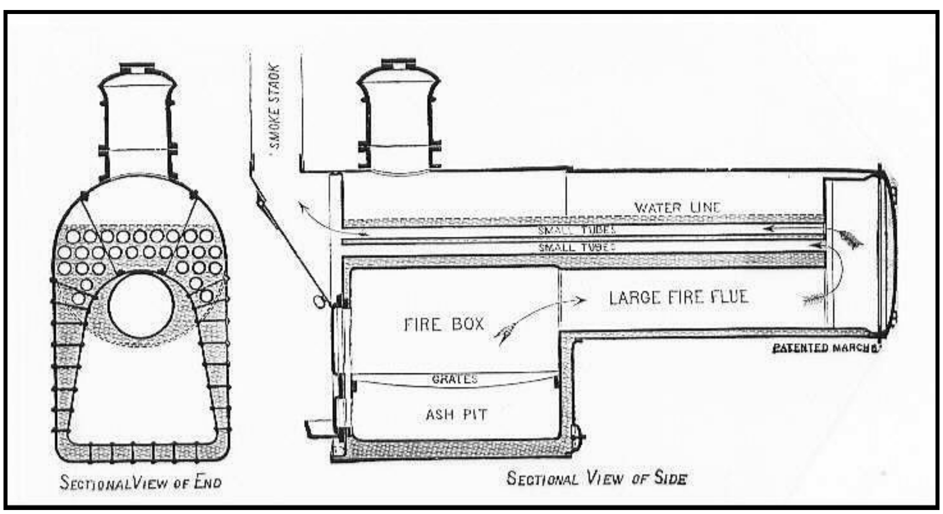


Figure E 60: The Pennsylvania boiler was portable, stood on skids, and provided greater fuel economy than the locomotive type. Note the path traveled by the flue gases, which prolonged contact with the boiler surfaces. Source: Rand Drill Company, 1886:46.

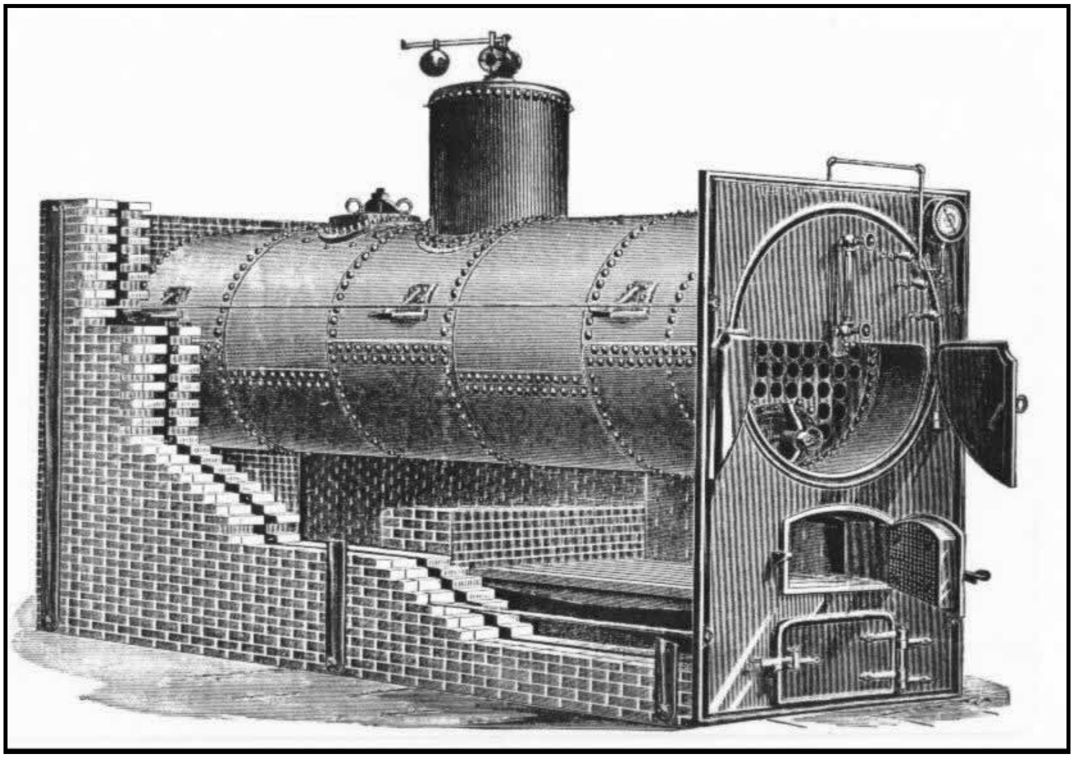


Figure E 61: The return-tube boiler was the most popular industrial steam generator prior to the widespread embrace of electricity. The unit consisted of an iron shell, a masonry setting, and a cast iron façade. Flue gases traveled from the firebox behind the façade and under the shell. The gases rose 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.

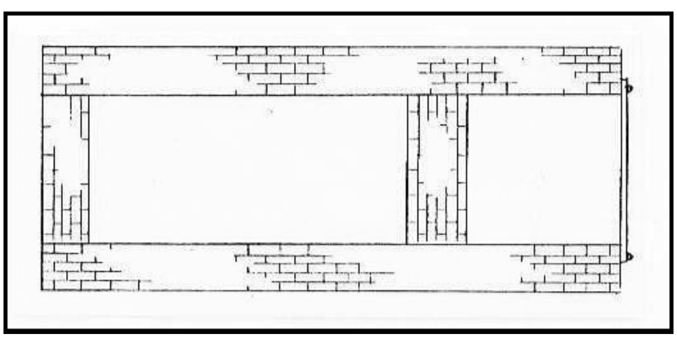


Figure E 62: Few return-tube boilers currently remain intact and have been reduced to setting remnants and foundations, such as the one in the plan view. Source: Twitty, 2002:145.

Headframes

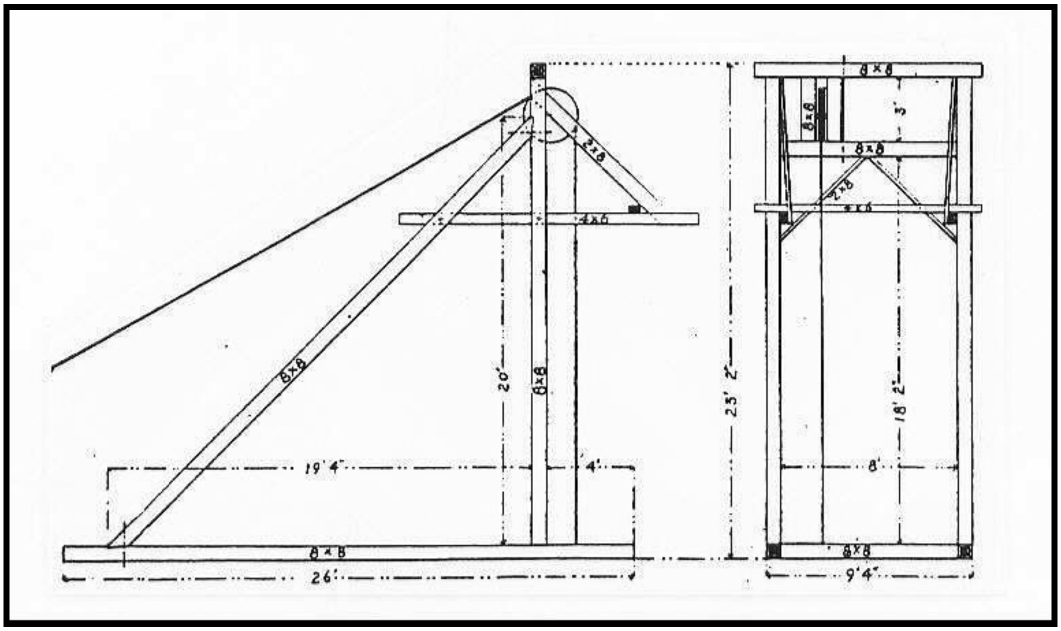


Figure E 63: The two-post gallows headframe was the most common type for prospect shafts. Sinking-class versions were less than 25 feet high and stood on timber footers. Source: *Engineering & Mining Journal* 3/7/03 p366.

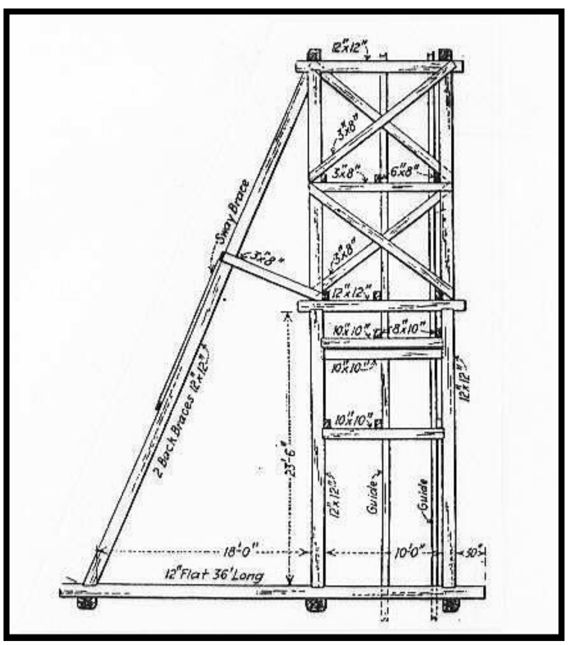


Figure E 64: The headframe at left is a four-post derrick type. Production-class headframes such as the one illustrated tend to be higher than 25 feet. Source: *Engineering & Mining Journal* 12/28/17 p1216.

