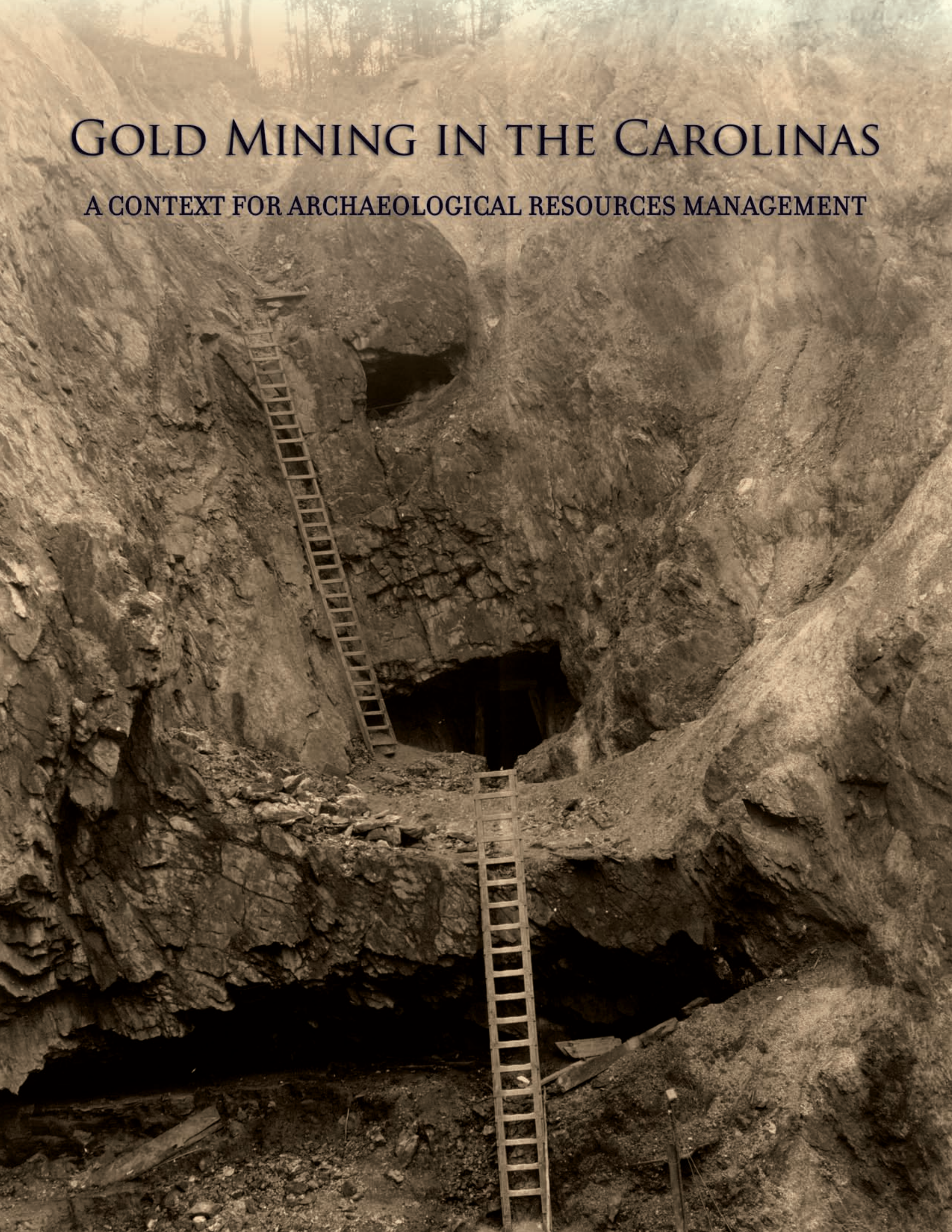
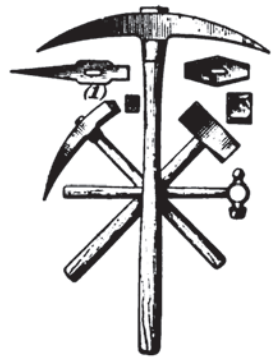
GOLD MINING IN THE CAROLINAS

A CONTEXT FOR ARCHAEOLOGICAL RESOURCES MANAGEMENT





Gold Mining in the Carolinas

A CONTEXT FOR ARCHAEOLOGICAL RESOURCES MANAGEMENT

Report submitted to:
Haile Gold Mine, Inc. • 7283 Haile Gold Mine Road • Kershaw, South Carolina 29067

NEW SOUTH ASSOCIATES
PROVIDING PERSPECTIVES ON THE PAST

Report prepared by:
New South Associates • 6150 East Ponce de Leon Avenue • Stone Mountain, Georgia 30083

Natalie Adams Pope – Principal Investigator

Brad Botwick – Archaeologist and Author

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Abstract

Gold mining was a significant early industry in North and South Carolina. The first commercial gold mines in the United States were in North Carolina, and the development of the mining industry led to important developments in the region's economy, settlement, industry, and landscape. Although a moderate number of cultural resources relating to the Carolina gold mining industry have been identified, there has been little archaeological research into it to date. Most of the research has been completed for compliance or heritage projects, and site identification and evaluation has been hindered by the lack of a comprehensive historic context.

This document comprises a first step towards providing such a context. It contains an overview of the Carolina gold mining industry that discusses its historic development and significance. Also included is a description of the procedures used for mining and handling gold ore in the Carolinas from the nineteenth to early twentieth centuries to help researchers understand the specific functions of individual cultural resources. The document also provides descriptions of property types expected at historic gold mines in the region. A literature review describes the past gold mining in the Carolinas and explores how archaeologists have approached the evaluation and study of gold mine sites in the region thus far. Finally, the document presents recommendations for survey and documentation followed by specific guidelines for evaluating the National Register of Historic Places significance of gold mining sites in the Carolinas.

This context was written as a part of mitigation of Archaeological Site 38LA383, the Stamp Mill at Haile Gold Mine. The purpose of this context is to provide guidance for archaeological studies of gold mining in the Carolinas, regardless of whether it is related to compliance with Federal laws, heritage studies, or academic research. This context can be used to aid researchers in making National Register evaluations under Section 106 of the National Historic Preservation Act but does not dictate mitigation efforts or actions, which are negotiated on a case by case basis for eligible properties. It should be noted that any mitigation efforts should be proportionate to the undertaking and provide sufficient flexibility to allow for a variety of creative mitigation options.

Since the discovery of gold on the Haile property, the mine has been opened and closed numerous times. This has compromised the integrity of historic mining features that may have otherwise contained research potential. The Stamp Mill is the only known recorded mining feature that has been determined worthy of further study. This context as well as an archaeological documentation report produced by New South Associates satisfies a Memorandum of Agreement between the South Carolina State Historic Preservation Office and Haile Gold Mine.

Table of Contents

List of Figures

List of Tables

I. INTRODUCTION

Gold mining was a significant activity in North and South Carolina. Gold was discovered in 1799 in North Carolina and for a time before the Civil War, mining was the second most important economic activity in the State. The gold industry in South Carolina developed later, but the State saw significant developments in the technology and science of gold ore processing. Despite its importance in these states, there has been little scholarly attention given to gold mining. This document presents a first effort at developing a historical context for the management and study of gold mine sites in the Carolinas.

A native metal, gold is widely distributed in the Earth's crust. It is concentrated in economically viable quantities only in some locations. In the Carolinas, it occurs in meta-volcanic and meta-sedimentary contexts associated of the Piedmont and, more specifically, in a series of linear regions that generally run in a northeast to southwest axis from Virginia to Georgia. Where it occurs in high enough concentrations, gold can be found as free particles eroded from the host rock and deposited in stream valleys (placers), embedded as veins in host rock--typically quartz in Carolinas (lodes), or as disseminated mineralized deposits (sulfides). All three types of deposits supported profitable gold operations in the Carolinas at different times.

The earliest commercial gold mines in the United States were in North Carolina and, for a period before the California Gold Rush, the Carolinas and Georgia produced nearly all the gold circulating in the country, remaining an important economic activity until the Civil War. Although gold production never regained its earlier importance, efforts to restart the gold industry in the Carolinas gave rise to a period of experimentation with new methods and technologies of extracting gold from lower quality ores. Over the nineteenth and early twentieth centuries, gold mining in the Carolinas contributed to new economic activities and organizations, technologies, land use and settlement practices, labor arrangements, and business practices.

In addition to presenting an overview of gold mining in the Carolinas, this document describes the processes, technology, and equipment involved in regional gold mining, insofar as they are known. As noted, several different mining processes were used in the region, mainly to target different types of deposits. For naturally occurring free gold (gold fragments eroded into stream deposits), miners could use relatively simple collection methods (gravity). For gold remaining embedded in host rock, other techniques were required not only to extract the gold-bearing rock but also to free and separate the gold from it (crushing and processing). As these kinds of sources became exhausted, miners increasingly sought other or new ways to extract gold from mineralized deposits. These recalcitrant ores required treatment with chemical baths, roasting, and /or mechanical separation, all of which required more elaborate structures and equipment than had been seen previously in Carolina gold fields.

Mines in general are unique archaeological resources because individual features and cultural deposits belonging to a single site can be widely dispersed across a landscape with areas containing empty space or features with different functions or chronologies between them. Many of the standard approaches to locating and recording archaeological sites are problematic in dealing with historic gold mines. More productive strategies involve greater archival research in preparation for fieldwork, greater use of pedestrian survey and visual inspection, and expansion of survey areas to account for the broad and sometimes disconnected character of gold mine sites. Similarly, in evaluating gold mine sites, archaeologists must be aware of their potential large size and the various separate activity areas that together comprised individual mining operations.

Finally, evaluation of gold mining sites, like any archaeological or historic property, requires consideration of the site's historic significance. The four National Register of Historic Places (NRHP) Criterion of Significance and seven aspects of integrity provide frameworks for determining if a site is significant. Archaeological sites are most often judged on the basis of their research potential but historic gold mines may contain large and visible structures and surface features that evoke their associations to the historically important events, people, and technologies of mining. In evaluating gold mine sites, it is important to consider their possible historical associations as well as their information value. To assess the research value of a gold mine site, it is useful to compare the site's datasets against pre-determined research issues or questions. This context proposes a series of topics and specific questions to guide archaeologists in determining whether or not a site has the ability to expand our understanding of Carolina gold mining.

This document represents part of the mitigation effort for Site 38LA383, representing the remains of the late nineteenth- to early twentieth-century Haile Gold Mine stamp mill in Lancaster County, South Carolina. The South Carolina Division of Archives and History agreed to a "creative mitigation" that involved documentation of the history of the site (History and Archaeology of the Haile Gold Mine Stamp Mill [Site 38LA383]) along with the preparation of a historic context report for other gold mine sites in the region. Archival research pertaining to 38LA383 provided a detailed historic context that indicated both the function of the stamp mill in the operation of the mine, and the overall historic significance of Haile Gold Mine. Among the most important gold producers in the southeast, Haile was also the site of important innovations in the chlorination process for extracting gold from sulfide ores. Archaeological fieldwork at the stamp mill, the only extant portion of the overall gold mine operation, included mapping and limited excavation, which documented the site's arrangement with respect to the physical landscape and provided details about its spatial organization, the flow of ore through the plant, and construction details (Botwick and Swanson 2011).

The purpose of this context is to provide guidance for archaeological studies of gold mining in the Carolinas, regardless of whether it is related to compliance with Federal laws, heritage studies, or academic research. This context can be used to aid researchers in making National Register evaluations under Section 106 of the National Historic Preservation Act but does not dictate mitigation efforts or actions, which are negotiated on a case by case basis for eligible properties. It should be noted that any mitigation efforts should be proportionate to the undertaking and provide sufficient flexibility to allow for a variety of creative mitigation options.

This context report was developed by New South Associates, Inc. The recent re-emergence of gold industry in the Carolinas provided an opportunity to consider the history and archaeology of this important mineral industry.

II. Physical Environment of Gold in the Carolinas

The geology and environmental context of gold significantly affect where it is found and how it is obtained. This chapter provides an overview of the physical contexts of gold in the Carolinas to understand the historical development of the regional gold mining industry.

DESCRIPTION AND PROPERTIES OF GOLD

Gold is a native metal (a metal found in its metallic form, either pure or as an alloy, in nature) and is distinguished by its weight, malleability, and color. It is usually yellow but impurities can change it to silver-white or orange-red. Pure gold has a relatively heavy specific gravity of 19.3, which was a means for separating it from host rock or overburden. Its resistance to all acids except aqua regia (a mix of hydrochloric and nitric acids) was another basis for extracting it. Gold is grouped with siderophile elements (those having a geochemical affinity for metallic iron), a property that causes it to collect in residual fluids and later metallic or sulfide phases rather than in earlier silicate phases of cooling magmas. In nature, gold forms alloys with other metals and almost all gold contains some silver and frequently copper and iron as well (Carpenter 1999:7).

Purity is a common way of describing gold. Purity, or fineness, refers to the weight proportion of gold in an alloy or in impure gold and is expressed in parts per thousand. Gold usually contains about 10 percent other metals, giving it a fineness of 900. “Karat” also describes purity expressed in 24ths rather than parts per 1,000. Thus, 24-karat gold is 1,000 fine or pure and 10-karat gold refers to an alloy of gold and one or more other metals that is 10/24 or 41.7 percent gold by weight. Fineness refers only to the gold content of an alloy and not its non-gold constituents (Carpenter 1999:7; Butterman and Amey 2005:1-2).

Gold has numerous uses because of various special properties. It conducts electricity, does not tarnish, works easily, can be drawn into wire or hammered into thin sheets, alloys with many other metals, can be melted and cast into detailed shapes, and has an attractive color and luster. Gold has highly symbolic values in many cultures, and it remains a standard for assessing beauty, wealth, purity, accomplishment, and power (Geology.com 2005). Historically and at present, its most common use is for jewelry (Carpenter 1999:7; Geology.com 2005). At least 85 percent of the newly consumed or reused gold in circulation goes into jewelry. About 10 percent of worldwide use is for coinage. It also has numerous other industrial, medical, and decorative uses, and about 12 percent of annual consumption goes toward electronics, medicine, dentistry, computers, awards, pigments, guilding, and optics (Butterman and Amey 2005:1; Geology.com 2005).

PHYSIOGRAPHIC CONTEXT OF GOLD IN THE CAROLINAS

North and South Carolina encompass portions of four physiographic regions: the Coastal Plain, the Fall Zone/Sandhills, the Piedmont, and the Blue Ridge (Figure 1). Gold is found mainly in the Piedmont with minor amounts in the Blue Ridge (Feiss et al. 1991:325). In South Carolina, gold is also found in the Sandhills region where it overlaps older Piedmont rocks has been eroded from the older Piedmont rocks.