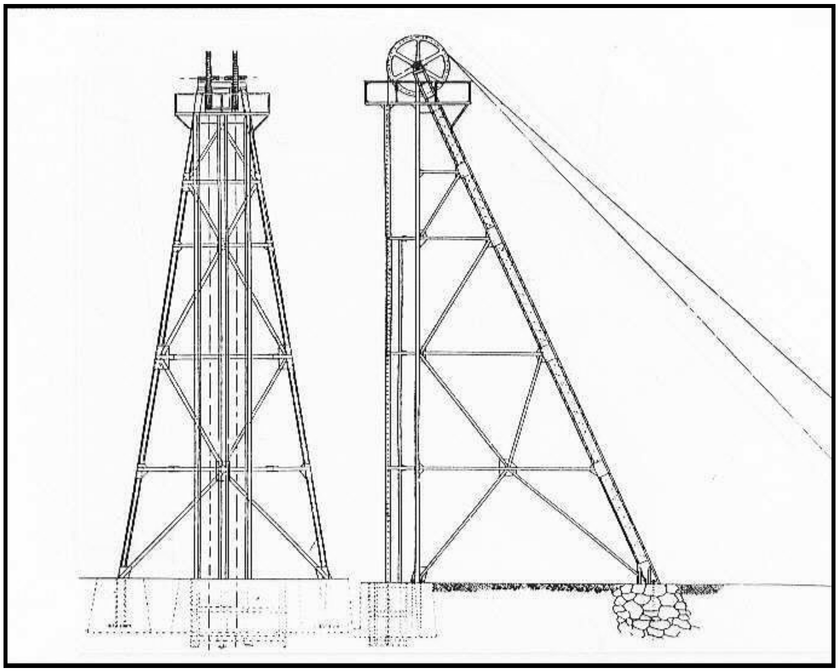


Figure E 65: The illustrated headframe is a production-class two-post gallows structure known as a Montana type. These headframes were usually tall, well-built, and stood over deep shafts. Source: Twitty, 2002:233.

Air Compressors

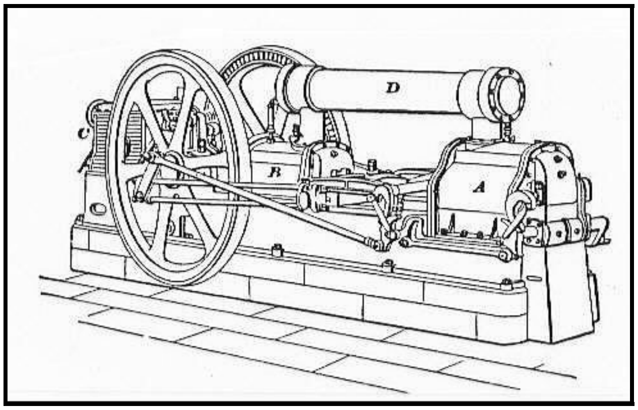


Figure E 66: The line drawing depicts a straight-line steam compressor that provided two stages of compression. One compression cylinder is at right, another is at center, and the steam drive cylinder is at left. The flywheels imparted momentum to the machine. Source: International Textbook Company, 1899, A20:32.

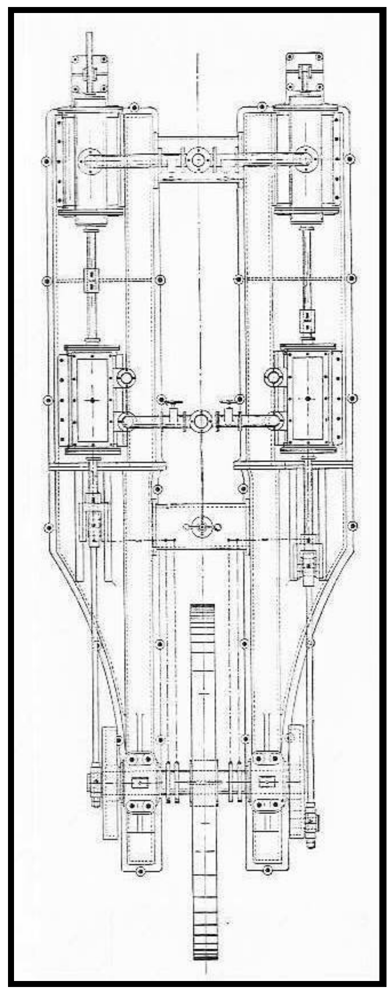


Figure E 67: The plan view shows a typical pre-1910 duplex steam compressor. The compression cylinders are at top, the steam drive cylinders are at center, and the flywheel is at bottom. Source: Ingersoll Rock Drill Company, 1887:34.

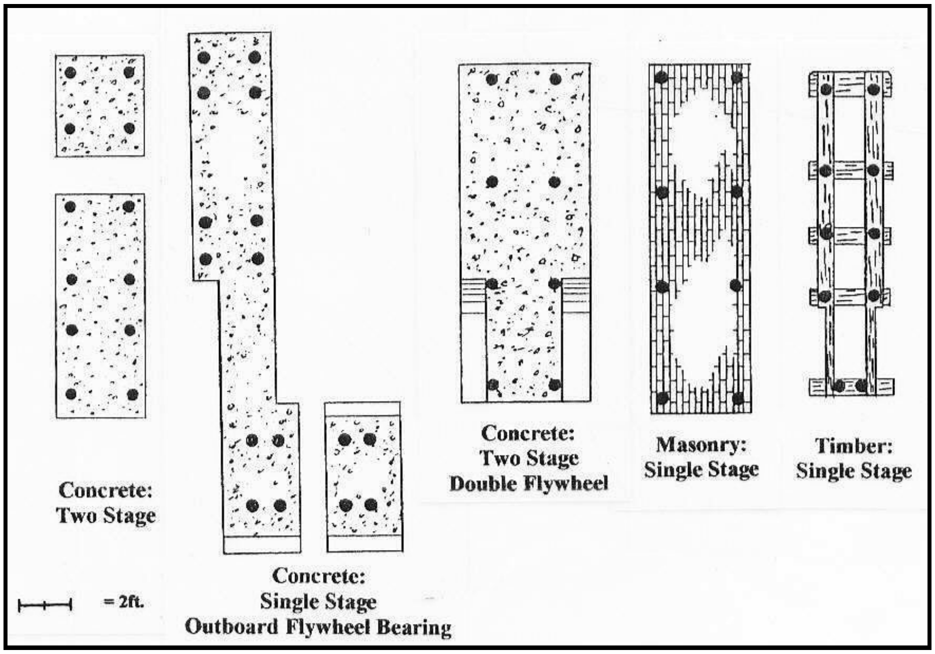


Figure E 68: The plan view depicts foundations for straight-line compressors. Source: Eric Twitty.

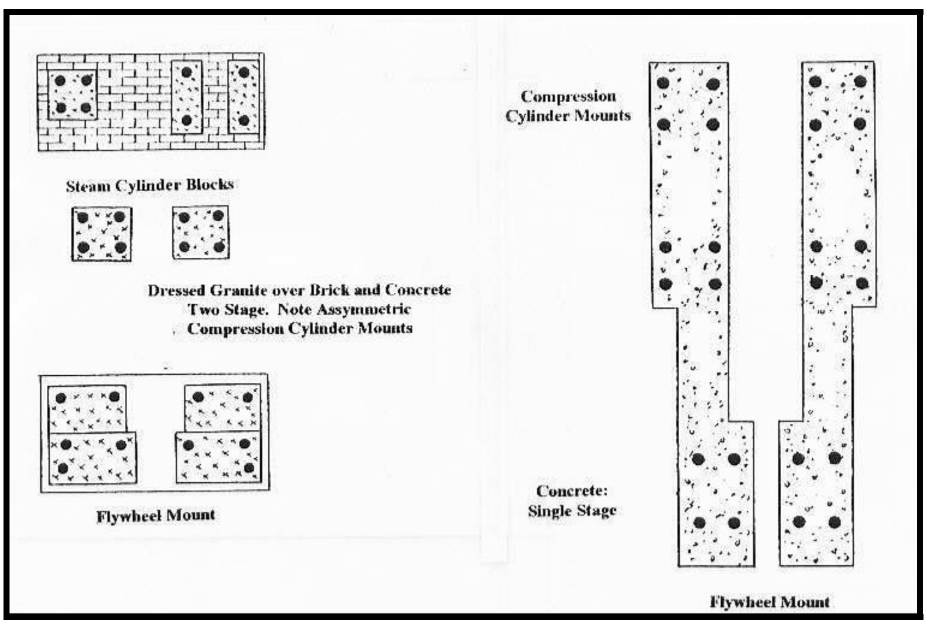


Figure E 69: The plan views portray two common foundations for duplex steam compressors. The foundation at right was for a machine like the one in Figure E 67, and the foundation at left anchored a compressor with compound action. Source: Eric Twitty.

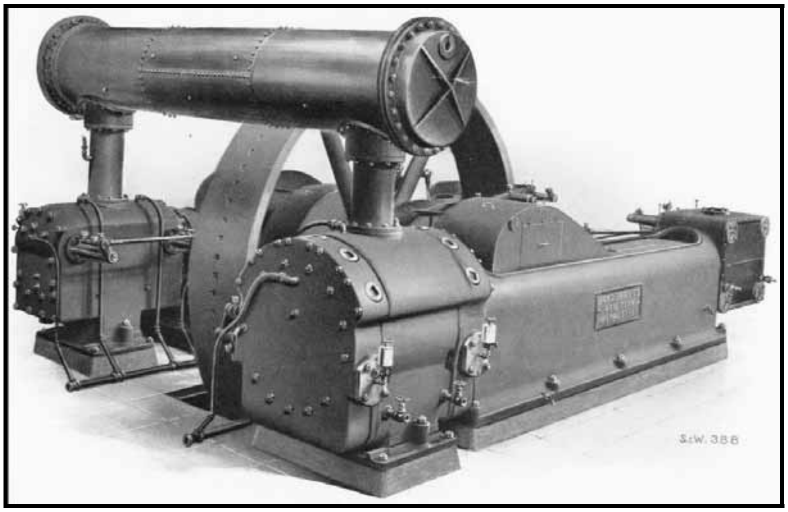


Figure E 70: During the 1890s, the above form of duplex compressor became popular. Originally, these machines were powered by steam, and by the 1900s, some were also belted to motors where electricity was available. Source: Rand Drill Company, 1904:12.