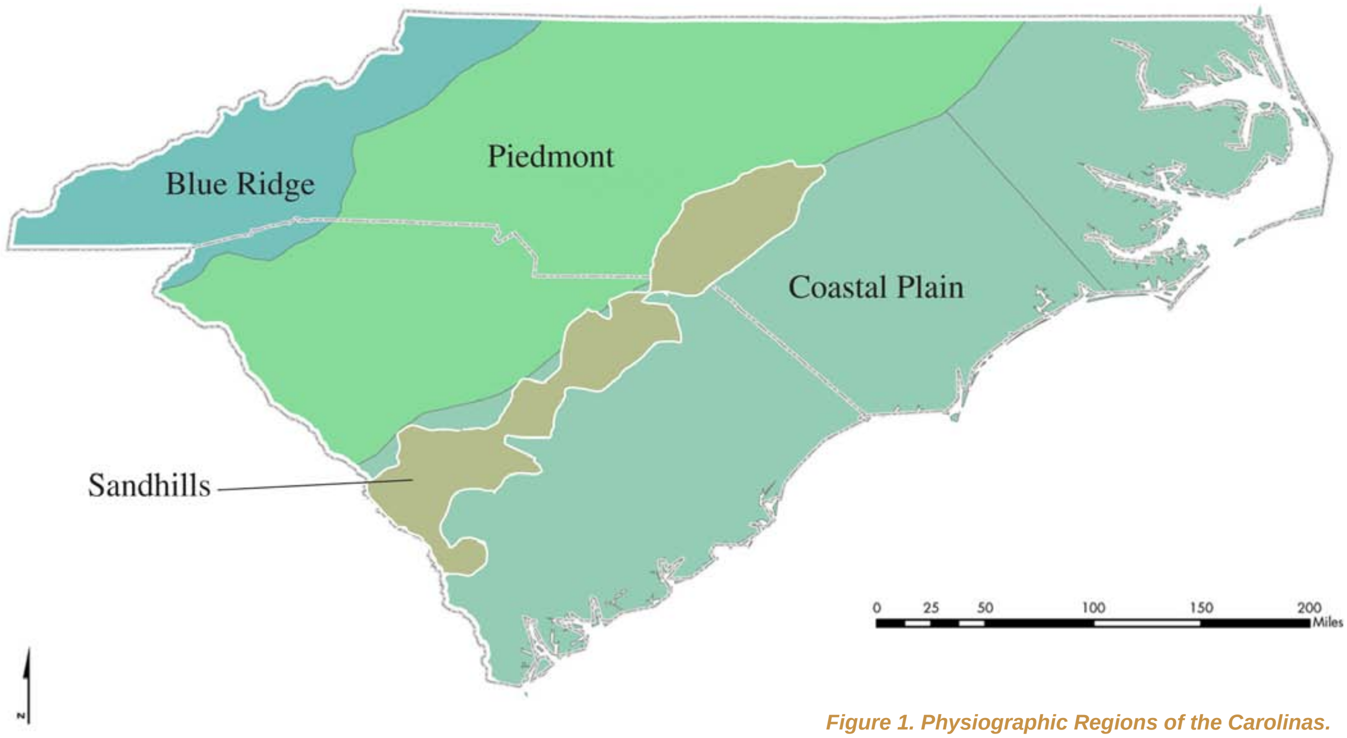


Figure 1. Physiographic Regions of the Carolinas.

The Blue Ridge is part of the Appalachian Mountain system. It is a region of steep ridges, inter-mountain basins and valleys that intersect at varying angles, giving it a rugged character. Elevations reach heights over 1,500 meters (5,000 ft.) above sea level (asl). Rocks forming the Blue Ridge are mostly crystalline schists and gneisses that resist erosion and contribute to the region's rugged terrain (Kovacik and Winberry 1989:14-16; North Carolina Geological Survey [NCGS] 2004). Valleys are typically steep-sided, narrow, and separated by thin ridge crests. Streams are short and fast flowing with many rapids and waterfalls (Kovacik and Winberry 1989:17).

East of the Blue Ridge, the Piedmont comprises a dissected plain characterized by gently rolling areas interrupted by steep valleys along larger streams. In the western part of the region, the terrain becomes quite rugged. Height differences between the hills and valleys range up to several hundred feet and overall elevations in the Piedmont are about 100-200 meters (300-600 ft.) asl (Murphy 1995; NCGS 2004). Rivers are long, have many tributaries, and wide floodplains. Broad uplands, whose elevations vary little in local areas, separate the valleys (Kovacik and Winberry 1989:17).

The Piedmont and Blue Ridge have a complex geologic history. Rock types within the Piedmont are primarily metamorphic schists, gneisses, and slates, with some intrusions of igneous granite. Six hundred million years ago during the late Precambrian, the region now comprising the Piedmont perigondwana terrain consisted of an island or continental fragment off the gondwana coast. About 470 million years ago, this landmass collided with the mainland, setting off the formation of the Blue Ridge Mountains. At the same time, intrusive activity injected magma into cracks, joints, and cavities in the existing strata where it eventually cooled to form granitic plutons. The Piedmont and Blue Ridge thus have different geologic histories but topography, relief, and elevation distinguish them as separate physiographic regions (Kovacik and Winberry 1989:16-17). As discussed below, the volcanic activity and metamorphism were important in the formation of workable gold deposits.

The Sandhills is a unique region in the Carolinas that overlaps the Fall Line and marks a rough boundary between the Coastal Plain and Piedmont. Kovacik and Winberry (1989) treated the area as a distinct province of South Carolina. Diemer and Bobyarchick (2005) described it as a sub-district of the Fall Line in North Carolina, where it only extends northeast as far as Harnett and Lee counties. Rounded hills with gentle slopes characterize the region. Relief is generally moderate but becomes rugged in places, with ridge and hillcrests reaching 15-76 meters (50-250 ft.) above adjacent valley bottoms. Maximum elevations are 220 meters (725 ft.) asl. The Sandhills originated as an ancient shoreline during a higher stand of the Atlantic Ocean. When the sea retreated 40 million years ago, it left the remnant dunes and beaches inland (Kovacik and Winberry 1989:18; Diemer and Bobyarchick 2005). Gold finds in the Sandhills are associated with the Carolina Slate Belt, which is geologically related to the Piedmont but overlapped by Coastal Plain sediments on its eastern side (McCauley and Butler 1966:16).

GEOLOGY OF GOLD IN THE CAROLINAS

Gold occurs widely but sparsely through the earth's crust and waters and only a small portion of it was concentrated enough to be economically recoverable (Butterman and Amey 2005:12, 14). Gold so aggregated exists in two principal forms: placers and lodes, with lodes being subdivided into veins and disseminated deposits or mineralized zones (Carpenter 1999:16). Lodes are primary deposits containing the gold as it first concentrated while placers are secondary deposits containing gold eroded from lodes. Lode deposits occur in diverse shapes and sizes including tabular cross-cutting vein deposits, breccia zones, irregular replacement bodies, pipes, stockworks, and other shapes. In disseminated deposits, gold commonly associates with the sulfide minerals of arsenic, copper, iron, silver, and other metals but is occluded in them and does not enter the crystal lattices except in the sulfotelluride nagyagite and possibly the argentiferous calaverite sylvanite gold sulfide uytenbogaardtite. Gold is intimately associated with quartz and chalcedony in many different kinds of ores (Butterman and Amey 2005:13-14).

In the Carolina Piedmont, gold-bearing mineral deposits are mostly stratabound in metavolcanic-metasedimentary sequences or associated with intrusive bodies. Volcanic-hosted massive sulfide deposits are an important source of base metals, silver, and gold. In general, these occur in the Carolina slate belt, while a few sulfide-facies iron formations and massive pyrite bodies are known from the Kings Mountain belt. The most important gold-bearing sulfide deposits of the Piedmont were those of the Cid District in Davidson County, North Carolina, the Gold Hill District in Rowan, Stanly, and Cabarrus counties, North Carolina, and the Lincolnton-McCormick District, McCormick County, South Carolina. Host rocks for these massive sulfides include metamorphosed felsic pyroclastic rocks including the Uwharrie Formation and Albemarle Group in North Carolina and the Persimmon Fork Formation, Richtex Formation and Lincolnton metadacite in South Carolina. Gold was also situated in stratabound stratiform massive sulfide deposits and volcanic-hosted and carbonate-hosted deposits in the Piedmont. The greatest part of this mineralization is the Carolina Slate Belt metavolcanic rocks, with minor amounts from the Kings Mountain Belt (Feiss et al. 1991:328-329).

The Carolina Slate Belt, which accounted for most gold production in the Carolinas contains thick sequences of undifferentiated felsic and mafic metavolcanic rocks labeled the Uhwarrie Formation in North Carolina, the Persimmon Fork Formation in central South Carolina, and felesic pyroclastic sequence in the Little River

Series along the South Carolina-Georgia border. Rocks include crystal, lithic, and vitric tuffs and breccias as well as flows. Above these volcanic formations lie metasedimentary sequences of subaqueous epiclastic argillites, metamudstones, and metagraywackes known as the Albemarle Group in North Carolina, the Richtex Formation in central South Carolina, and the upper sedimentary sequence of the Little River Series in southwest South Carolina to northeast Georgia (Feiss et al. 1991:332). Stratabound gold mineralization was common at the transition site from the metavolcanic to the metasedimentary sequence, and most Carolina Slate Belt gold mines and prospects lie along or within a mile of these contacts (Feiss et al. 1991:332; Murphy 1995:83; Carpenter 1999:18). Gold typically occurs as submicroscopic particles disseminated in unaltered metavolcanic and metasedimentary rocks. Where present, gold is always associated with pyrite, but there are extensive areas of barren pyritic rocks. In quartz, gold occurs as individual grains and ribbons. In pyrite, it occurs as inclusions, and in quartz and pyrite, it occurs on grain boundaries and fractures (Feiss et al. 1991:332).

In the Blue Ridge, gold was mostly mined from placers and a few quartz veins. Lode deposits of the region are associated with metamorphic quartz veins in mica schists and amphibolites of the Ashe Formation equivalents. These were not major prospects and lode deposits in the region do not appear to have produced significant quantities (Feiss et al. 1991:325).

Gold-bearing quartz veins and disseminated lode deposits formed through ancient volcanic activity and the effects of hot circulating water. Disseminated deposits formed at the same time as the associated rocks and commonly occur with iron and copper sulfides (pyritic materials). Gold-bearing quartz veins formed later when mountain building caused the original rocks to heat, deform, and fracture (Knapp and Glass 1999:6). As magma cooled and created granite plutons, elements within it bonded and crystallized in an orderly way determined by each mineral's crystallization temperature, the presence of other minerals, and the temperature of the cooling magma. Quartz and rare metals such as gold, silver, copper, and platinum crystallized last and, as hot liquid solution, filled cracks in the granite and spread into the nearby surrounding rock. When the gold finally solidified, it formed concentrated pockets or flakes within and near the quartz veins (Murphy 1995:81-82).

Six geological belts produced gold in North Carolina (Figure 2). The Eastern Slate Belt had chief production areas in Warren, Halifax, Nash, and Franklin counties. The Carolina Slate Belt, extending southwest from Person County through South Carolina and into Georgia, contained important mines in Moore, Randolph, Montgomery, Stanly, Rowan, and Cabarrus counties. The Charlotte Belt, which supported some of the largest and most productive mines in North Carolina, was met in Guilford, Davidson, Rowan, Cabarrus, and Mecklenburg counties. The Kings Mountain Belt, containing scattered mines in Cleveland, Gaston, Lincoln, and Catawba counties, extended into South Carolina. The Piedmont Belt contained the South Mountain gold region between Rutherfordtown and Morgantown in Burke, McDowell, and Rutherford counties. The Blue Ridge Belt lay west of the Piedmont (or in the Blue Ridge). Most of the counties here produce gold but Ashe, Cherokee, and Henderson counties were the most important (State Board of Agriculture 1896; Knapp and Glass 1999:7).

In South Carolina, gold deposits are most often associated with two major belts of low-ranking green schist to amphibolite grade metamorphic rocks that trend northeasterly across the central portion of the State. To the southeast is the Carolina Slate Belt, which as noted extends from North Carolina to Georgia. South

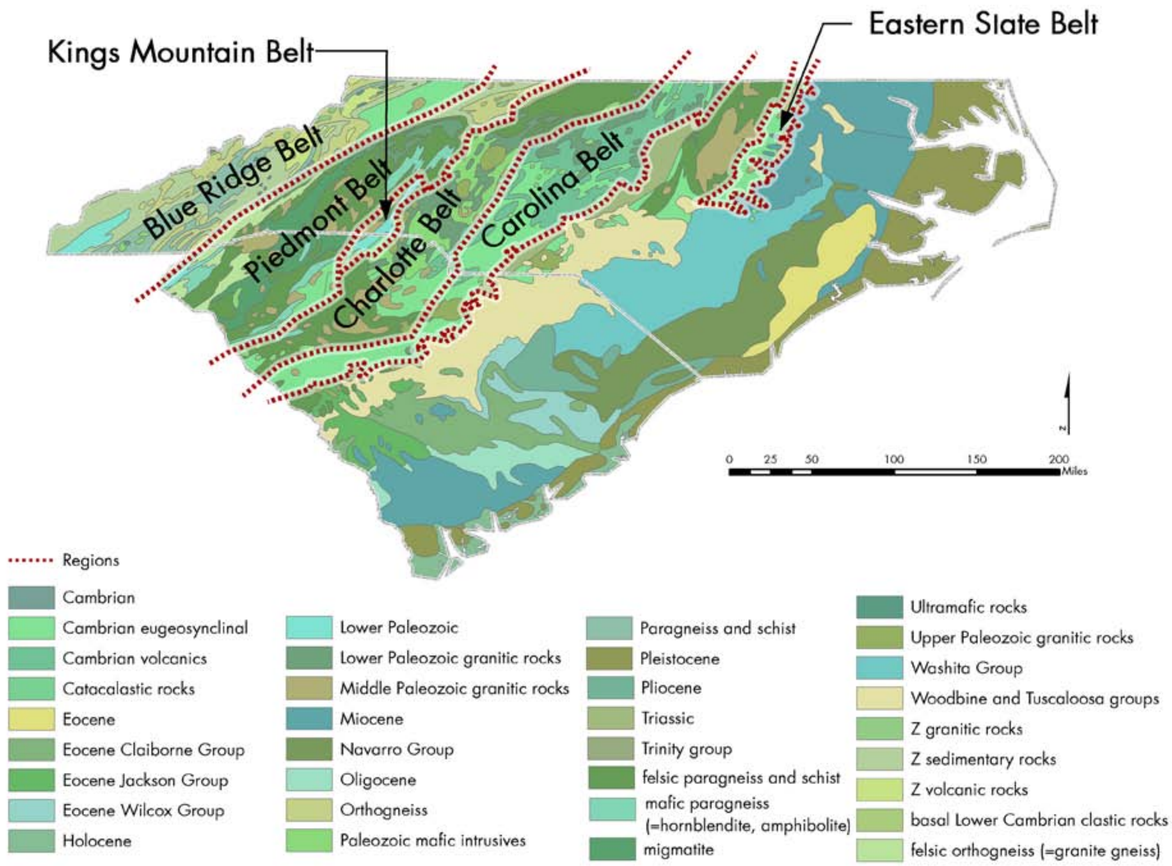


Figure 2. Gold Producing Regions of the Carolinas.

Carolina counties that were important gold producers in the Slate Belt included Lancaster, Chesterfield, McCormick, and Fairfield. The second belt is the Kings Mountain belt, which extends south from North Carolina and includes lodes in Abbeville, York, and Cherokee counties (McCauley and Butler 1966:16).

GOLD DEPOSITS

In the Carolinas, economically important gold sources were in lode and placer deposits. Lode deposits occur as disseminated deposits and veins. Veins are generally less than 1.3 meter (4 ft.) wide but can be larger. Their lengths may vary from only a few to hundreds of meters and they may be isolated or in groups. Most dip steeply and trend to the northeast. Veins consist mainly of quartz. Gold is found in the upper oxidized zones of veins where it has been freed by weathering within the quartz vein or at the margins of the veins. Below the weathered zones gold occurs in small fractures, around grain boundaries, or as irregular masses (Carpenter 1999:16). Mining gold from vein deposits involved crushing the host rock to free the gold particles and then collecting these through various methods (discussed in Chapter IV).

As disseminated deposits, gold is associated with volcanic country rock that was altered and mineralized, chiefly to quartz, sericite, and chlorite. Mineralized zones may be greater than 30 meters (100 ft.) wide and have indefinite boundaries that grade into the country rock. Ore quality varies throughout and gold typically occurs in only a small portion of the zone. Gold in disseminated deposits is so finely distributed that it is difficult to detect without magnification or other means. Gold is often hosted within the sulfide minerals, particularly pyrite (Carpenter 1999:16-18). Typically, the mineralized zones contain low-grade gold ores that must be extracted through complex mechanical and chemical procedures to make their recovery worthwhile.

Placers are secondary deposits containing gold derived from weathered and eroded lodes that have been transported and concentrated by gravitational forces, water, and wind (Butterman and Amey 2005:14). They are found mainly on present stream valleys flowing through the areas where lode deposits occur but can also be found in relict streambeds floating in valley or ridge slopes. Some placers are also in colluvial material that moves downslope but has not been influenced by stream action. In the Piedmont, placers can also lie in residual saprolite overlying weathered lode deposits (McCauley and Butler 1966:14; Murphy 1995:82; Carpenter 1999:19).

Alluvial deposits containing gold are usually three to six feet thick but vary in width and thickness depending on the material available for transport, the size and velocity of the stream, and the terrain the stream crosses. These deposits overlie weathered but undisturbed country rock. The coarsest fragments of alluvium, usually quartz, settle immediately above the country rock and deposits grade up to finer material. Gold typically occurs with the coarse layer (McCauley and Butler 1966:14; Carpenter 1999:19). In placer deposits, gold is loose or free and can be collected through relatively simple methods such as hand picking. Most often, placers were worked with simple mechanical methods such as panning, rockers, and sluices that are discussed in detail in Chapter IV.

III. Historic Context: Gold Mining in the Carolinas

Historians of mining, as well as historians of North and South Carolina, have generally overlooked the importance of gold mining in the region (Knapp 1975:1). Until recently, gold mining was, if anything, considered too insignificant an economic activity in the Carolinas to warrant serious investigation. Writing around the time gold mining ended (for a period) in the region, for example, MacClaren (1908:488) asserted that gold mining in the United States "may be said to have commenced only with the fourth decade of the nineteenth century." In other words, despite the fact that gold was being mined in the Carolinas in the early 1800s, with substantial activity by the 1820s, the 1849 discovery of gold in California truly inaugurated the industry in the country. He acknowledged that the "Appalachian states supplied much of the gold required for coinage between 1830 to 1850," but characterized the total output of the southeast as insignificant compared to what came afterward from the western states.

While the southeast never produced the quantities of gold as the west, the region produced considerable gold supplies in the nineteenth century, with North Carolina being particularly significant in establishing the region's industry and its character. In terms of importance to the State's economy, gold mining during the nineteenth century was second to agriculture and had significant impacts on the settlement and growth of the central part of the State. Moreover, experience and skills learned and equipment used in Carolina gold mines were important in developing the western gold fields. Also, later in the nineteenth century important gold-handling innovations were made in the Carolinas that made it possible to extract gold from refractory ores. Finally, some of the models for industrial operations and organizations later put into use in North Carolina's furniture, textile, and tobacco industries were first developed in gold-producing operations (Kickler 2011).

Histories of gold mining in the Carolinas include studies by Green (1937), Knapp (1975; Knapp and Glass 1999), and Glass (1985) for North Carolina. The following overview relies heavily on these sources. For South Carolina, McCauley and Butler (1966) and Murphy (1995) provided historical information although these authors were primarily concerned with geology rather than history.

Overall, the history of gold mining in the Carolinas was marked by initial discoveries around the turn of the nineteenth century followed by gradual development of the industry as miners worked part-time around the agricultural cycle. In the 1820s, gold mining grew into a more professional occupation as production increased and new ore sources were discovered. This period lasted into the 1840s and 1850s, after which production declined. Gold mining revived in the last quarter of the nineteenth century and persisted to about World War I. Characteristics of this period included experimental technologies, new forms of investment and speculation, and a few very large operations. Mining started again in the 1930s and lasted until World War II, but this period saw relatively little production.

DISCOVERY AND EARLY DEVELOPMENT

The first authenticated discovery of gold in the United States took place on John Reed's Cabarrus County, North Carolina farm in 1799 (Green 1937; Knapp 1975:1). This discovery set off the development of gold mining in the State. According to the story, Reed did not realize that the 17-pound gold rock his son found in Little Meadow Creek was valuable and sold it for $3.50 after a few years of using it as a doorstop. Later, upon learning the value of the discovery, Reed set to work actively searching the creek for more. In 1803, after ascertaining the strike was worthwhile, Reed took on three partners, all relatives, to expand the operation. Under this arrangement, once the crops were in and the water level of the creek had lowered in the late summer, the partners supplied equipment and slaves to dig for gold (Knapp 1975:3-4).

Figure 3. Early Mining in the Carolinas Relied on Basic Tools and was Conducted on a Small Scale (Goodrich 1831).

The discovery of gold at Reeds Mine did not trigger a frenzied rush, but it set in motion a process of steady growth and improvement. New mining initially focused on the creeks surrounding Reed's property. Most mines were not very lucrative and few emerged as noteworthy. All mining at this time was in the Piedmont counties of North Carolina. Despite the generally low level of activity, gold discoveries were made in several central and western counties through the 1820s. Mining techniques remained crude and mining development remained haphazard (Green 1937:9; Knapp 1975:6-7; Knapp and Glass 1999:8-12) (Figure 3).

Many miners did not own the properties they worked but leased plots from landowners and sought gold seasonally between agricultural cycles. Most were subsistence farmers who ran their agricultural activities with few, if any, slaves. Cotton agriculture began spreading into the region during the first decades of the nineteenth century and created an interconnection between this crop and gold. When cotton prices declined after 1818, for example, some farmers and slave owners turned their attention to mining. As cotton production rose over the years, while prices fell and production costs remained the same, cotton producers faced the option of emigrating to another state or switching to mining. Cotton plantations also relied heavily on slave labor and its expansion into the Piedmont led to the increased use of slaves in the gold mines (Knapp and Glass 1999:12).

The practice of mining gold part-time persisted in North Carolina for 20 years after the initial Reed discovery. Green (1937:8) described gold mining during this time as lacking skill, system, and scientific method. It generally consisted of small-scale operations involving individuals or small groups of miners working together. Wealthier landowners often preferred investing in land and slaves and put slaves to work looking for gold with little additional investment in equipment or expertise. This led, in Green's (1937:13) view, to mining being conducted in a "desultory, careless, extravagant, and unskilled manner." All of the work focused on relatively easy to reach placers in creek beds and equipment was the simplest kind available: picks, shovels, and pans. More elaborate but still simple gear was introduced as the easier to find large nuggets started to become scarcer (Green 1937; Knapp 1975:5). Wooden boxes, washers, and rockers were simple devices that essentially relied on the same process as panning: the separation of free gold particles from waste material by suspending the mix in water and washing out the lighter waste while gold sank. The chief improvement of these later devices over panning was in the volume of material that could be processed. By 1809, some miners had begun to use mercury to improve the recovery process (Green 1937:8). Mercury forms an amalgam with gold and thus "captures" it as the gold-bearing ores wash across a mercury-covered surface. The gold was separated from the mercury in a retort that drew off the mercury, leaving the gold behind to be smelted.

For the first 20 years of the Carolina gold industry, production was at a low-level and not as lucrative as it could be and there was no effort at expanding mining operations. There was no development of a South Carolina gold industry during this time. Although a gold find was made in the Greenville district in 1802, there was no subsequent development. Mining for copper had taken place prior to the American Revolution in South Carolina but if any gold was found along with the copper, it was not reported. No significant mining took place until after gold was found at the Haile property in Lancaster County in 1827 (McCauley and Butler 1966:8, 10).

EXPANSION AND CLIMAX OF THE GOLD MINING INDUSTRY

After about 1825, gold mining operations in North Carolina expanded. Much of the work at this time remained sporadic and not very lucrative, but over time gold mining started to have economic and social impacts and a few mines started operating systematically. By the 1830s, portions of the State experienced a genuine gold rush and mining become the second most important economic activity after agriculture (Knapp and Glass 1999:13). The South Carolina gold industry also emerged as an important concern during this period. Gold was discovered on the property of Benjamin Haile in 1827, which eventually developed into one of the state's most important gold mines, and a second operation started at the Brewer mine in Chesterfield County in 1828. The first shipment of South Carolina gold to the U.S. Mint was in 1829 (McCauley and Butler 1966:8).

From the 1820s to the Civil War, gold mining in North Carolina went through two general periods of development. The first of these lasted about 10 years from the mid 1820s to mid 1830s, which covered the onset of more vigorous development and then stabilization of the industry. The period after the mid-1830s to about 1849 saw the establishment of a branch of the U.S. Mint in Charlotte but declining productivity. The discovery of gold in California in 1849 exacerbated but did not cause the decline (Green 1937; Knapp 1975; Knapp and Glass 1999). South

Carolina entered the gold industry at the end of the 1820s and caught the rush affecting North Carolina. Gold was first found at the Brewer mine in 1828 and operations quickly expanded to included between 100 and 200 miners by 1830-1831 (Graton 1906:90; McCauley and Butler 1966:10). Benjamin Haile soon turned his holdings over to tenants willing to lease and mine 50-foot parcels along Ledbetter (now Haile Gold Mine) Creek (Murphy 1995:72; Botwick and Swanson 2011). This continued for about 20 years, the tenants being planters who sent slaves to perform the manual labor of mining gold (McCauley and Butler 1966:46).

During the antebellum period, knowledge of the nature and extent of gold deposits in the Carolinas grew considerably. The gold mining industry also introduced certain innovations to the Carolina Piedmont like steam power, wage labor, corporations, and northern and foreign investment (Knapp and Glass 1999:124). For South Carolina, the antebellum era has been considered a single period for gold mining (McCauley and Butler 1966; Murphy 1995:72), although it is clear that the gold mining industry here went through similar stages in its development and yield, reaching a production peak around 1833 and then entering a long period of declining output (McCauley and Butler 1966:10).

Several events and trends contributed to these developments. During the period, mining moved from exclusive exploitation of placers to include lode sources. The discovery of gold in a quartz vein in 1825 in Stanly County (part of Montgomery County at that time) led to a renewed interest and a systematic search for new sources. Vein mining comprised a means of reaching gold at its source instead of relying on irregular stream deposits. Also, it offered hope that gold supplies could be obtained from particular strata or ore layers (Knapp 1975:7). New discoveries by farmers continued to expand the known extent of gold throughout the region, while depressed cotton prices also contributed to development as farmers sought alternative sources of income (Green 1937:10-11; Knapp 1975:7; Knapp and Green 1999:13).

Capital investment was another new development. Mining companies began obtaining incorporation grants from the State, the first being the North Carolina Gold Mining Company. This was an important change in the way gold mining was organized and carried out, as corporations using skilled workers and mechanical equipment had the capacity to outpace and marginalize individual miners and small partnerships. A related change was the source of the capital. Rather than being raised locally, northern U.S. and European, primarily British, investors provided the funds for developing the industry (Knapp and Glass 1999). Speculation, much of it dishonest, also came to be an important aspect of the North Carolina gold industry (Green 1937:13).

Moreover, the new emphasis on vein mining made these new forms of capitalization, organization, and scale necessary. Vein and quartz mines required deep excavations, mechanical processing of ore, and specialized workers. The process of extracting ore, shoring mine shafts and drifts, stamping the ore, amalgamating it, and separating the gold from the amalgam could require between 25 and 100 workers (Green 1937:13). The expense of buying, installing, and operating the equipment, and hiring the labor--much of which was necessary before any gold was produced --was beyond the reach of most individual landowners and small partnerships. Vein mines discovered during the 1825 to 1835 period, such as the Capps, Rudisill, and McComb mines in Mecklenburg County, North Carolina, were thus controlled and operated by gold mining corporations employing experienced miners and the latest technology. At the same time, however, prospectors continued to discover and develop dozens of mines, albeit less formally and elaborately (Knapp 1975:8).

Mining began to take on the shape of a full-time profession at the end of the 1820s. Local laborers were considered incapable of accomplishing the required work, opening the way for foreign-born miners. Numbers of new immigrants appeared in the region, with varying skills and experiences, and skilled prospectors came to be recognized as a distinct occupational group (Green 1937:11; Kickler 2011). Notable among the newcomers were European mining experts, particularly Cornish natives who had a cultural heritage of mining in their home country (Knapp and Glass 1999:19). Foreign workers, though, were not only from Cornwall; they came from numerous places in Europe and South America. To this mix were added native-born whites and African Americans who, if not considered proficient miners, could perform menial labor (Green 1937). Women, both white and black, also worked in the gold fields, mainly as panners at smaller family-run operations. African-American slavery was another feature of antebellum gold mines. Some corporations put slaves to work in the mines or in support roles such as cutting timber, growing food for miners, or performing assorted unskilled tasks (Knapp and Glass 1999:20-21). By at least the end of the gold mining era, however, African-American workers were performing similar work as white men. Harpers Magazine (1857) described a Gold Hill mine where observers found "a couple of negroes boring in the rock with iron sledge and auger." Given that slaves were often put to work at various small-scale mining operations, it is not surprising that they would develop the abilities of experienced miners.

As the 1830s progressed, the gold industry began to impact the State in various ways. Counties in the gold region were noticeably wealthier than those in other areas. In addition, the region's economies expanded as a result of gold providing jobs, putting money into circulation, and increasing property values. Gold mining also promoted technological growth. Tradeoffs to these developments, according to contemporary observers, included alcoholism, "moral degeneracy from easy money," and neglect of agriculture (Knapp and Glass 1999:27). Extremes of wealth and poverty were also created while more industrialized mining took its toll on the lives and health of miners. Mining also had significant environmental consequences in surface erosion and contaminated water supplies (Knapp and Glass 1999:27-28).

The development of the mining industry in the 1830s gave rise to several regional boomtowns, including Brindletown, Bissell, Capps, Jamestown, Washington, Morgantown, Gold Hill, and Charlotte. These towns sprang up in the wakes of major strikes, providing sources of housing, goods, supplies, and services to suddenly swelled ranks of miners. As mines were exhausted or news of richer discoveries came out, these boomtowns could suddenly become deserted or nearly so (Green 1937:14).

Charlotte consisted of a small village at the beginning of the 1820s. Gold strikes and mine development near it spurred its growth as the local mines during the decade became some of the State's most important ones (Knapp and Glass 1999:14). Mining companies invested in the town, building large and luxurious houses for supervisors and additional but less extravagant housing for mine workers. The St. Catherines Mine, located southwest of the town, put up stables, storehouses, carpenter shops, a smelting and assay house, and saw and gristmills (Green 1937:16). In 1837, the U.S. Congress granted Charlotte a branch of the U.S. mint to coin the gold being produced in the region.