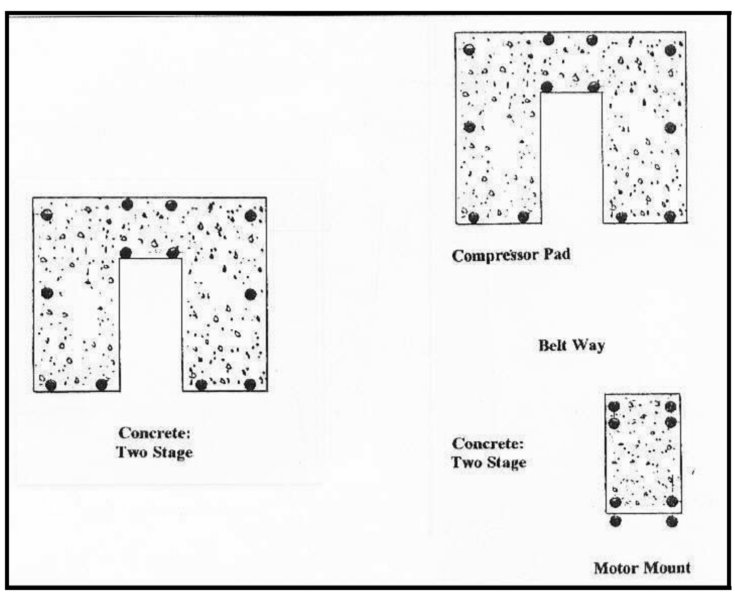


Figure E 71: Compact duplex compressors were mounted to foundations like those in the above plan view. The foundation at left anchored a steam-powered unit, and the one at right was for a belted version, which became popular by the 1910s. Source: Twitty, 2002:109.

Figure E 72: The V-cylinder compressor, similar to a large engine, became one of the most popular compressor types during the 1930s. Note the foundation. Source: Eric Twitty.

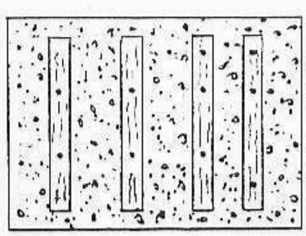


Figure E 73: The illustration at left is a plan view for a V-cylinder compressor foundation (see Figure E 72). Timber footers are embedded in a concrete rectangle around 3 by 4 feet in area. Source: Eric Twitty.

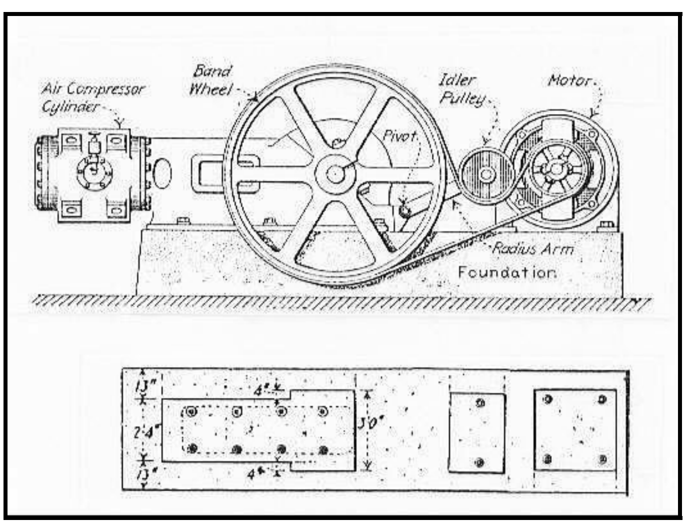


Figure E 74: The profile illustrates the type of small, belted compressor popular between the 1910s and 1940s. The plan view shows the foundation, which features mounts for the compressor and motor. Source: Eric Twitty.

Architecture

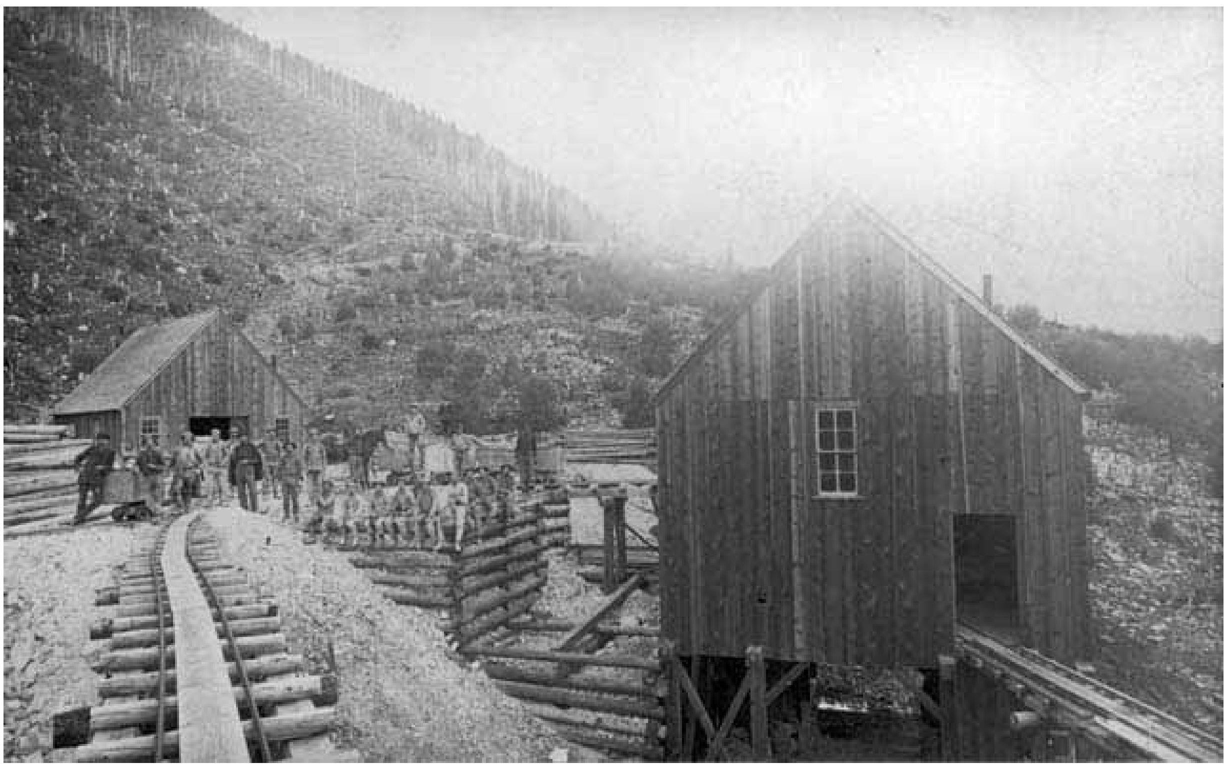


Figure E 75: The buildings at the North Star Mine, on Sultan Mountain in 1885, are typical of vernacular architecture specific to the mining industry. The building at left is a tunnel house enclosing a blacksmith shop, and the building at right is an ore sorting house. The buildings were probably custom-designed on-site by a company official for function and economy, rather than for appearance. The steep roofs are an adaptation to the heavy snows of San Juan County. The log cribbing was a structure designed to be filled with waste rock for a larger level area on the steep mountainside. Source: Denver Public Library, Western History Collection, X4570.

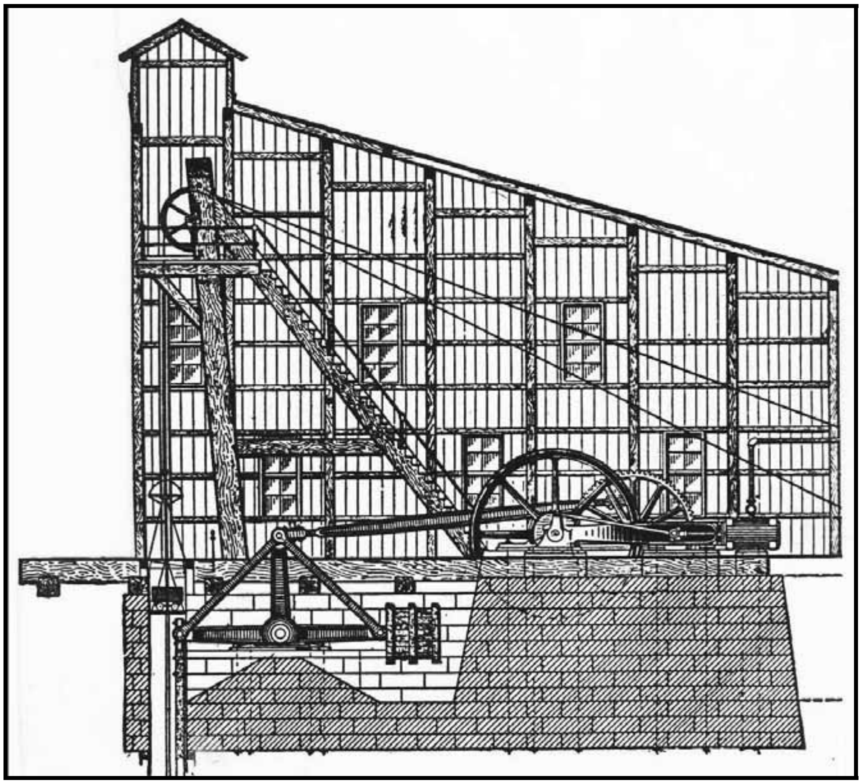


Figure E 76: Shaft houses enclosed the shaft collar, headframe, hoist, power system, and usually the blacksmith shop. The shaft house in the profile also features a Cornish pump and steam engine, rarely used in San Juan County. Source: International Textbook Company, 1899, A43:3.