Southerners began promoting the creation of branch mints in 1830. Traveling to the national mint in Philadelphia was difficult and dangerous. Moreover, there was no uniform circulating medium in the south. Gold in raw form was used for exchange but was of uncertain purity. Also, once sent to Philadelphia, little of the coined gold returned south to circulate. Without an official mint, several private mints emerged to meet the demand for coinage. The Bechtler mint in Rutherford County was the most famous and operated from the 1831-1857, handling gold in both North and South Carolina (Knapp and Glass 1999:29; Kickler 2011). Christopher Bechtler emigrated from Germany in 1829, arrived in Philadelphia, and made his way to North Carolina where he advertised his mint in July 1831, suggesting he quickly moved to the region to take advantage of the emerging gold rush. Christopher died in 1843, and the business continued under the direction of his sons and nephew (Trinkley and Hacker 1995:15-16).

Meanwhile, efforts to have Congress authorize a branch of the U.S. Mint in the region continued. Congress finally approved three branches, one in New Orleans to handle gold and silver, and one each in Charlotte and Dahlonega, Georgia for coining gold only. Construction of the Charlotte mint began in January 1836 and the mint opened in December 1837. Destroyed by fire in 1844, the mint was rebuilt and repaired after another fire in 1845 (Green 1937:25-27). The mint produced steadily to the Civil War despite problems in the gold mining industry and constant political opposition from Congressional Whigs (Knapp and Glass 1999:31-32). Although the Federal government had become involved in the gold industry, the private Bechtler mint continued to operate because of the quality of the coins it turned out (McCauley and Butler 1966:11; Carpenter 1999:15).

In the mid-1830s, the North Carolina gold industry quickly but temporarily declined as a result of various influences. For one, deposits at the mint declined. Second, the gold rush in Burke County, which was based on placer deposits, ended. From that point, only poor whites, free blacks, and possibly slaves worked the residual sources and only sporadically. Another reason for the decline was the emergence of new investment and work opportunities, which drew money and labor from the placer mines. New investments included vein mining in other counties and states, as well as agriculture and railroad construction. Vein mining also faced a crisis, however. The economic panic of 1837 left large firms short of funds, bankrupt, or dormant. Also, poor management practices and difficulties in keeping mechanical equipment operating caused some mines to fail (Knapp and Glass 1999:30-31).

Mining processes began to encounter new challenges as well. As easy to reach placers and vein sources were used up, and mines went deeper underground, expenses and safety risks increased. In addition, the ores encountered once the water table was reached were mainly sulferet or pyrite ores that were difficult to separate from gold. To make a profit, mining companies required efficient methods for dewatering the mines and then processing these ores. During the antebellum period, no good solution to the problem was found and mining often stopped upon reaching the water table (Knapp and Glass 1999:31).

The North Carolina gold industry rebounded at the end of the 1830s. The establishment of the mint helped in the resurgence, bringing national attention to the North Carolina gold fields and another round of increased speculation heading into the 1840s (Green 1937:30). New companies seeking to get started in mining formed. Often, these companies were not focused on gold but had multiple interests such as manufacturing or land development. By the 1840s, mining had recovered, production expanded, and activity increased at numerous mines (Nitze and Wilkens 1896:679; Knapp and Glass 1999:35).

Among the important developments at this time was the discovery of gold on the Portis property in Franklin County in 1838, which opened the Eastern slate belt. Activity soon followed in Nash, Halifax, and Warren counties. Mining also began in the Cid District in Davidson County at this time (Carpenter 1999:15). The Gold Hill district in Rowan County emerged as one of the most important and renowned gold areas in North Carolina as well, with the first mining operations taking place in 1842. Gold Hill quickly developed into a small village supported by three mines initially. At least 15 mines were active in the District by 1848 (Carpenter 1999:15; Glass 1985; Knapp and Glass 1999:35).

Gold mining in North Carolina was well developed by the 1840s and incorporated industrial labor practices and equipment necessary for large-scale operations (Figure 4). Although small-scale operations persisted throughout the gold region, mining corporations had begun utilizing mechanical equipment for moving and processing ore and materials. The basic operation of a lode or vein mine (described in more detail in Chapter IV) involved extracting ore from the mine, hoisting it to the surface, crushing it to release gold, and then separating the gold pieces from the uneconomic material waste ore. Mechanical devices that were introduced to the gold industry during the antebellum period included stamp mills, devices developed in Europe in the seventeenth century and adapted for use in North America. Stamp mills had a vertical component, the stamp, which crushed gold-bearing ore against a block. Any easily collected gold was taken from the crushed product while the residue might be discarded or sent for further processing in Chilean mills or arrastras, which were relatively simple grinding devices. Collection was facilitated with the addition of mercury to form an amalgam with the gold (Knapp and Glass 1999:23-24). Power to operate mechanical devices could be provided by humans, animals, or water. Later, steam engines were put to work as well (Glass 1985:428).

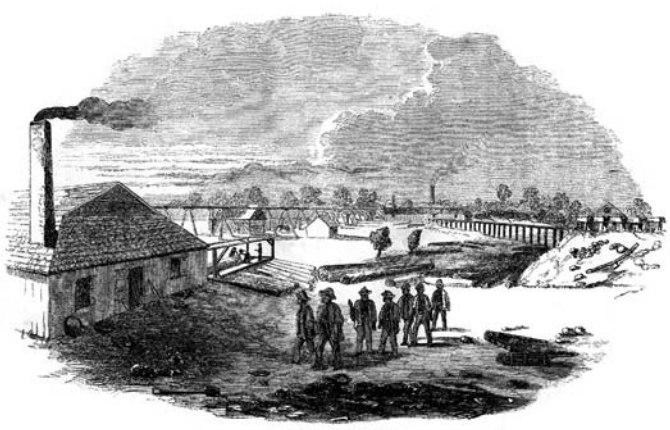


Figure 4. Carolina Gold Mines Became More Industrialized by the 1840s (Harpers 1857).

Gold mining in South Carolina went through a slightly different trajectory through the 1830s. The Haile and Brewer mines dominated production in the State until 1838. That year, just after the Charlotte mint opened, production at both declined sharply as the relatively easy to reach placers became exhausted. The mines tried to find ways to recover gold from deeper deposits but were not generally successful (Murphy 1995:74). Efforts to improve production at the Haile Mine included the installation of a stamp mill in 1837, which would be used to crush lode deposits and release gold as well as prepare the ore for further processing (Botwick and Swanson 2011). This seems to have been an isolated development, however. At the nearby Brewer Mine, ore continued to be processed using manual techniques of rockers, arrastras, and Chilean mills into the 1880s; the first stamp mill was built here only in 1886 (Graton 1906:90; McCauley and Butler 1966:36). Overall production in the State, as noted, continued to decline through the end of the antebellum period. While over 300 mines operated in the State between 1820 and 1850 (Murphy 1995:75), there was little of the capitalization and industrial organization seen in North Carolina.

Figure 5. African-American Miners Drilling Holes for Blasting in a North Carolina Gold Mine (Harpers 1857).

Glass (1985) described the conditions of miners work and non-work lives in the Gold Hill, North Carolina area at this time (1840s-1850s). Glass noted that mining first began in the Gold Hill area in 1842 and was first focused only on surface deposits along streambeds and the sides of ridges. As early as the mid-1840s, however, larger companies began hard-rock mining underground and in the process, created an industrial environment that redefined the nature of the work and the relationship of miners to nature, machinery, and fellow workers.

With respect to the nature of the work, Glass was primary concerned with the underground operations, which reflected the most extreme change in the mining industry in this area from the earlier periods. Miners first sunk vertical shafts to varying depths and then worked in horizontal drifts to reach the desired ore deposits. Underground work was done by hand, with teams of miners hand-driving steel bars into the rock and then using blasting powder to break the ore free and into manageable fragments (Figure 5). Loosened ore was loaded into buckets and hoisted to the surface where it was placed in wheelbarrows and taken to the mill. At the mill, the ore was sledged to further break it up and then put through various pieces of machinery for crushing, grinding, and agitating to extract flakes of gold. Although mule power was mostly used in the hoisting from the mines, steam power was increasingly common for powering the mill equipment (Glass 1985:423-428).

The various processes of extracting and milling ore led to important divisions of labor in the mine workforce. The work required hard physical labor and specialized skills, as well as supervision and teamwork. Miners working underground needed to understand the nature of the ore deposits and required the ability to follow rich deposits. Technical staff at the mine included engineers, blacksmiths, wheelwrights, and carpenters, and each specialist required support from common laborers. Non-mining personnel included managers or company agents who handled accounting, payroll, and supply. At simpler operations, many of these job requirements overlapped, but as mining became more complicated, the workforce grew more complex. The first sign of change was the division of the workforce into shifts in the late 1840s (Glass 1985:428-430).

Within shifts, workers were further separated into the "underground force" and the "top ground force," each including both "miners," who performed the skilled jobs (e.g., drilling, timbering, blasting, and mechanical operations on the surface), and "laborers" responsible for most of the manual chores (e.g., cobbing, carrying ore). Of the workers classed as miners at Gold Hill at this time, about half were from Cornwall. Laborers were mostly native-born whites or slaves. Women also worked in the mines, although their participation was restricted to surface tasks such as operating log washers to re-process mill tailings. Women were more likely to find employment in the mine village performing tasks like washing, sewing, and teaching (Glass 1985:430, 442). Respecting gender, Glass (1985:442) found that the mining community of Gold Hill was unusual compared to others in having a relatively large proportion of married men and smaller families.

Glass also found that mining in this area provided a decent, but not extravagant living. Miners mostly rented or lived in boarding houses or hotels and could not afford to accumulate large amounts of real estate or personal property. The wages were determined through negotiation, a practice possibly derived from Cornish precedents, which gave them some autonomy. Wage rates paid to unskilled workers and children suggested they were also subject to negotiation. Rates paid for slaves, however, were more uniform, suggesting fixed costs for hiring them. Slaves and white workers could also earn income with extra work and odd jobs, such as shop work, cleanup, breaking ore, or dipping candles (Glass 1985:436-438).

Many miners lived in company towns or communities that grew up near the mines. Glass (1937) cited records of the High Shoal Gold Mining Company between 1848 and 1849 that indicated the company operated a commissary. The company bought corn, bacon, flour, tallow, potatoes, beef, and meal to feed the miners, and also sold them shoes, tobacco, sugar, and tea. Miners often found themselves in debt to these company stores (Glass 1985:439).

Mining was extremely dangerous. Accidents resulting in maiming injuries and death were common, and increased through the antebellum period. The most frequent causes of injury included blasts, slips from ladders and platforms, and falling objects within the shafts (Glass 1985:434-435). Although badly needed, no efforts to provide relief to the hazardous conditions in the mines were made until the North Carolina General Assembly passed "*An Act to Provide for the Inspection and Regulation of Mines"* in 1897. This legislation, however, did not provide meaningful protection for miners because sufficient safeguards never went into place and little pressure was ever put on mining companies to comply with the regulation (Barber 2008).

North Carolina gold mining in the 1840s peaked in intensity and then declined as the California gold rush started. Although activity fell off, production remained comparable to that of the 1830s. Some capital and skilled labor did move west, though, and miners who had gained experience in Georgia and the Carolinas, as well as Cornwall, introduced important developments to California (Green 1937:31; Carpenter 1999:15; Knapp and Glass 1999:36).

Heading into the 1850s, investors saw opportunities in North Carolina gold mining. The State legislature tried stimulating interest by sponsoring geological and mining reports on the State's mineralogical resources (Green 1937:31). The legislature further passed acts to promote mining and manufacturing. Additional inducements included low wages, improved transportation, higher land values, and gains in agriculture, manufacturing, and commerce. The outcome of these incentives and attractions was an increase in outside investment, as before mainly from the northern states and Europe, with an emphasis on corporate mining. This time, many of the firms did not actively mine, but only promoted and sold stock to northern investors. Also, new mining companies were not restricted to dealing with specific minerals, and many companies produced copper as well as gold (Knapp and Glass 1999:37-38).

Also in the 1850s, mining engineers started various, mostly unsuccessful experiments intending to extract gold from refractory ores. Hydraulic mining was also introduced. This technique, perfected in California, involved firing jets of water at earthen banks or hillsides to wash out the gold-bearing matrix. Sluices carried away the material and caught free gold particles in riffles (Knapp and Glass 1999:41-42). Although its effectiveness was demonstrated in North Carolina, particularly in servicing placers already worked by older methods, hydraulic systems were not widely used in the State prior to the Civil War (Green 1937:35-36).

In South Carolina, the most significant development of this time was the opening of the Dorn mine in McCormick County in 1852, which obtained a reputation as a particularly rich prospect and led to the formation of the New York-based Dorn Mining Company (Whitney 1854:133; Murphy 1995:75). In only 16 months, between 1852 and 1853, this property yielded ore from an open pit 300 feet long, 15 feet wide, and 12 feet deep before its returns declined sharply after 1853 (McCauley and Butler 1966:52; Feiss et al. 1991:329). Writing in the mid-nineteenth century, Whitney (1854:133) stated that there was virtually no gold mining at this time in South Carolina, but McCauley and Butler (1966:11) cited evidence for considerable mining activity, even if production was low. There were 58 mines operating in the years before the Civil War distributed among Chesterfield, Lancaster, Spartanburg, Union, York, Abbeville, Edgefield, Greenville, and Pickens counties. The limited production at this time might reflect the generally low-level and amateur method of mining. Lieber (1858:59) expressed consternation at mine owners who treated their holdings like a “child’s game” rather than an “earnest business.”

Despite optimistic assessments (Whitney 1854:129), the gold mining industry faltered in the Carolinas during last years before the Civil War. While the war ultimately contributed to the end, by the mid-1850s most mines were either out of business or struggling financially. There were several reasons for this change in fortune. For one, the New York money markets tightened. Also, the investment bubble burst following a period of flagrant speculation and dishonest marketing of mining stocks (Knapp 1975:13-14). Inadequate technology combined with inept management and general inefficiency also contributed to the decline. Finally, the easily obtainable gold sources were generally exhausted and as yet there were no techniques to profitably extract gold from refractory ores and pyrite (McCauley and Butler 1966:11; Knapp and Glass 1999:43). Many mine operators closed down when faced with the necessity of employing ever-increasingly complex equipment and procedures for extracting ore from deep deposits (Murphy 1995:75).

REVIVAL AND DECLINE

Efforts at reviving the Carolina gold industry following the Civil War were sporadic but continued until about World War I, when all significant production stopped. Mining resumed in the 1930s in response to rising gold prices but finally stopped completely during World War II. The period after the Civil War was characterized by the continued use of industrialized methods and systems, and the application of new technologies to extract gold from refractory ores. Also, there were instances of substantial individual activity and success, but overall the industry lacked the energy it had in prior years. In North Carolina, the gold industry occupied a much smaller proportion of the State’s economy and society than it did before the war (Knapp and Glass 1999:124-125).