Figure E 77: After shaft houses were outlawed during the 1910s, mining companies erected hoist houses to enclose critical facilities. In this example dating to the 1930s, the left roofline features an angled cupola for the hoist cable, which ascended to a headframe left and out of view. Source: Eric Twitty.

Aerial Tramways

Figure E 78: Aerial tramways played a significant role in the success of mining in San Juan County. They allowed many companies to overcome difficult terrain and ship high volumes of ore from remote locations. Without tramways, transportation costs would have been too high. The photo illustrates the Bleichert system that descended from the Iowa Mine to the mill, background. In the Bleichert system, the buckets coasted over a stationary track cable fixed to the tower top, and were pulled by a second, lower traction cable. Note the cross-member and rollers for the traction cable. The tower is a pyramid type, the most common in the county. Source: Denver Public Library, Western History Collection, X-62249

Figure E 79: The Bleichert tramway was a distinct system in many regards. Its buckets could be detached from the traction cable once in the terminal and moved at leisure. This increased efficiency and capacity, and decreased spillage. During the 1930s, Mayflower Mill workers receive a full bucket. The bracket suspended at upper center automatically released the bucket from the cable. Source: Denver Public Library, Western History Collection, X-62255.

Figure E 80: The through-type was the second most popular tower design in San Juan County. The structure was stout, resisted horizontal stresses, and even withstood minor avalanches. Intact towers such as this on the Gold Prince system are rare and important engineered structures. Source: Eric Twitty.

Figure E 81: Terminals for both Bleichert and Hallidie tram systems featured sheave wheels for the traction cable. A heavy frame braced the wheel against the pull of the cable. These vital components contribute integrity to a tramway resource when present. Source: Eric Twitty.

Figure E 82: Small-scale system aspects, such as these factory-made cable cradles, are important details. They are rare, meaningful for interpretation, and contribute integrity. Source: Eric Twitty.

Ore Beneficiation: Smelting, Ore Concentration, and Amalgamation

Smelters

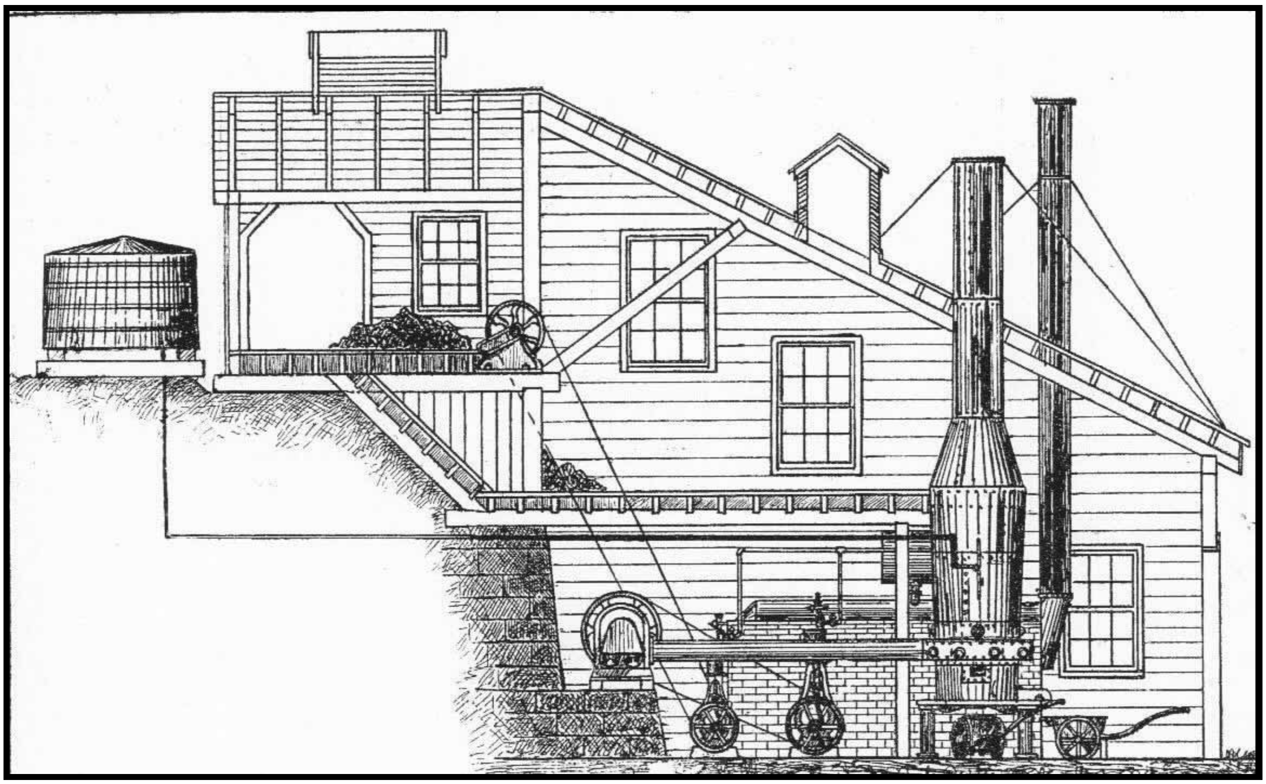


Figure E 83: The profile illustrates a small and simple smelter. Workers sorted crude ore at top left and then fed the material into a crusher marked by the upper wheel, which is a belt pulley. The resultant cobbles and gravel accumulated on the floor at center, and workers periodically fed the material into the furnace at lower right. The type of furnace, free-standing and pre-fabricated, was common by the 1870s. Note the blower system in front of the brickwork at bottom, which forced air into the furnace for great heat. In many cases, smelters also had concentration machinery to process complex ore in7 advance. Source: *Mining & Scientific Press* 4/28/83, p281.

Concentration Mills

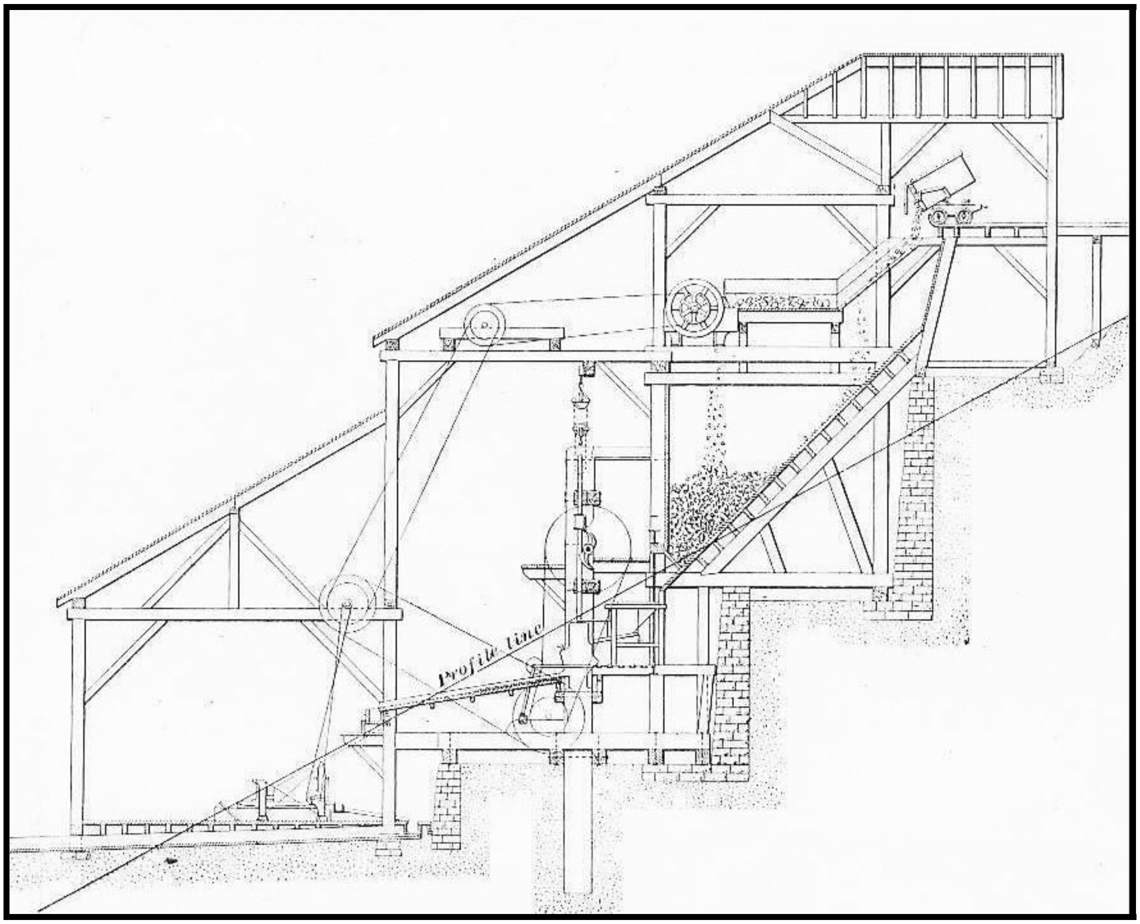


Figure E 84: The profile illustrates both the stairstep configuration of a typical concentration mill and the process flow path. Workers dumped ore onto a screen at top, and fine material passed through while course cobbles were diverted into a crusher. A stamp battery at center then pulverized the ore into a slurry, which passed over amalgamating tables that extracted free-gold and silver. The slurry then descended to concentration machinery on the lower platform. That machinery separated out the gold and silver that refused to amalgamate. Source: International Textbook Company, 1899, A43:214.

Crushing Machinery

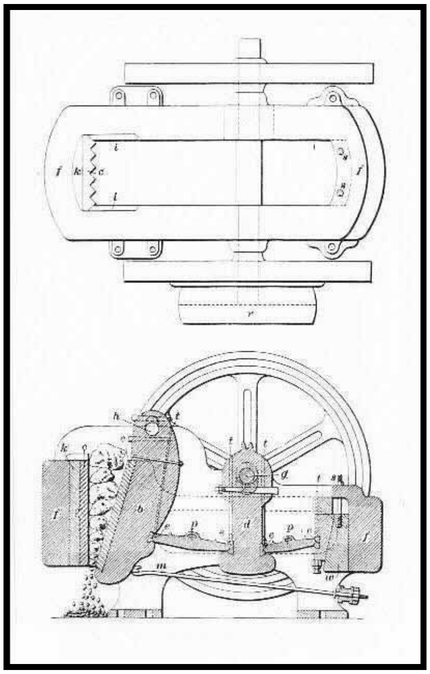


Figure E 85: The plan view, top, and profile, bottom, illustrate a jaw crusher, which provided initial crushing at most mills. Source: International Textbook Company, 1899, A43:2.

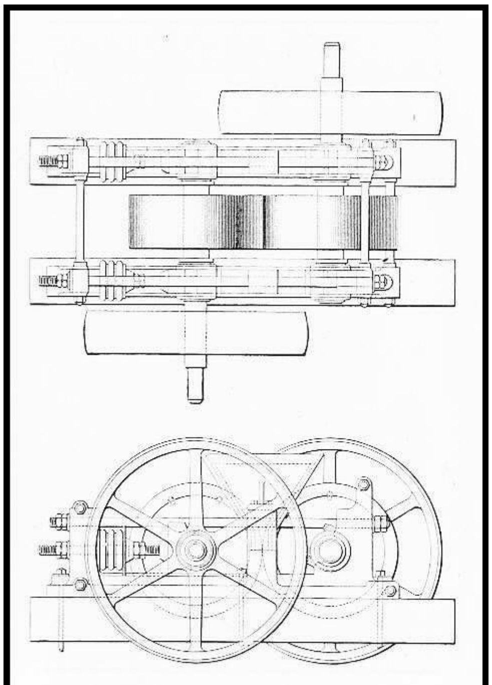


Figure E 86: The plan view, top, and profile, bottom, illustrate a device known as a crushing rolls, which was popular for secondary and tertiary crushing. Source: International Textbook Company, 1899, A43:12.

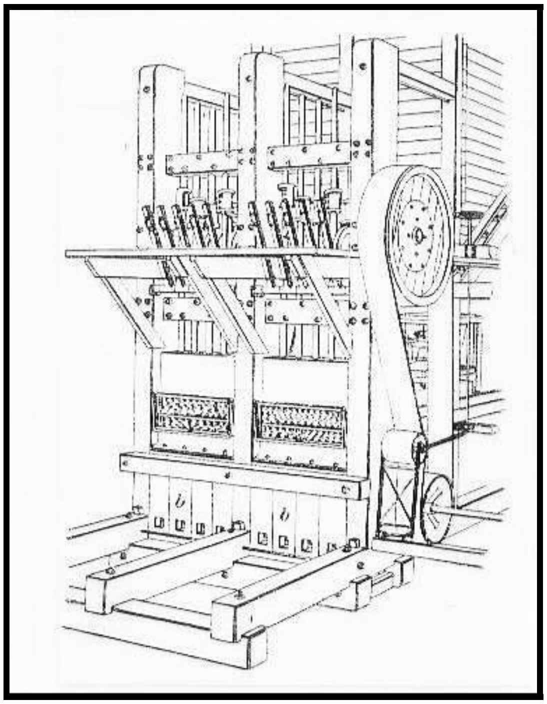


Figure E 87: The quarterview illustrates the front of a stamp battery, which provided secondary crushing at some mills. Stamp rods are visible between the timber posts, and their heavy iron shoes pounded ore in the battery boxes below. The battery boxes are bolted to pedestals of upright timbers, which are often the only remnants of stamp batteries today. Source: International Textbook Company, 1899, A43:27.

Figure E 88: When a stamp battery was dismantled, the pedestals for the cast iron battery boxes were often left in place. The pedestals consist of timbers on-end and feature anchor bolts on top, and each is around 2 feet wide, 3 feet high, and 5 feet long. Source: Eric Twitty.

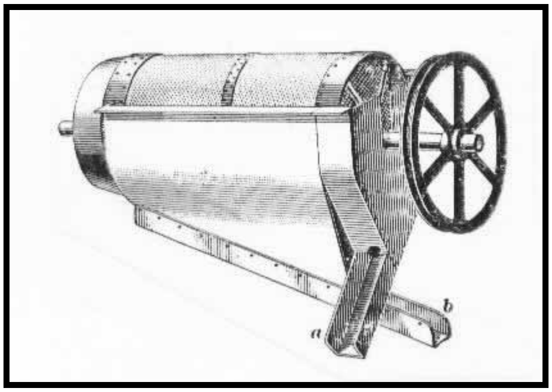
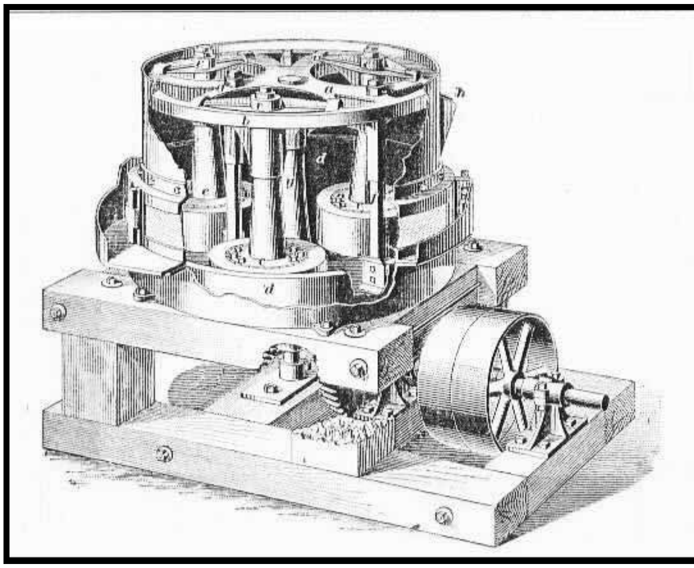


Figure E 89: Most mills relied on trommel screens to sort crushed rock between processing stages. Source: International Textbook Company, 1899, A43:12.

Figure E 90: 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 cast iron walls. Note the timber foundation. Source: International Textbook Company, 1899, Z43:47.



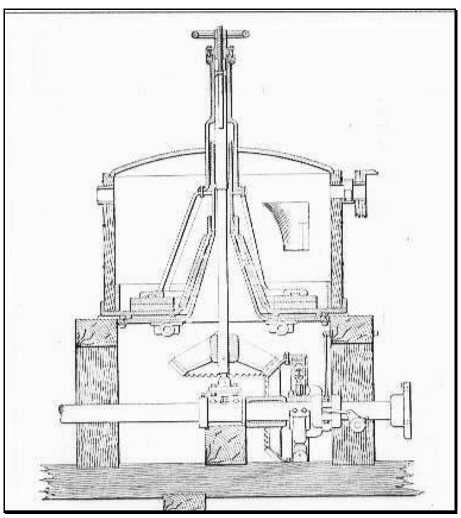


Figure E 91: The profile depicts a grinding pan, used for tertiary crushing and sometimes to amalgamate gold ore. Heavy shoes on a central axle rotated around the cast iron floor and ground ore. They were largely ineffective on complex ore. Source: International Textbook Company, 1899, A43:172.

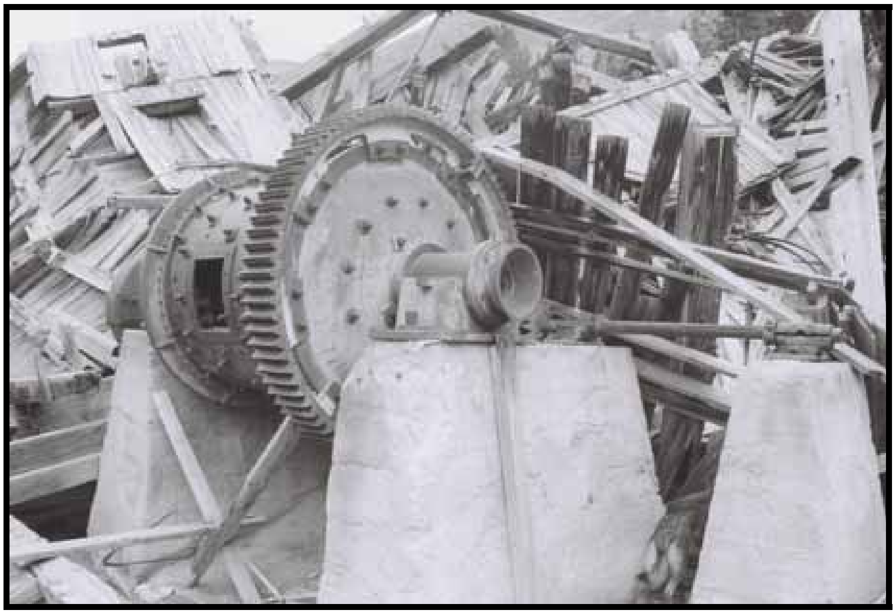


Figure E 92: Ball mills became popular for fine grinding by the 1910s. As the entire cylinder slowly rotated, tumbling steel balls in the chamber ground screened ore to a slurry. A hatch covered the opening.. Note the concrete foundation, distinct in footprint. Source: Eric Twitty.