Although gold mining continued on a small scale under the Confederate government, the Civil War essentially ended any significant operations. Recovery started as early as the late 1860s but on a smaller scale than before the war. Efforts to promote North Carolina mines to northern investors arose almost immediately after the war ended as local interests tried to restart the State's economy. Turning to northern capital was necessary because of the up-front costs involved in reopening the badly damaged mines. It took a while for investment and production to begin, however, because lingering resentment made it difficult for southerners to accept overtures by northern capitalists. Nevertheless, some preliminary work started by 1867 when work to reopen the Rudisill mine began. At the Kings Mountain mine in Gaston (Cleveland) County, a new, all-iron stamp mill was installed, while at other mines new equipment was ordered and set up in preparation for the eventual resumption of mining (Knapp and Glass 1999:125-126).

The federal, state, and local governments contributed to the effort at reviving the industry. The Charlotte mint reopened in 1868 as an assay office. (Ingots had to be sent to Philadelphia to be coined.) The assay office continued operating until 1908, partly as a pork barrel. The State restarted the geological survey, which turned out numerous reports on the mining industry, its progress, and potential. The State also created an industry to inspect and regulate mines, particularly coal mines (Knapp and Glass 1999:126-127). As Barber (2008) pointed out, however, this agency tended to be friendlier to the mine operators than the miners.

Ultimately, individual initiative reopened various Carolina mines in the 1870s. To make a profit, mining operations during this period required more expensive equipment, maintenance, and supplies than during earlier periods, along with skilled workers and managers who commanded high salaries (Knapp and Glass 1999:128). Nevertheless, typical operations exhibited a high degree of "haste and waste" as absentee owners ordered equipment and facilities without understanding the specific requirements of their sites. This sometimes resulted in mills that were not able to run full-time owing to not having enough ore available. In other instances, the rush to bring in the latest equipment led to waste because particular deposits could have been processed more efficiently using older methods. Finally, many operations employed unskilled managers. The net result was the failure of many gold mines during this period (Knapp and Glass 1999:129). Production during this period and into the 1880s followed a pattern of intermittent upswings and declines, which Nitze and Wilkens (1896:679-680) largely attributed to short-term increases in production at individual mines. In general, production was low prior to 1880, with South Carolina returns being under $10,000 annually (McCauley and Butler 1966:11). North Carolina mines performed considerably better, producing between $66,000 and $141,000 worth of gold between 1866 and 1888 (Carpenter 1999:17).

In the 1880s, the industry began to show steady improvement. Production, while increasing, remained below the average national output. Some of the improvement was due to the return of northern and European investors, who contributed the modernized equipment necessary to get at and process deeper ores. Because of the low quality of these ores, they had to be handled in increasing quantities to maintain gold production. In spite of these developments, North Carolina mines paid few dividends to stockholders (Knapp and Glass 1999:130-132).

An exception to this trend was the Phoenix mine in Cabarrus County, North Carolina (Figure 6). Mining resumed here before 1880 under the supervision of German-born Carl Adolph Thies. Thies introduced the Mears chlorination process for handling sulfuret ores to the Carolinas and then streamlined it into the "Thies process," which he then set up at the Haile

Figure 6. Phoenix Mine, Cabarrus County, North Carolina. View of the Mill and Chlorination Plant, Circa 1907 (Platt 1907).

Gold Mine in Lancaster County, South Carolina (Nitze and Wilkens 1896:685; McCauley and Butler 1966:11; Murphy 1995:76; Botwick and Swanson 2011). Thies' system (described in detail in Chapter IV) was well suited to the region's ores. It was not patented and the cost of the plant was relatively low. Additionally, it recovered around 90 percent of the gold in the sulfide ore compared to about 40 percent yielded by other methods. Production at the Phoenix Mine rose, making it one of the few mines in the area to pay dividends to stockholders. By 1887, it had become one of the largest mines in the State but operations halted when Thies moved to South Carolina to take over the Haile Mine (Knapp and Glass 1999:137-138).

During this era, numerous techniques and procedures for handling sulfide ores were tried in the southeast. Nitze and Wilkens (1896:685) characterized the region as the "'proving-ground' of almost all the patent gold-saving processes invented." The experience of E. Gybbon Spilsbury, Thies' predecessor at Haile Gold Mine, provides an example of this. Spilsbury took over as superintendent of Haile in 1880. Prior to this, the mine tried to reopen using straight amalgamation processes, which were no longer suitable for the kinds of low-grade ore available. Recognizing that the only way to turn a profit from the mine was to extract gold from sulfides and pyrites, Spilsbury instituted several changes. His improvements included turning from open-pit to underground works and installing or expanding equipment to better process the stamp mill tailings. Spilsbury's eight-year tenure was marked by experimentation with various techniques including roasting stamp mill tailings before putting them through another round of amalgamation and employing a Blake dry crushing mill to produce finely ground ores, a procedure soon abandoned. He also tried the Designolle process, which used a solution of mercuric chloride to improve the recovery of gold from concentrated ores after stamping. This also failed to produce acceptable results. Finally, by the late 1880s, Spilsbury considered using chlorination but never had the chance to try it at Haile (Botwick and Swanson 2011).

Thies' improved chlorination process kept the Haile Mine going into the early twentieth century and made it the only profitable South Carolina gold mine at this time (Graton 1906:77, 111). In North Carolina, too, most mines were not successful during this period and the largest deposits at the Charlotte assay office were by mines involved in prospecting and developmental work, not regular operators. The chief problem with North Carolina mines was the low quantity and quality of the extant ore. Each dollar of gold cost nearly two dollars to produce (Knapp and Glass 1999:138). Moreover, inept management persisted. "By 1895, the southern gold fields for many years had been the playground of dubious technicians, promoters, and inventors. Numerous mines had been directed by innocent amateurs or dishonest bunglers" (Knapp and Glass 1999:439).

The first few years of the twentieth century saw a resumption of gold mining in North Carolina, as new processing methods were applied and efforts were made to modernize the industry. Production quadrupled between 1900 and 1915, partly as a result of the cyanide process that developed late in the nineteenth century and quickly replaced older methods. Upgraded milling equipment also contributed to the resurgence (Carpenter 1999:15; Knapp and Glass 1999:140-141; Hardesty 2010:84).

In South Carolina, several mines opened or restarted around the turn of the century (Graton 1906; McCauley and Butler 1966). Nevertheless, except for the Haile mine, not many went into full operation. Additionally, some activity was by individuals working placers (Graton 1906:111). While Haile Gold Mine remained the most prominent and productive operation in South Carolina during this period, the region around Smyrna and Hickory Grove in York and Cherokee counties emerged as an important locus of gold mining and prospecting (Murphy 1995:76).

North Carolina gold production declined suddenly and dramatically after 1915. The reason for this was the lack of sulfur-free ore that could be processed economically. The sudden closing of the Gold Hill mine in Rowan County added to the problem because this mine yielded over a quarter of all gold from the State at this time. Finally, the outbreak of World War I led northern and European investors to turn away from gold and toward war production, which was more pressing and profitable. Finally, gold by this time comprised only a small part of the State's industry and other opportunities began to draw investors and potential labor (Knapp and Glass 1999:146). Similarly, World War I marked the end of any significant gold production in South Carolina as wartime needs drew off labor and investment interest (Murphy 1995:76).

In 1934, gold prices rose from $20.67-$35.00 per ounce, leading to a renewal of activity in the Carolinas. Low labor costs and new processes of separating minerals also contributed to the revival. Many old abandoned properties were revisited and exploration for new sources commenced. Most activity, though, was on a small scale during the Great Depression, and often involved amateurs panning or using old-fashioned rockers (Knapp 1975: 17; Carpenter 1999:15; Knapp and Glass 1999:147). More experienced miners were attracted to opportunities in western mines (Murphy 1995:78). Twenty-six mines operated in South Carolina during this period (1931-1942). The area around western York and eastern Cherokee counties in South Carolina saw some gold-related development at this time. An assay office operated in Hickory Grove between 1933 and 1936, while at Smyrna the White Star Milling Company built a 50-ton flotation mill to process ore extracted from the surrounding area. The mill did not survive long, however, operating only from 1934-1936. In addition, despite the activity, the new cyanide plant at Haile Gold Mine, completed in 1937, accounted for almost 98 percent of all gold production in the State, indicating that most efforts did not amount to much (McCauley and Butler 1966:12).

his period of activity lasted until World War II. Labor shortages caused by the war was a factor, but most importantly War Production Board Limitation Order L-208 required nonessential gold mines to shut down so that labor and equipment could be applied to activities deemed more necessary for the war. Much of the machinery at regional plants was then sold for scrap.

There were sporadic efforts at mining for gold after the war but not many significant developments. In the late twentieth-century, however, rising gold prices encouraged companies to search for and develop low-grade ore deposits that formerly would have been unprofitable. Recent activities have included reopening the Haile, Brewer, and Barite Hill mines in South Carolina using the cyanide heap-leach method. The Ridgeway mine, also in South Carolina, began producing gold in 1988 with the vat-leach method (Carpenter 1999:15).

This period of activity lasted until World War II. Labor shortages caused by the war was a factor, but most importantly War Production Board Limitation Order.

IV. Mining and metallurgy of Gold

Ores are natural mineral compounds of metal and other substances such as oxygen or sulfur. In a mining operation, desirable minerals go through progressions that take them from the earth, break them free from the valueless rock, and concentrate them into a form that has value and repays the cost of the operation. The preliminary stage of all mining operations is prospecting, involving the search for valuable minerals. Subsequent mining and ore handling is generally divided into three principal stages: extraction, beneficiation, and refining. Extraction is the removal of minerals from the earth. Beneficiation is the process of increasing the proportion of valuable ore relative to the host rock and usually encompasses several steps and procedures. Refining converts the mineral into a state of purity suitable for use (Noble and Spude 1997). The following overview describes the most basic and common methods used to mine gold in the Carolinas during the nineteenth-early twentieth centuries and provides a context for understanding how individual sites and features functioned.

PROSPECTING

Prospecting comprised the search for valuable ore bodies and the first step in gold mining. It was conducted similarly for tracer and lode deposits (Nobel and Spude 1997:10). Miners ("prospectors") hand-dug numerous test pits ("prospects") in areas thought to contain geological formations containing gold. Mechanized prospecting developed in the early twentieth century using power shovels, backhoes, bulldozers, and truck-mounted augers. Prospecting sites may be common in mining districts and be found in stream valleys, streambeds, benches, and uplands. An area of early mineral exploration would contain scatters of hand-dug holes and associated waste dumps (Hardesty 2010:35).

Figure 7. Panning was an Important Prospecting Method (Rickard 1932).

Gold occurs as loose or free particles in placer deposits and identifying these sources was accomplished through panning (Figure 7). Gold tended to accumulate at the lowest levels of placers, just above the bedrock. As prospectors moved upstream they looked for old eddys or deposits of iron magnetite, manifested as black sand, which were often associated with gold. The prospector tested deposits by mixing water and dirt to the pan to create a solution. The fine sand and mud were poured off and fresh water added. As the prospector swirled the

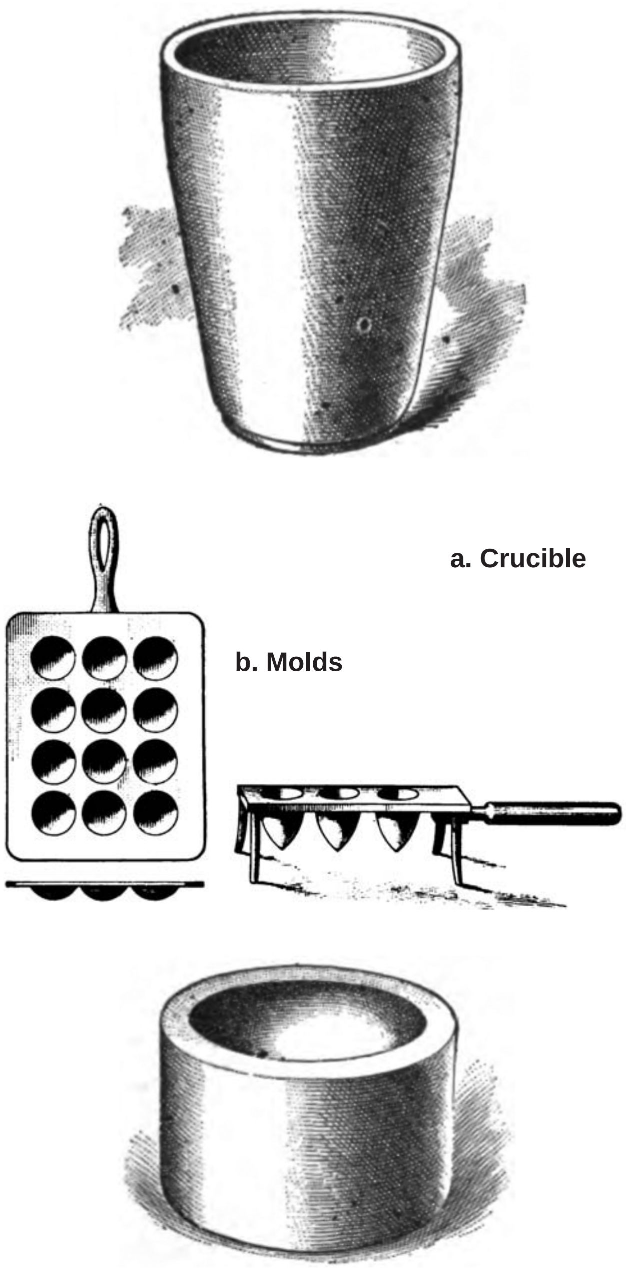


Figure 8. Assaying Equipment (Colliery Engineer Company 1899).

mixture, water washed over the rim, carrying away the lighter particles and eventually left the gold and heavier minerals in the bottom. Prospectors could estimate the potential size and gold yield of a deposit from the weight of dirt in the pan and the value of the gold removed from it (Colliery Engineer Company 1899:38.7-9).

"Assaying" was another way to check the proportion of metals in ores. Gold was assayed with heat or smelting followed by an additional process of cupelling (Thrush 1968). The procedure involved pulverizing the ore, mixing it with the flux--usually lead containing litharge--in a ceramic crucible, melting it in a furnace, and casting it in a button mold. Once cool, the slag surface of the button was chipped away and the button hammered into a cube, which went into a cupel, or small shallow cup, made of bone ash (Figure 8). The cube was melted again in a furnace, which oxidized the lead flux and allowed the bone ash to absorb it, leaving the gold behind. The same procedure was also used to test mine and milling results and determine the quantity of the output (Colliery Engineer Company 1899:36.1-3, 40; Hardesty 1988:38, 2010:105).

EXTRACTION

Extraction falls into two classes: surface and underground mining, the method used depended on the physical location of the desired ore and available technology. Surface mining was used for minerals accessible at shallow depths or at natural cuts, such as stream valleys. Surface mining for gold commonly involved placers or other alluvial deposits containing free gold particles (Hardesty 2010:34). Placers typically occur in stream valleys but might also be in higher elevations where they were deposited in older landforms. Small placer deposits were most often mined through simple hand-dug pits or burrows (California Department of Transportation [CALTRANS] 2008:86).

Surface mines could range in size from small to massive cuts or pits that were dug by hand until the twentieth century (Figure 9). Underground mining for gold in the Carolinas was more cost effective at reaching deeper ore

Figure 9. Haile Pit, Haile Gold Mine, Lancaster County, South Carolina, 1904 (USGS Photographic Library).

bodies and veins. Mechanical excavating equipment developed during the early twentieth century made surface mining more economical than underground mining, however, and many of the mid-century gold mines in the two states were open cuts. Prior to this, however, surface mines were hand-excavated or worked with drag scrapers pulled by mules or horses.