Concentration Machinery

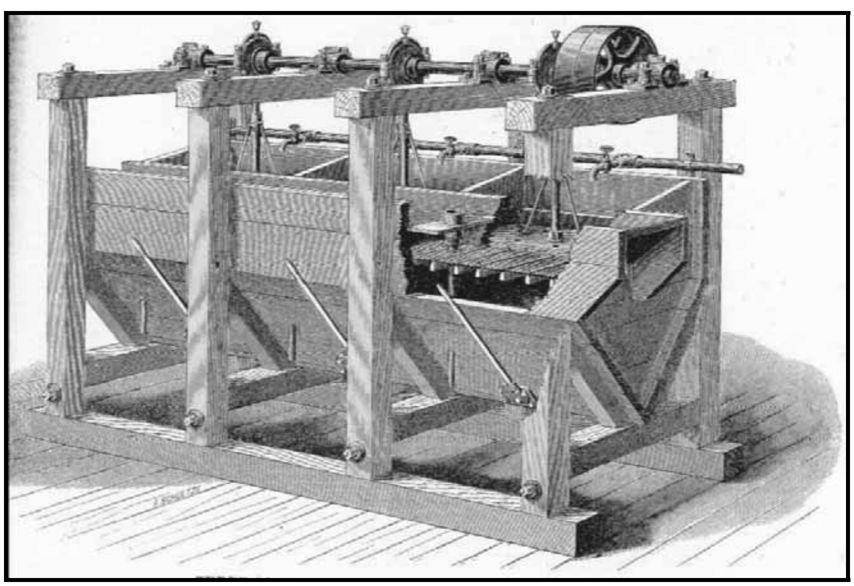


Figure E 93: The jig was an effective and popular concentration device from the 1870s through the 1900s. The crank at top moved screen plungers up and down in the slurry-filled cells. The agitating action classified ore particles by size or weight, depending on the application. Source: *Mining & Scientific Press* 8/9/90, p83.

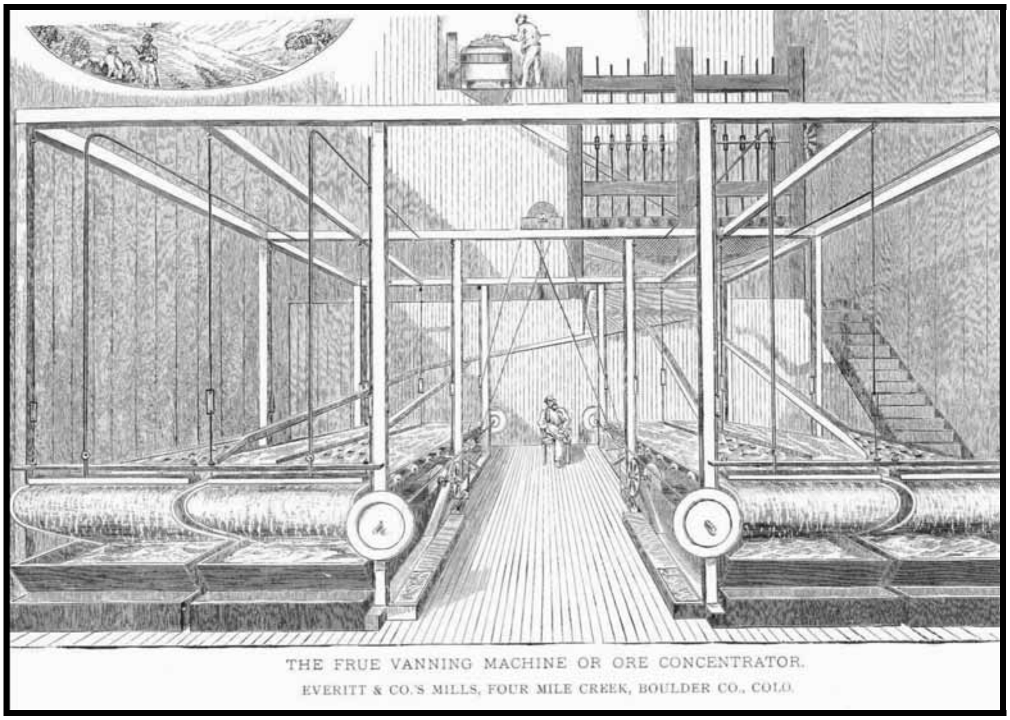


Figure E 94: Frue vanners were used with some success to concentrate complex silver ore prior to 1900, although the drawing is of the Everett Mill in Boulder County. As the vanner vibrated, finely ground ore settled against its broad rubber belt while water jets and a scraper removed light waste material. Note the stamp battery at upper right. Source: *Engineering & Mining Journal* 11/24/77, p387.

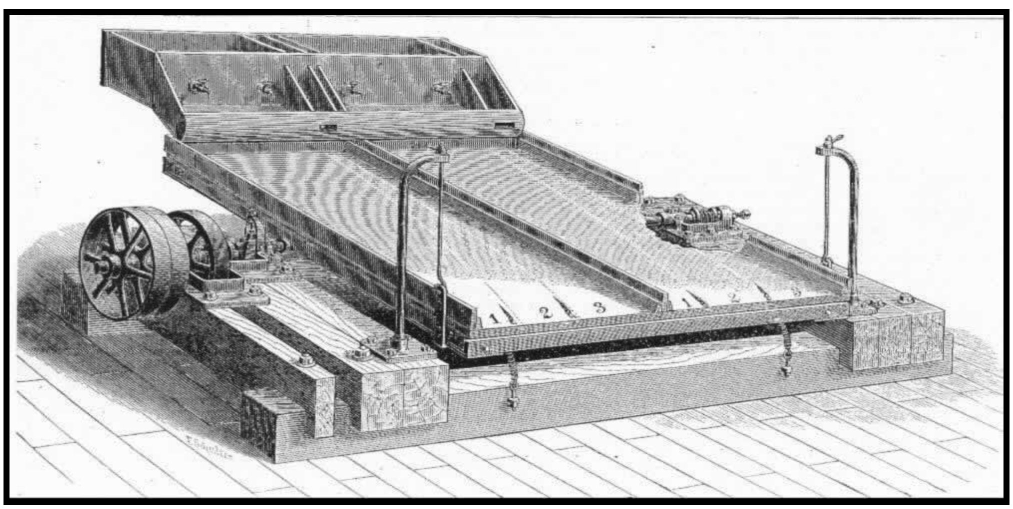


Figure E 95: Known as both a percussion table and a bumping table, this 1880s apparatus used vibratory action to concentrate finely ground silver ores. Source: *Mining & Scientific Press* 8/9/90, p83.

Figure E 96: 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. Source: Carol Beam, Boulder County Parks and Open Space.

Figure E 97: Vibrating tables like the one in Figure E 96 above were anchored to foundations of three concrete or timber footers, often 5 feet wide and 15 feet long. Source: Eric Twitty.

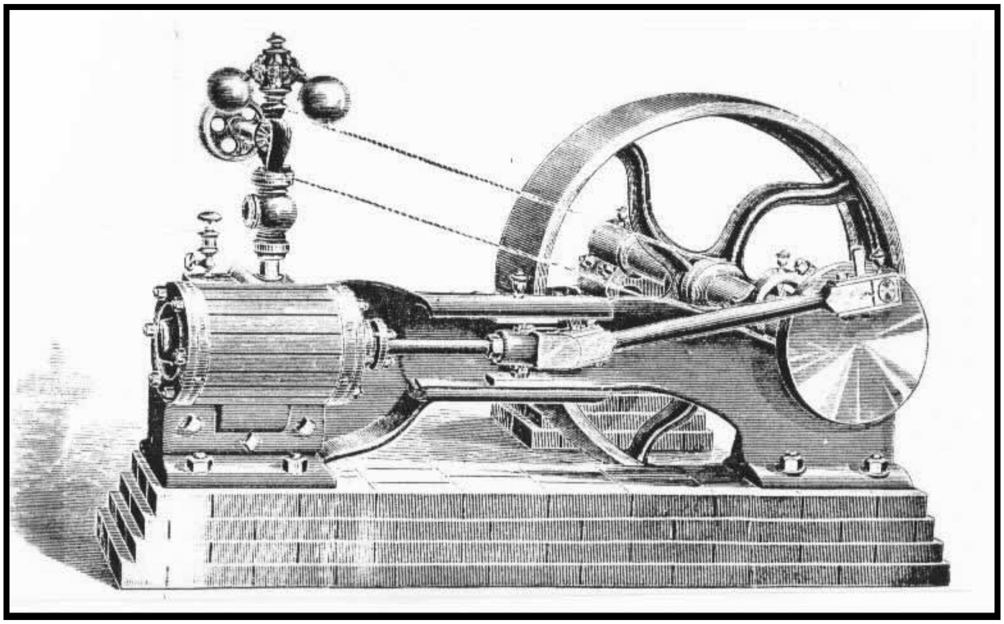


Figure E 98: Until electricity became available during the 1890s, horizontal steam engines powered nearly all concentration mills. A drive belt passed around the flywheel to a mill's system of driveshafts. Note the masonry foundation. Source: Ingersoll Rockdrill Company, 1887:53.

Figure E 99: By the 1890s, mining companies increasingly used electric motors to power their mills, provided electricity was available. This motor drove an air compressor at the Kittimac Mine. Source: Eric Twitty.