Hydraulic systems were another method of surface mining that involved applying water to a mine face or bank to wash out ore and waste material, typically saprolite, which was then sorted and washed away in sluices. One method, known as "hydraulicking," involved shooting high-powered streams of water at the bank to be excavated. Water pressure was developed by running canals and aqueducts, sometimes for miles, from a natural source to a point above the mine, where gravity fed the water through pipes to a nozzle known as a giant or monitor. A variation on the method known as "booming" operated intermittently but on a larger scale than hydraulicking. Booming entailed emptying a reservoir situated at the top of the mine, allowing the water to rush across the bank and flush the material into sluices. As the water passed through the sluices, the heavier gold particles settled out and were collected (Colliery Engineering Company 1899:39.27). Although these techniques were used in the Carolinas, it is not clear how prevalent they were. Green (1937:35) said they were used in North Carolina to rework tailings from other methods but generally were not common.

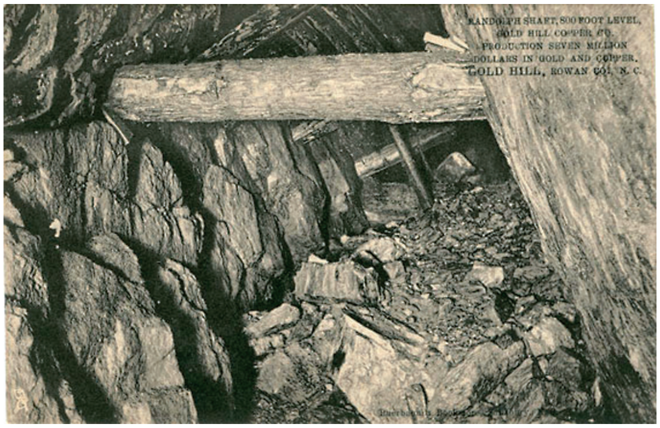


Figure 10. Underground Mine: The Randolph Shaft, 800-Foot Level, Gold Hill Copper Company, Rowen County, North Carolina, Unknown Date. The Mine Produced Both Gold and Copper (Rowan County Government 2008).

Underground mines were developed to reach deeper ores (Figure 10). The technology and methods used depended on the geology of the ore body as well as the engineering techniques considered best to extract the ore while maintaining safety and productivity. The simplest underground mines, known as "rat holes," consisted of single horizontal adits or vertical shafts, and were typical of small-scale operations. "Planned mining" involved more elaborate networks of underground workings (Hardesty 2010:38, 41-43). Miners had specific terms for various components of these underground spaces. "Shafts" referred to vertical openings from the surface. "Adits" were horizontal openings from the surface, most often excavated into a slope. "Drifts" consisted of horizontal openings dug from the side of a shaft. "Crosscuts" were horizontal tunnels running at angles to the axis of the ore body. "Winzes" were shafts dug downward within the mine from a drift or other horizontal opening. "Raises" comprised shafts dug upward to connect different levels of a mine's interior. The exterior entrance to a mine was the "portal." "Tunnels" were horizontal passages open at both ends. Subterranean mine systems also included "stopes," large open spaces for extracting ore that were often stepped to access an inclined ore body. Individual mines could contain several of these features in combination. Additionally, mines required ventilation, which was often provided by arranging shafts and tunnels to encourage airflow, sometimes by digging special ventilation shafts, and by adding special equipment that helped circulate fresh air (Figure 11).

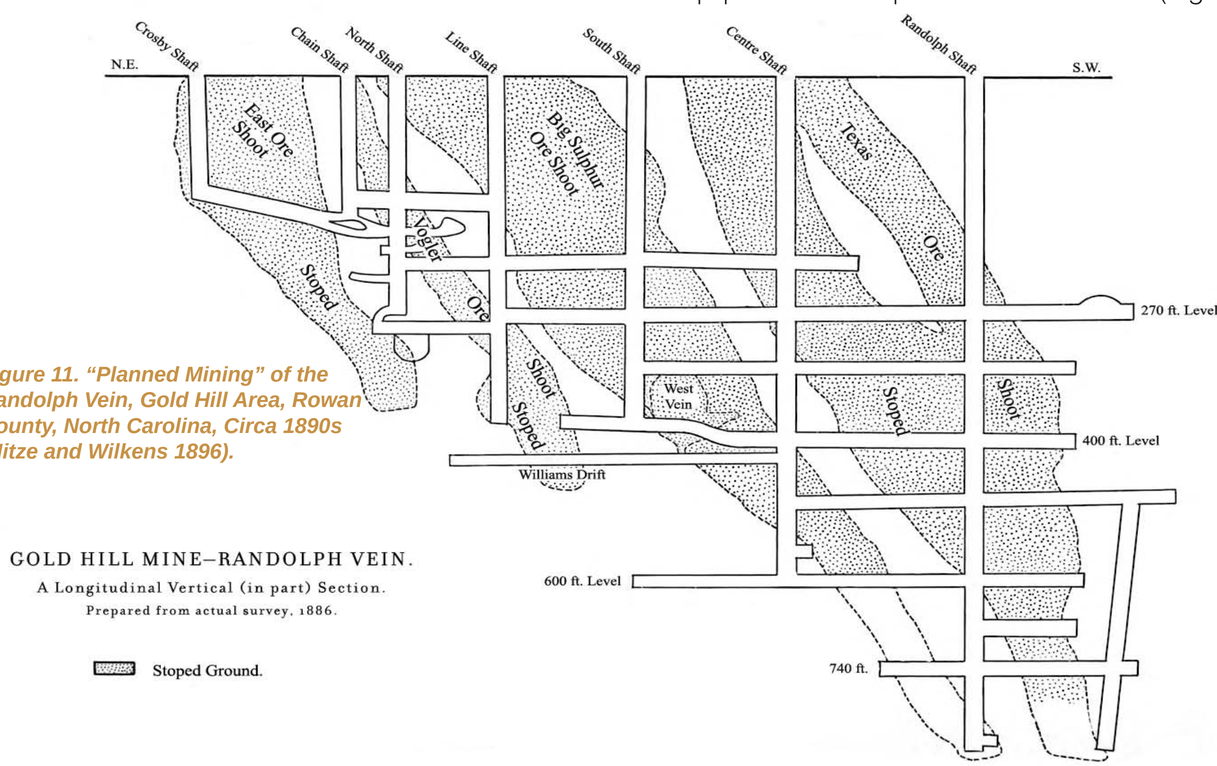


Figure 11. "Planned Mining" of the Randolph Vein, Gold Hill Area, Rowan County, North Carolina, Circa 1890s (Nitze and Wilkens 1896).

The general procedure for developing an underground mine was to sink one or more shaft to approach or intersect the gold-bearing strata. Once that was accomplished, drifts were opened at different levels to follow the ore (Knapp 1975:11). Much of the work was accomplished through hand excavation. Blasting was also in use by the mid-1800s and late in the century, pneumatic rock drills and hammers were introduced. The steps for working in an underground mine were to first, drive blasting holes into the rock with cast steel bars about 1.5 inches in diameter, 3-4 feet long, and having one end shaped into a chisel. Miners worked in pairs, one holding the bar and the other hammering it to depths between 18 inches and three feet. The hole was then loaded with blasting powder and sealed with a fuse extending through the plug (Glass 1985:423). After the explosion, the waste rock was discarded and the ore taken in wheelbarrows or cars to the main shaft for hoisting.

Drainage was a constant problem in mines and was handled either mechanically or by arranging the workings to allow water to flow out of an adit on the hillside. Ultimately, mechanical pumps were used (Hardesty 2010:53-55). These were steam-driven and operated continuously, while the piping and equipment used for them often took up considerable space in the underground areas. Timbering or building wood supports to hold up shafts and drifts was not usually necessary in the Carolinas because the surrounding rock usually held itself. Timbering was mostly used when extra support was necessary, such as in holding up pumping apparatus (Glass 1985:423, 426, 431).

Glass (1985:431-433) described working in underground gold mines around the middle of the nineteenth century. Miners entered and left the mine through shafts from the surface using a series of ladders that stood on narrow wooden platforms set about every 20 feet and reaching depths of several hundred feet. The rungs and platforms were typically covered in slippery mud and the miners made the trip carrying their tools and equipment with them. Once inside the mine, the only light came from the candles that miners wore in their hats. The mine atmosphere was filled with smoke from blasting and dripping water. The ceilings were low and the footing was uncertain and sometimes partially blocked by ore piles. Moreover, crosscuts and other interior passages were usually made only the minimum size necessary, making it necessary to travel on hands and knees in some places.

Whether a mine was underground or at the surface, it required means to remove the ore from the mine and transport it to the mill or plant for processing. Wheelbarrows were the simplest method for moving materials around. More elaborate methods included tracked trams and ore cars powered by mules or horses, and later by steam, diesel, or electricity.

Removing ore via vertical and inclined shafts required special structures and equipment. The simplest methods involved having miners or laborers carry ore containers and gear up and down ladders. Mechanical equipment included windlasses powered by hand or animal (horse-powered versions were known as “whims”), and later by steam or other fuel (Figure 12). More elaborate structures included headframes, consisting of tower-like structures built over the mineshaft, which might be simple frameworks or enclosed structures (Figures 13 and 14). Powered winching mechanisms raised and lowered a cage or bucket from a pulley or sheave mounted in the top of the tower (Hardesty 2010:49-51). Larger North Carolina mines used Cornish-style iron buckets known as “kibbles” to hoist ore and people to the surface (Knapp 1975:12). Later, various forms of skip or cage were used and different arrangements of headframes, hoisting engines, and hoisting drums or reels were developed (Ketchum 1912).

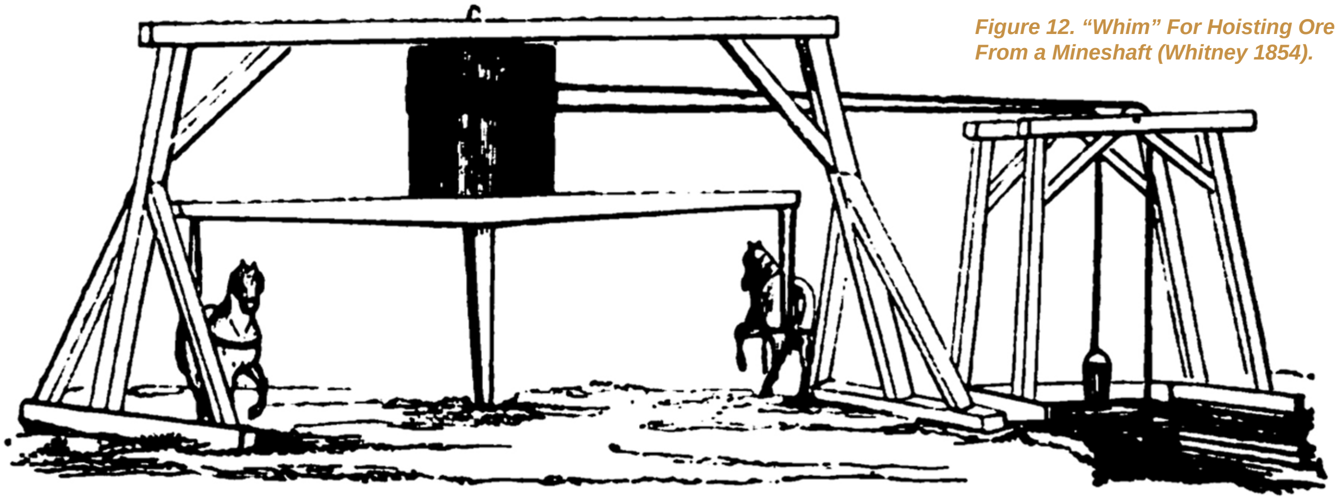


Figure 12. "Whim" For Hoisting Ore From a Mineshaft (Whitney 1854).

Figure 13. Headframe--Phoenix Mine, Cabarrus County, North Carolina, Late 1800s (North Carolina Office of Archives and History).

Figure 14. Enclosed Headframe--Gold Hill Copper Company, Rowan County, North Carolina, Unknown Date (Rowan County Government 2008).

BENEFICIATION

Beneficiation refers to the process of separating valuable minerals from the worthless portion of an ore (gangue) and concentrating the valuable portion into smaller bulk and weight (Richards 1909:1; Allen 1920:4). In general ore handling, this procedure is also termed "concentrating." Gold occurs as loose particles or as inclusions within a surrounding matrix. Free gold is uncombined with other substances, and is most often found in placers or as constituents of weathered rock/saprolite. Relatively large gold particles can also be encased in other minerals and are released by breaking and crushing. For example, it commonly occurs in quartz rock from which the sulfides have been removed by leaching, leaving only the quartz, fingers or veins of free gold, and iron oxides. Finally, gold occurs in sulfides, which consist of compounds of sulfur with more than one element (Thrush 1968). In this context, gold is typically distributed as minute particles (Eissler 1900:6) that require complex procedures to separate from the gangue. Different beneficiation procedures were developed to handle ore and recover gold from these varying conditions. Hayward (1952) categorized these processes as mechanical methods, amalgamation, hydrometallurgical methods, and smelting.

MECHANICAL METHODS

Mechanical methods rely on the relatively high specific gravity of native gold to separate it from waste materials. The simplest techniques for gold mining, these methods were usually used on placer deposits and to supplement other methods. The essential procedure was to place gravel, sand, and soil into a container, add water, and agitate the mixture, which allowed the lighter waste materials to float and wash out while the heavier gold particles fell to the bottom of the container. Panning was the most basic form of concentrating but was limited as an industrial method because of the low speed and volume of material that could be processed.

Improved devices included rockers, sluice boxes, and variations such as the "long tom." Rockers consisted of boxes mounted on curved wooden runners (the "rockers") and having an open front. The top of the box had a perforated bottom and below this was a backward-sloping baffle board or canvas apron. The bottom level contained riffles. To operate, the miner put gravel in the top level and ladled water over it while manually rocking the device. The baffle board deposited the screenings to the back of the lower level and as they washed out the open front, the riffles caught the heavier gold particles (Richards 1909:323-324) (Figure 15).

Figure 15. Rocker or Cradle Rocker (The Colliery Engineering Company 1899).

A similar apparatus was the log rocker, consisting of split, hollowed out logs measuring about 20 feet long. These were used in conjunction with various hand and mechanical ore breaking and crushing processes. After being pulverized to the consistency of mud, the ore went to the log rockers where a stream of water washed it through the trough to an open end. Grooves cut into the bottom of the rocker were filled with mercury to catch the gold particles and form an amalgam. Log rockers were typically set up in multiple units and could be operated manually or with powered machines (Figure 16). These were sometimes used to recover any residual gold that had passed through other collection methods.

Another device, the sluice, consisted of a flat-bottomed trough or chute through which water mixed with sand and gravel flowed. Water continuously flowed through the sluice while sand and gravel were shoveled in. Riffles built into the floor of the sluice created a suspension that allowed the lighter materials to wash

Figure 16. Log Rockers, Gold Hill District, North Carolina, Unknown Date (Nitze and Wilkens 1897).

out while catching the heavier gold flakes. Sluices were also used along with hydraulicking and booming, as described above. The "long tom" utilized a similar principal as a sluice but consisted of a trough with a screen or perforated metal plate (the "riddle") at the outlet end. Sand and gravel were shoveled into the trough and agitated as a continuous stream of water washed through, carrying smaller particles through the riddle and into a lower tier with riffles that caught the gold (Figure 17). Sometimes, mercury would be added to the riffles to amalgamate with the gold (The Colliery Engineering Company 1899; Richards 1909:322; Gregory 1907:7; Hayward 1952:426).