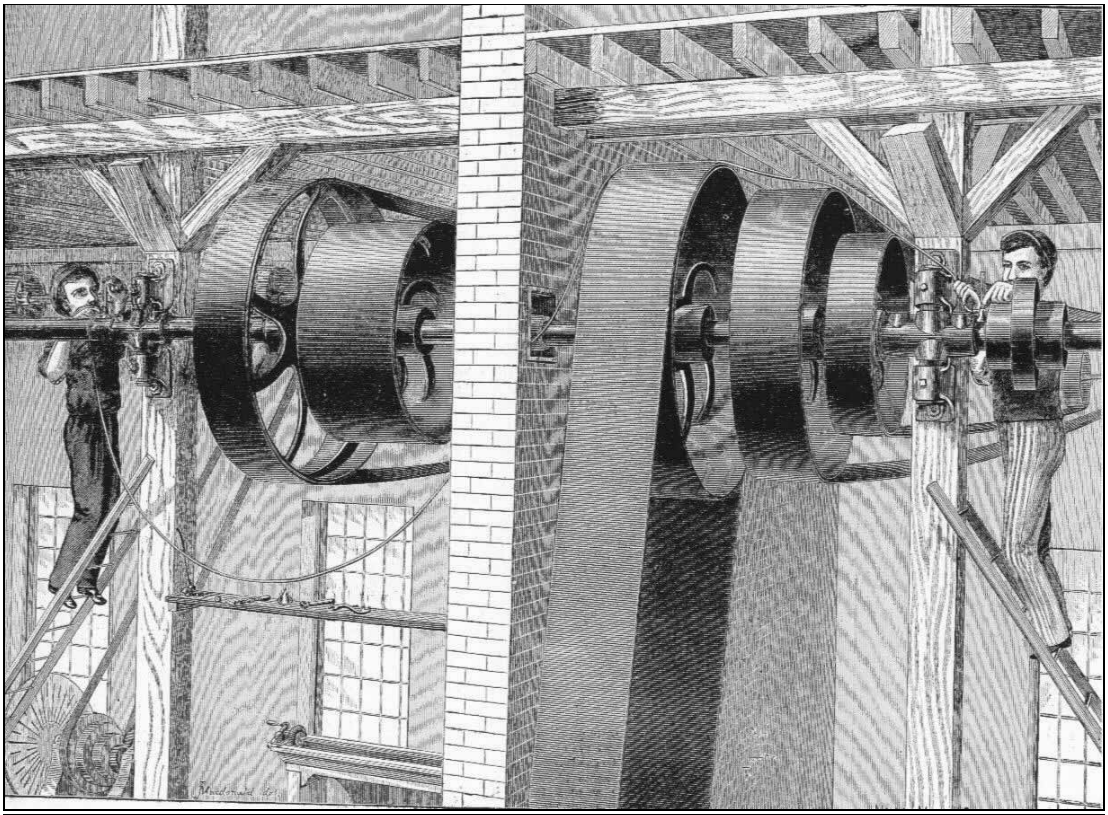


Figure E 100: A system of overhead driveshafts and belts was the most common means of transferring motion from a mill's engine to its various appliances. Source: *Mining & Scientific Press* 9/1/83, p129.

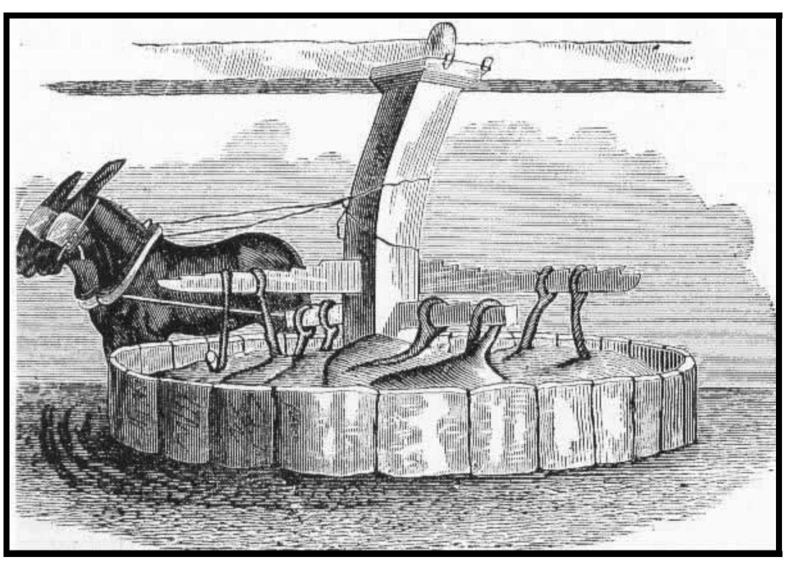


Figure E 101: The ages-old arrastra was used during the earliest years of mining in San Juan County to treat gold ore. The operator shoveled ore into the interior, added mercury, and waited for the rotating muller stones to grind the material into sand and slurry. As the ore fractured, mercury amalgamated with the gold. Because arrastras were simple and inexpensive, they were favored by prospectors. Source: *Mining & Scientific Press* 5/26/83.

Section F: Property Types and Registration Requirements

Property Type: Placer Mine

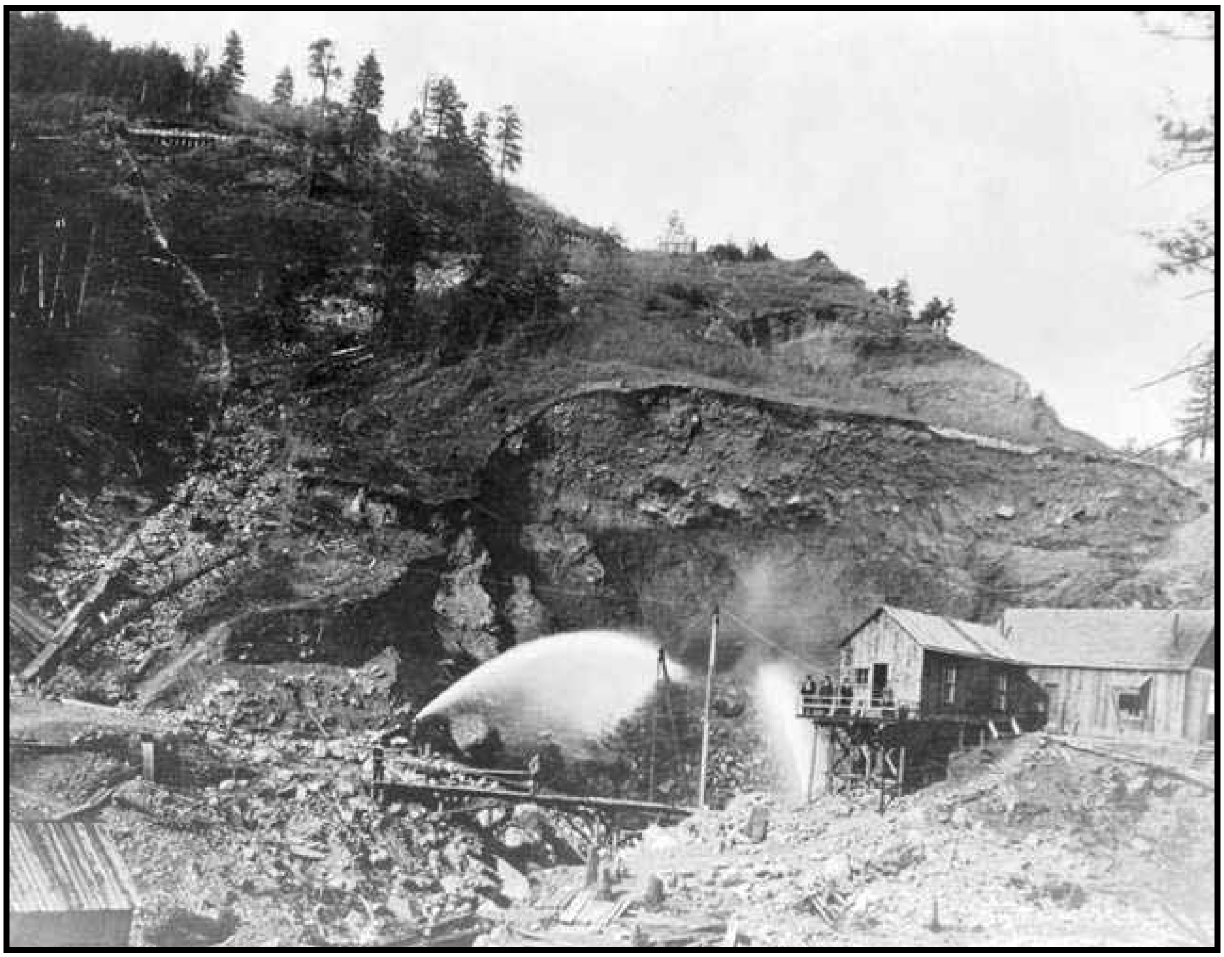


Figure F 1: The unidentified placer mine in San Juan County is a typical hydraulic operation. Miners use nozzles known as monitors to direct high-pressure water jets against gold-bearing gravel, liquefying the material. Water carried by a ditch then washed the gravel through a sluice, not visible, on the drainage floor. A flume at upper left traverses the mountainside and directs water into a penstock, the curved pipeline descending along the left edge of the photo. The penstock delivered the water, under great pressure, to the monitors. The buildings housed support facilities. The high cut-banks, infrastructure, and buildings are typical for hydraulic mining from the 1880s through the 1930s. Source: Denver Public Library, Western History Collection, X-60083.

Property Type: Hardrock Prospect

Figure F 2: By the early 1880s, the Belcher Mine recently joined the county's ore producers. In its primitive state, however, the mine resembled a deep prospect in many ways. The operation was small and simple, the underground workings were shallow, and the waste rock dump therefore small. In addition, the surface improvements were minimal, the structures few and crude, and access provided only by a packtrail. Although no buildings are evident, a blacksmith shop was probably nearby. Source: Denver Public Library, Western History Collection, C-77.

Property Type: Mine

Figure F 3: The unidentified 1930s operation in Cunningham Gulch illustrates a small, tunnel mine. The tunnel is well-developed, and the miners cached timbers and supplies on both sides of a rail line. The building at right is a blacksmith shop and probably houses an air compressor. The building, battered and clad with tarpaper, is characteristic of 1930s vernacular architecture at mines. Source: Denver Public Library, Western History Collection, X6195.

Figure F 4: The Sunnyside Mine, pictured in 1917, exemplifies the scale that some large mines attained in San Juan County. The mine, located above treeline on Lake Emma, had several tunnels, a complex surface plant, and massive boardinghouses for the crew. The surface plant included support facilities, machinery, a mill in the right background, and pump station on the lake. Although the plant evolved organically over time in response to need, it appears that the company engineer formally designed the buildings. Source: Denver Public Library, Western History Collection, X-62224.

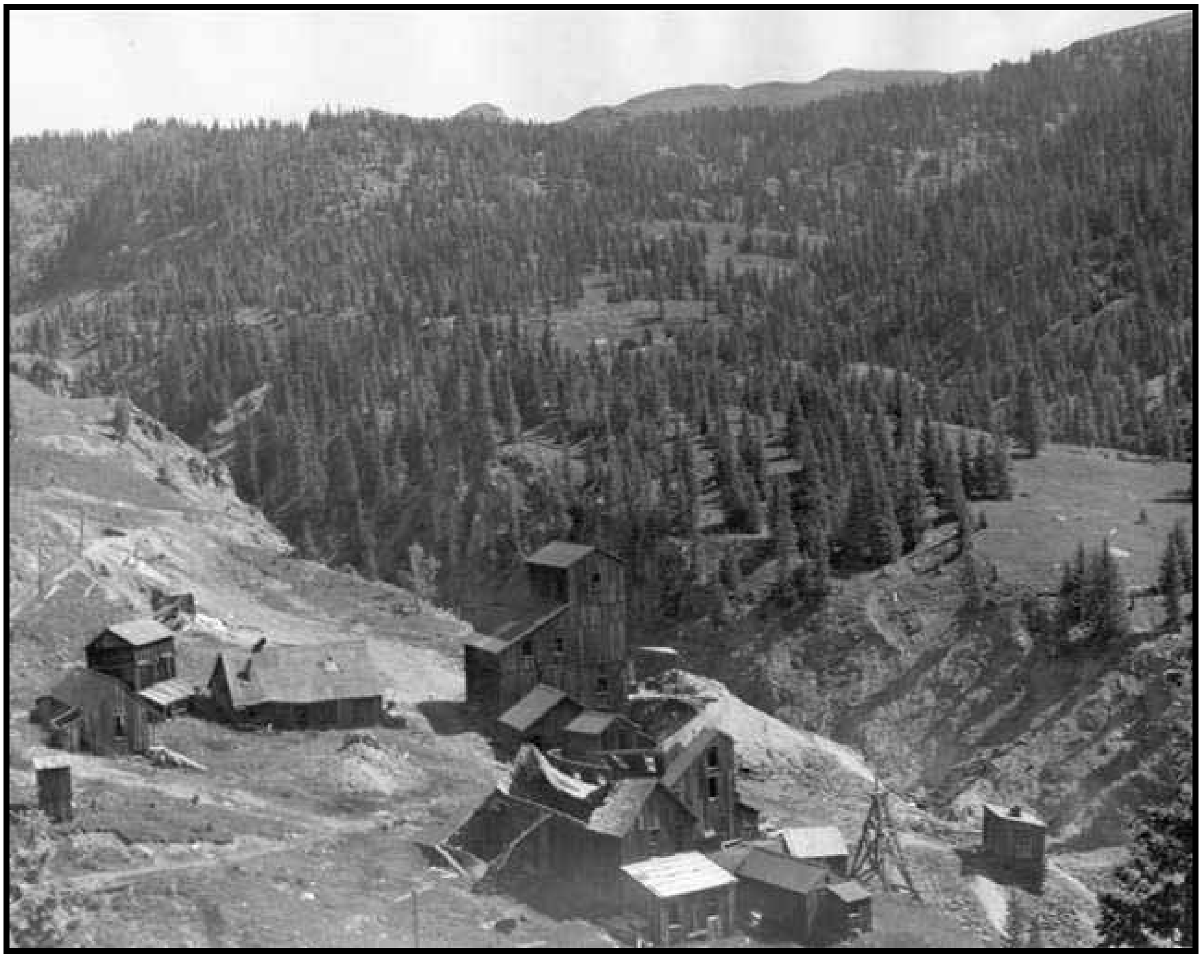


Figure F 5: Although the Silver Ledge Mine, above Chattanooga, was idle and dilapidated by 1920, it represents a well-developed shaft operation. The surface plant consists of multiple buildings added over time, and they are vernacular in design and construction. A shaft house stands at center, a shop is to its left, and the partially collapsed building may be a tram terminal. Source: Denver Public Library, Western History Collection, X-62196.

Mining Settlement and Residence

Property Type: Prospector's Camp

Figure F 6: A party of prospectors camps high on the west side of Cunningham Gulch, near the Highland Mary Mine in 1875. Archaeological features represent such sites today. Earthen platforms might represent the tents, the fire ring at right could be evident and overgrown, and a scatter of cans often extends downslope. Note the sacks of ore samples at right. Courtesy of U.S. Geological Survey, Jackson, W.H. 566.

Property Type: Workers' Housing

Figure F 7: Boardinghouses were the most common type of workers' housing in San Juan County. They ranged from the small and simple building at the Iowa Mine, top, to a large and well-built boardinghouse at the San Juan Chief, bottom. Most housing was vernacular in design and construction, influenced by available financial and material resources, perceptions of need, and skill. Mining companies adapted known building forms and methods of construction to the environment of the San Juans. Source: Eric Twitty.

Property Type: Unincorporated Settlement

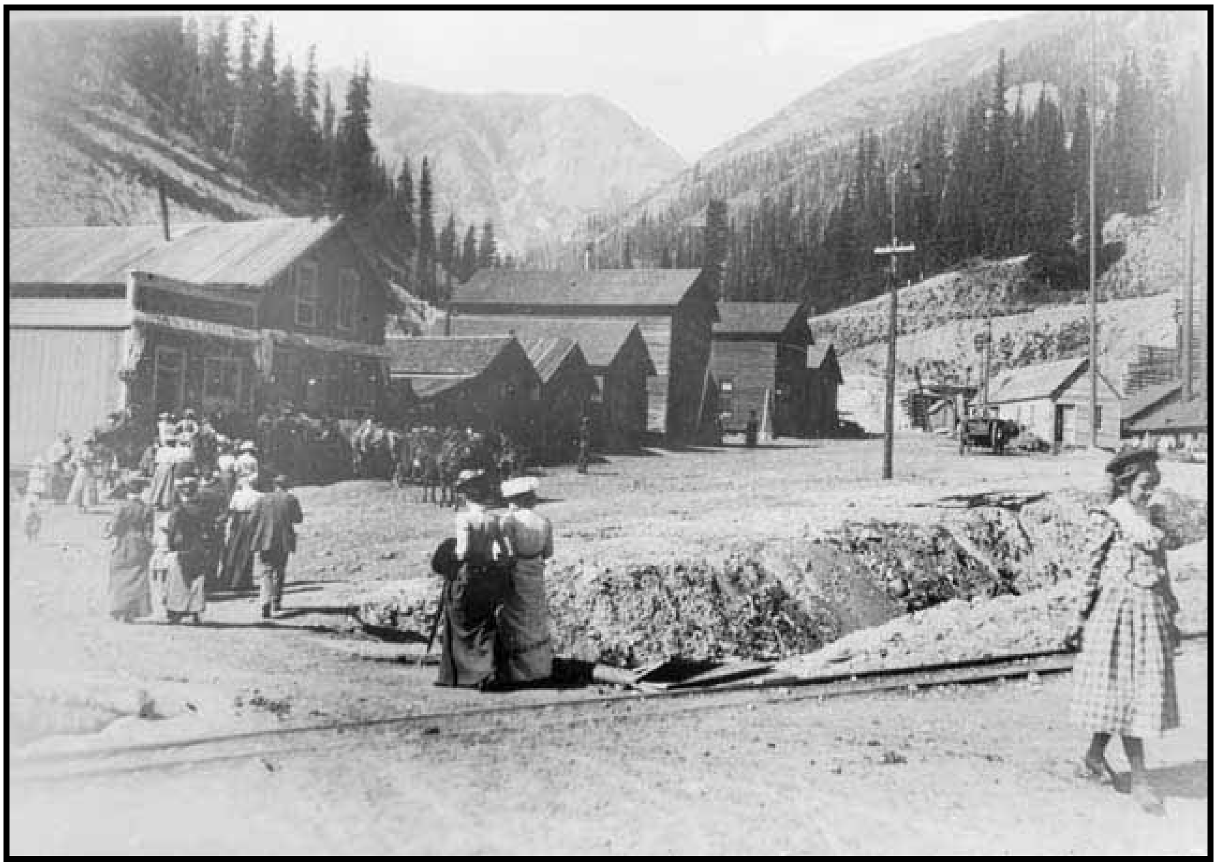


Figure F 8: Unincorporated settlements were rarely planned in advance and instead grew organically in response to a local housing need. Gladstone, pictured around 1900, was a community of employees at the nearby Gold King, Mogul, and Fisher mills. Like most unincorporated settlements, Gladstone consisted of residences scattered around a core of basic businesses, including a mercantile, saloon, and hotel, along a main road. Source: Denver Public Library, Western History Collection, X-7513.