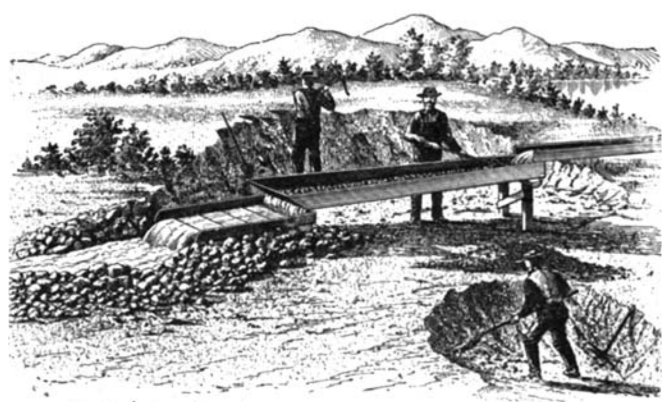


Figure 17. Long Tom (The Colliery Engineering Company 1899).

AMALGAMATION

Gold readily bonds to mercury, and the principal of amalgamation was to expose gold to mercury, which then drew it away from unwanted gangue. Common practice involved washing gold-bearing pulp (a mixture of water and ground ore capable of flowing) over a surface coated with mercury or amalgam. The gold was recovered from the amalgam by distilling the mercury in a retort and smelting the gold to remove residual impurities (Hayward 1952:430). Before reaching this point, the ore had to be reduced in size, a process conducted in one or more stages.

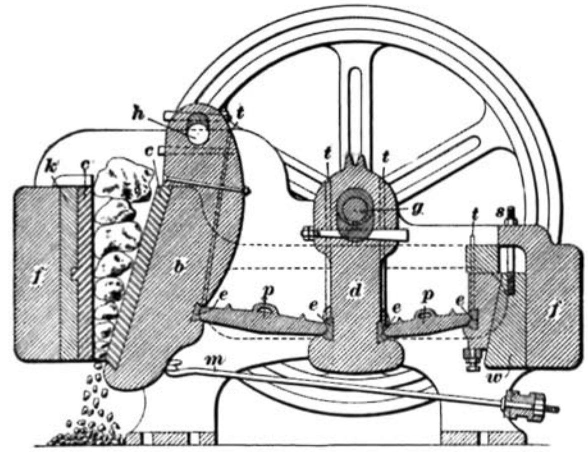


Figure 18. Blake Jaw Crusher. Blake Crushers Were Among the Most Common Types Used at American Mines (International Library of Technology 1902).

Breaking and Crushing

Although crushing ore could be an end stage in gold mining, it was nearly always a first step in extracting gold encased in hard rock or sulfides. As a stand-alone process, miners simply crushed the rock and collected the freed gold particles, commonly with one of the mechanical methods described above, such as panning. For amalgamation and hydrometallurgial processes, breaking and crushing was meant to reduce the rock for the machines that would handle it later, and to generate particles of a uniform size for subsequent treatments. Breaking was usually the first step, while crushing and grinding were applied sequentially to produce grains the size of coarse sand or finer ("slime"). This process of reducing and regulating the size of the ore fragments was known as "comminution" (International Library of Technology 1902:25.1; Thrush 1968).

Preliminary breaking reduced the ore to sizes suitable for the crushing machines and/or enhanced its friability. Methods included blasting, calcining by fire, hand hammers, and rock breakers. Blasting and hand hammering are self-explanatory. Other devices included jawbreakers that operated intermittently as the hinged jaws opened and closed (Figure 18), and spindle or gyrating crushers that ran continuously as rock was fed from an ore bin (Lock 1901; International Library of Technology 1902; Richards 1909; Hardesty 2010:67). Breaking took place underground at the mine, at the top level or surface of the mine, at the mill, or in a separate dedicated structure (Hardesty 1988:39).

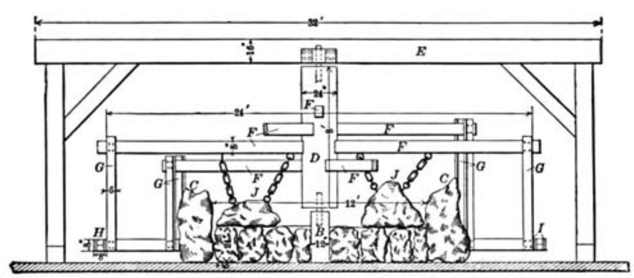


Figure 19. Cross Section of an Arrastra (Richards 1909).

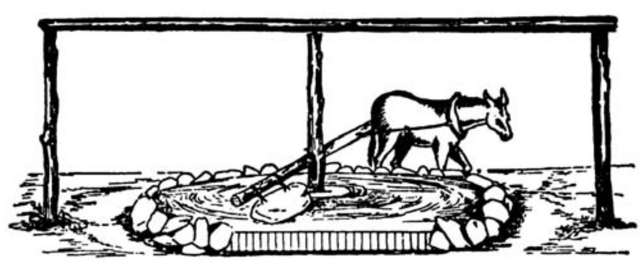
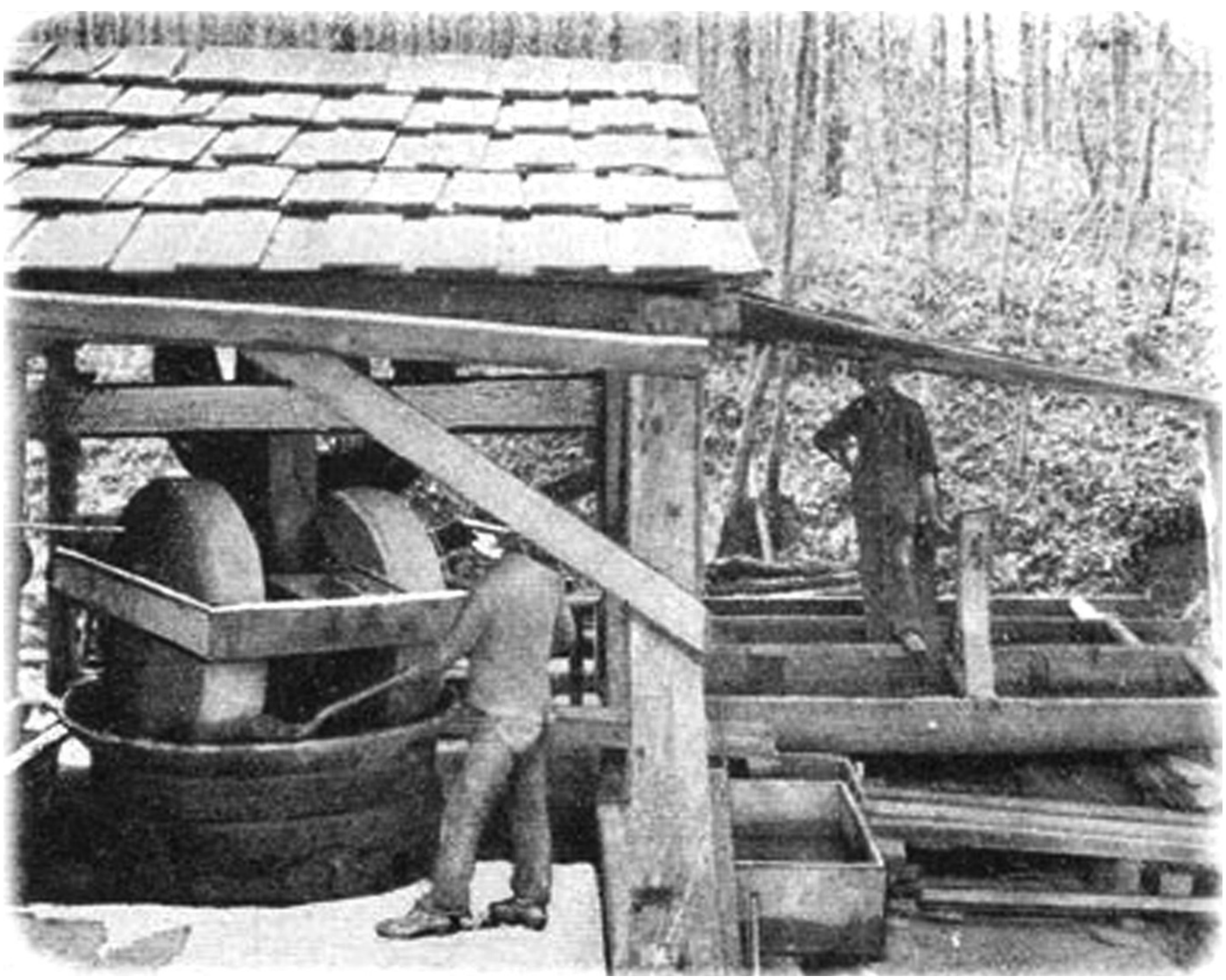


Figure 20. Operation of a Horse-Powered Arrastra (Rose 1898).

From the preliminary breaking, the ore went through processes that crushed or ground it into pulp that could be washed across the amalgamation plates. Early or "traditional" devices for this were arrastras, Chilean mills, and stamp mills. Arrastras were relatively simple devices. Often described as "primitive," they were used in Mexico by Spanish mining operations as early as the 1500s and persisted at small-scale operations in the American west into the twentieth century (Kelly and Kelly 1983:90; Van Bueren 2004; Hardesty 2010:17). Arrastras consisted of circular rock-lined measuring from 8-20 feet in diameter and varying in depth. They contained a central column crossed by a horizontal pole. Large stones slung from the poles were dragged around the arrastra to pulverize gold-bearing rock, which had been previously reduced to relatively small sizes (Thrush 1968; Hardesty 1988:39). Near the end of the grinding cycle, mercury was added to form an amalgamation. When complete, the pulp was let out of the arrastra and the amalgam was collected with sluices, cradles, or long toms. The process required considerable energy to operate and treated only low quantities of ore. To make a profit, relatively rich ores were necessary along with low investment and overhead costs (Kelly and Kelly 1983:86; Van Bueren 2004:7-8).

Chilean or chili mills resembled arrastras, consisting of circular enclosures with a stone or iron base. The principal difference was that Chilean mills used vertical rollers that ran around the enclosure to grind the ore (Figure 21).

Figure 21. Chilean Mill at North Carolina Gold Mine Near Salisbury (Nitze and Wilkens 1897).



Two variations existed: the first having the rollers rotate around a central point and the second having the base or a pan revolve around the central axis, which caused the rollers to turn (Thrush 1968). Early versions had one stone to rotate while later varieties had two or three wheels driven by water or steam (Richards 1909:152). Although they reflected an early technology, versions of Chilean mills remained in use through the nineteenth century.

Later devices for producing finely crushed slimes included a variety of grinding pans, tube and ball mills, roller mills, and pulverizers. These worked on different principles. Grinding pans had a heavy steel disc bear down on the ore as it rotated above a fixed plate. Tube and ball mills were cylindrical containers that rotated on a horizontal axis. Along with the ore, the mill contained stone or steel balls or rods that ground the ore as the machine rotated. As the ore achieved the desired size, it discharged through metal screens (Richards 1909; Hardesty 2010:69). These devices turned out the finely ground product from which very small metal particles could be recovered.

Stamp Mills

Stamp mills were the most common mechanized device for crushing gold-bearing rock in the nineteenth century. Miners from Cornwall introduced these devices to American goldfields and improved American versions were sometimes referred to as Cornish stamps. Stamp mills involved having a battery of heavy weights lifted by cams and then dropped on the ore, crushing it against a die (Roberts 1909; MacFarren 1910). They were often used in conjunction with amalgamation systems, although early operations might simply run the pulp through sluices to recover gold freed by the stamps (Quivik 2003:8).

The basic features of a stamp mill included the stamp, the mortar, and the lifting mechanism (Louis 1902:122) (Figure 22). The stamp consisted of a vertical steel rod ("stem"); a heavy steel weight at the lower end, composed of the "head" and "shoe;" and a collar or "tappet" about mid-way up the shaft. The stamp was suspended in a wooden or metal guide. Ore crushing

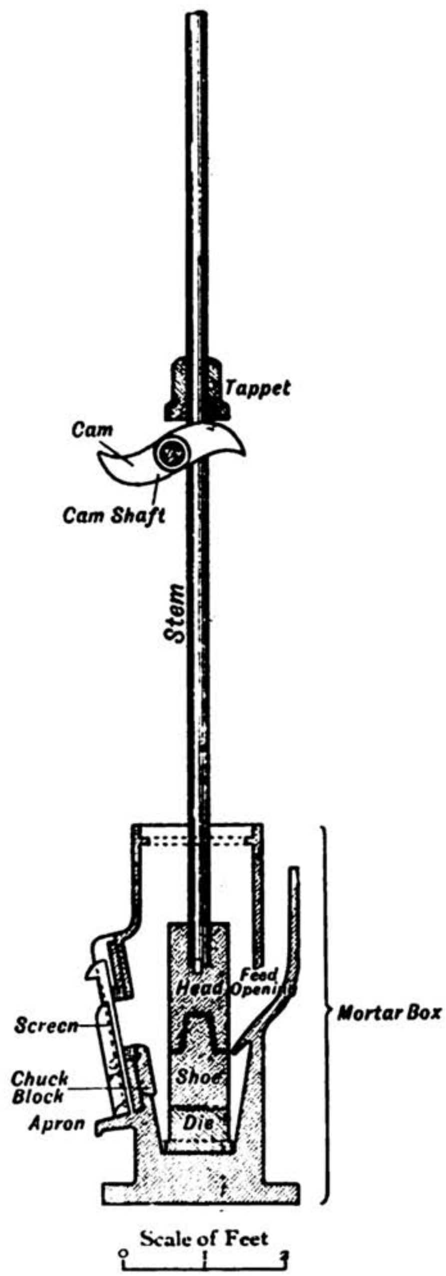
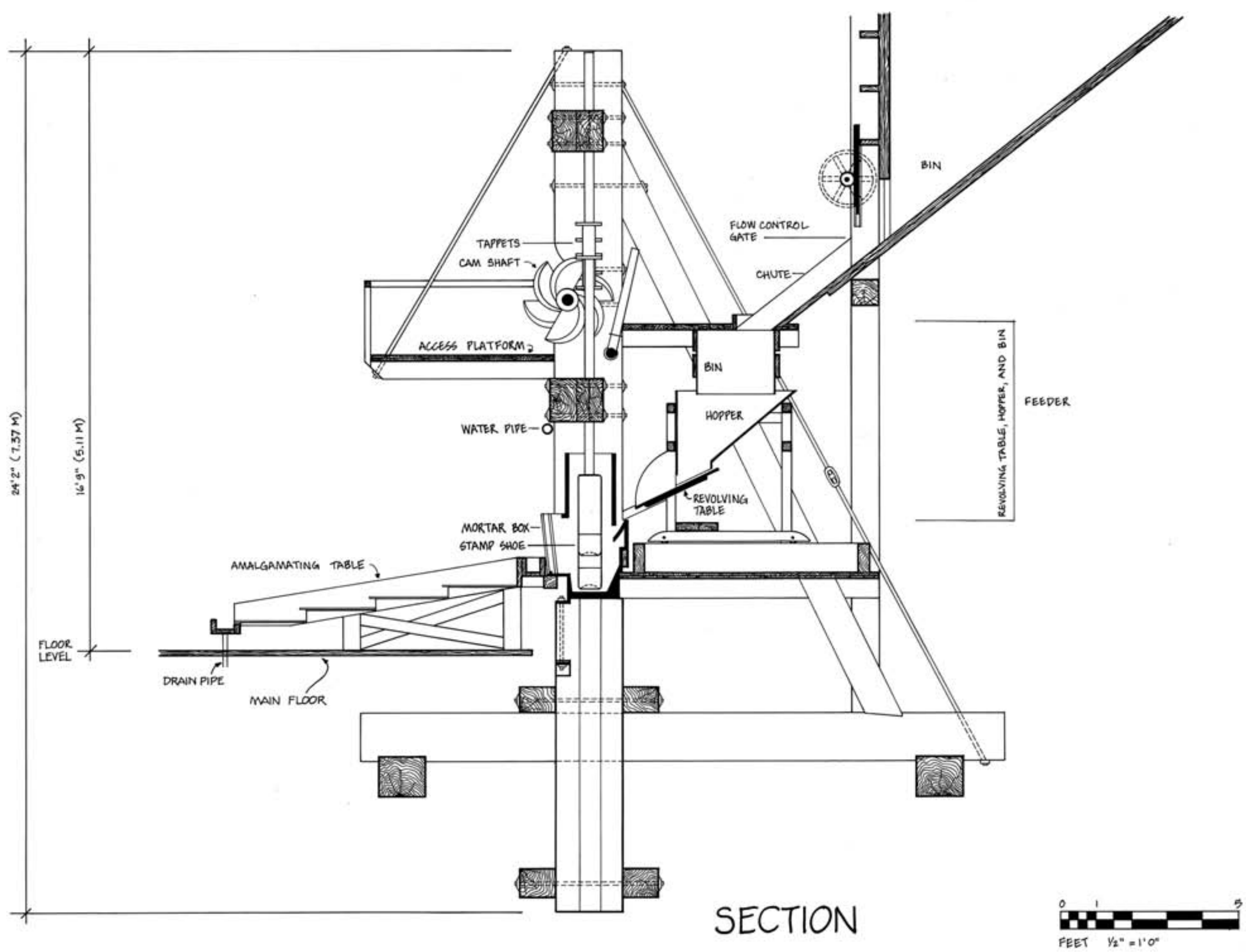


Figure 22. Basic Features of a Stamp (Gregory 1907).

took place in a container called a "mortar box," which had a feed opening or hopper for ore to enter and a screen across the discharge opening. Crushing took place on a die at the base of the mortar box. Mortar boxes were commonly sized to fit a row of 3-5 individual stamps. A camshaft extended across the stems just below the tappets. A pulley or spur wheel turned the camshaft, causing the S-shaped cams to engage the tappets, push the stamps upward, and then let them drop. The cams were usually arranged to fall separately in the order of 1-3-5-2-4. Ore was fed through the hopper with water and was crushed as it passed across the die. Once it reached the appropriate degree of fineness, it splashed through the screen and onto the apron plate at the front of the mortar box (Louis 1902; Gregory 1907:27; Hayward 1952:430).

Stamp mills or batteries were huge, multi-floor structures supported by large wooden frames and blocks to absorb the pounding (Figures 23 and 24). The aboveground portion of the mill could measure approximately 20 feet high and about 15 feet wide, including the drive pulley, for a five-stamp mill (Roberts 1909:87). The massive framing held the camshaft and guides for the stems. Built of wood, cast iron, steel, or wrought iron, the structure had to be extremely rigid and durable to withstand the constant hammering and the pull of the belt on the gearing. The usual arrangement consisted of two uprights for up to five stamps mounted on a horizontal sill. A third upright was added for a battery of 10 stamps. The uprights were connected

Figure 23. Stamp Mill Battery Section Showing Major Components (Arnold 1977).



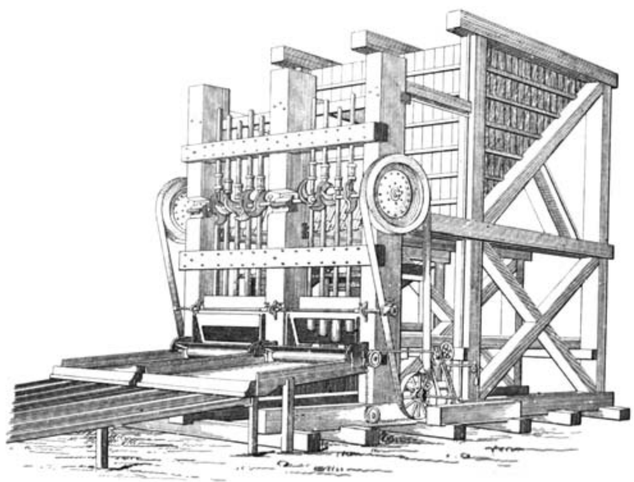


Figure 24 Ten Stamp Battery with Amalgamation Plates, Ore Bin, and Framing (Allen 1920).

with upper and lower guide beams through which the stems rose and dropped. Struts or more elaborate framing provided strength against the tension of the belt (Louis 1902:230). In addition, a platform or "cam floor" was added to the upper part of the uprights to give workmen access.

The battery sat upon the mortar block, which until the early twentieth century was typically built of logs, timber, or planks placed on end and bolted together. Logs measured eight to 15 feet long and 15-20 inches square. They were arranged to break joint and form a block between 20 and 30 inches wide by 48-60 inches long. Transverse straps of wood and iron were also added to the lower portion of the block to provide a wider base and assist in holding the block together. The blocks were set in custom-excavated trenches, which ideally were dug into solid rock or supported with rock or cement retaining walls. The bottom was rammed with cement and after the block was installed, the space between it and the trench walls was filled and rammed as well (Louis 1902:123-125; Roberts 1909:85).

Amalgamation took place simultaneously with stamping. The process entailed crushing the ore as described above and then placing the pulp in contact with mercury through various methods, the most common one was to wash the pulp from the mortar across copper tables or plates coated in mercury. A variant was the blanket table, consisting of a sluice-like device covered with wool. The heavier gold particles would settle into the wool and be recovered (Hardesty 2010:70).

The amalgamation process included the following fundamental steps. First, the ore was fed continuously into the stamp mill, sometimes with mercury added to increase the time the ore was in contact with it. Just beyond the mortar box were apron plates or tables with copper or brass surfaces coated with mercury. As the pulp washed through the screens and across the tables, it formed the amalgam. The interior of the mortar box might also be fitted with mercury-coated plates to increase the rate of amalgamation. At regular intervals, usually daily, the stamps were stopped to scrape the amalgam from the plates with a piece of hard rubber. The mortar boxes were cleaned as well and if they were being used, the inside plates were scraped and/or replaced. If amalgamation plates were not inside the mortar box, the residual sands would be collected and treated separately to remove gold. To recover the amalgamated gold, the amalgam was squeezed through canvas or chamois to strain out as much free mercury as possible and the remainder was put in a retort to distill the mercury, which could then be reused (International Library of Technology 1902:14-15; Louis 1902:310, 430; Richards 1909:103-106; MacFarren 1910; Hayward 1952:432-433).

The retort was a cast iron kettle with a tube that carried away the mercury vapor. These could be relatively small and portable or permanent brick structures with integral

Figure 25. Pot Retort. The Casing at the Lower End of the Tube is the Water Jacket For Condensing the Mercury Vapor (Richards 1909).

fireboxes (Figures 25 and 26). Balls of amalgam were loaded in the retort and heated to volatilize the mercury. The metal left in the kettle, called the "sponge," was put into a crucible for smelting along with a flux that separated the gold from residual impurities (MacFarren 1910:121-124).

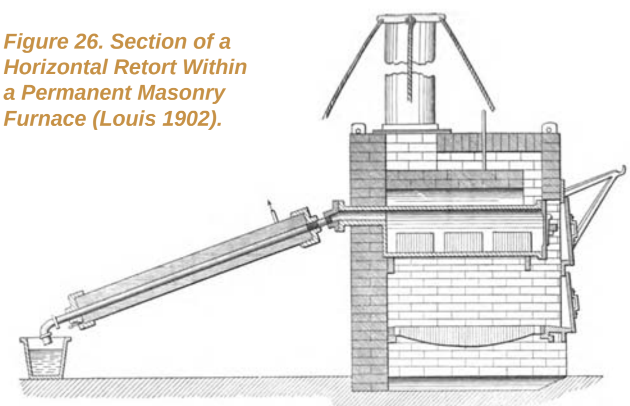


Figure 26. Section of a Horizontal Retort Within a Permanent Masonry Furnace (Louis 1902).

CONCENTRATING

In some instances, and especially through much of the nineteenth century, amalgamation was the only process used to separate gold from gangue and the tailings from the process were discarded. Improvements in ore handling allowed extraction of gold from the tailings, however. The first stage in treating the tailings was to increase the proportion of valuable material, a process called concentrating or classification that yielded "concentrates" or "sulfides" for further treatments.

Concentrating took advantage of the differences in specific gravity between two or more minerals, and the mechanical methods of beneficiation described above technically fall under this heading (Richards 1909). Machines used for the process, known as "concentrators," fell into two general categories. The first group used water currents to sort material into layers that could then be removed separately. Jigs were the main type of device in this category. The second category relied on the ability of heavier particles to cling to a surface against the force of a stream of water. This group included table and belt concentrators (International Library of Technology 1902:26.22). The type of machinery in use depended on the specific minerals involved, their individual properties, and the preliminary treatments that had already been completed. Both types were employed in Carolina gold mills.

Jigging involved sending intermittent water currents through a mixture of minerals to separate the ones with different specific gravities. The crushed minerals were placed in a box with a screen bottom and water was either pulsed through the mixture using a plunger or

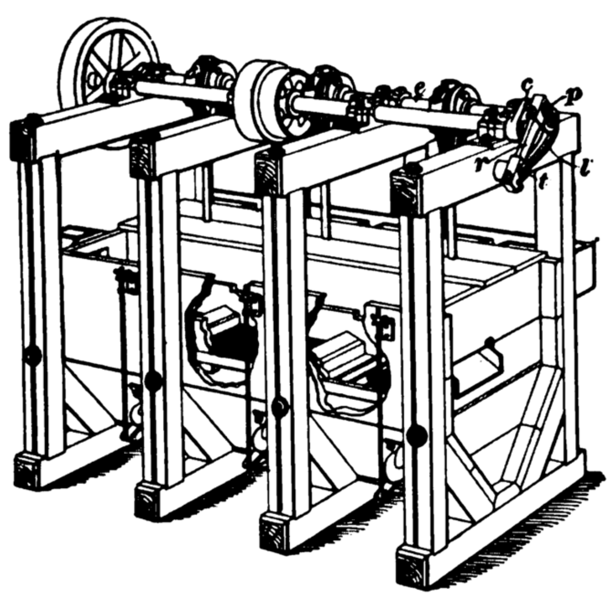


Figure 27. Three-Compartment Hartz-Type Jigs (International Library of Technology 1902).

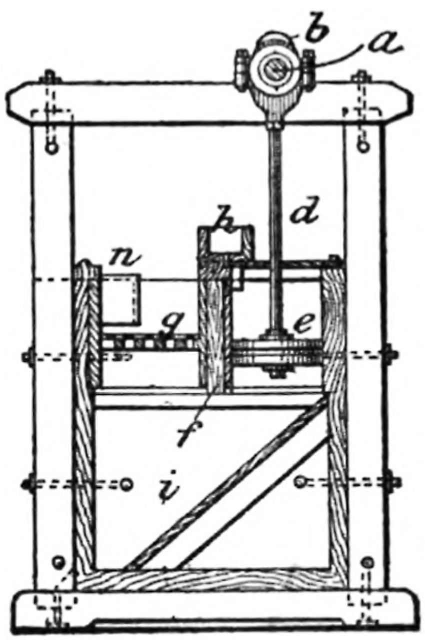
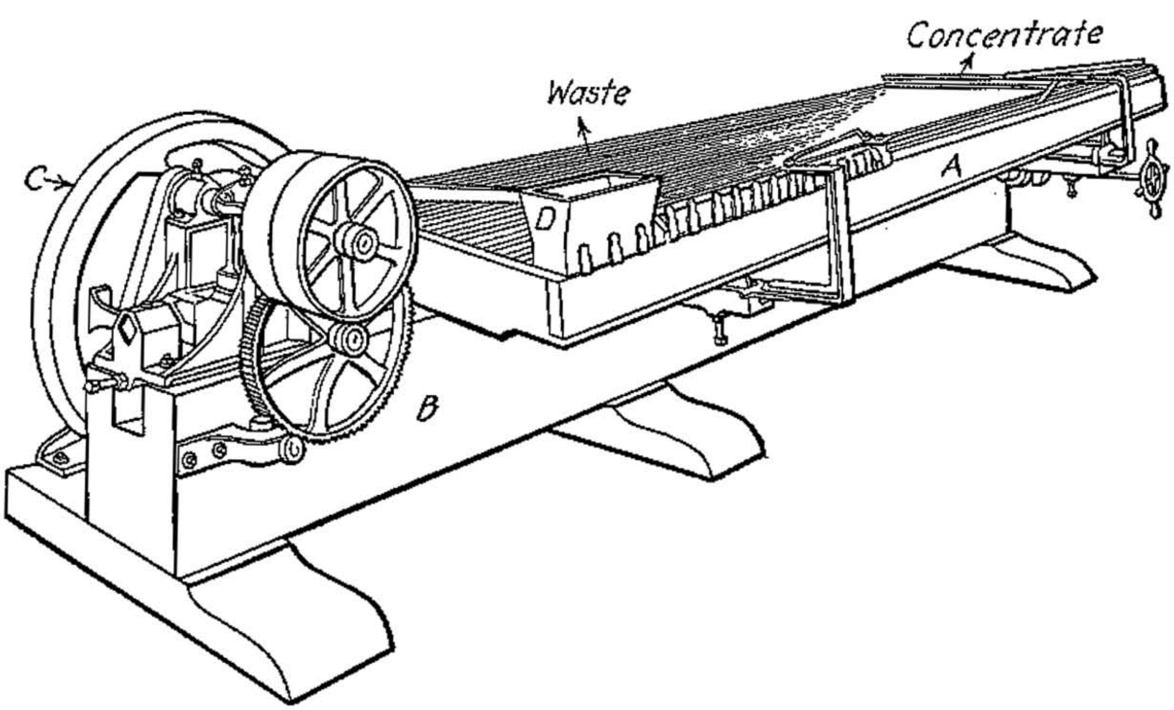


Figure 28. Section of a Hartz Jig Showing Arrangement of the Piston and Ore Box (Eissler 1900).

Figure 29. Wilfley-Type Concentrating Table (Hayward 1952).

piston (Figures 27 and 28). Alternatively, the box was moved up and down to put the minerals in suspension. The minerals settled into layers that could be collected separately (Richards 1909:277; Hayward 1952:6).

Other types of concentrators were known as "bump tables" or shaking tables. These essentially consisted of a rectangular surface covered with longitudinal shallow riffles that ended at a smooth cleaning surface at the discharge end (Figure 29). A mechanism oscillated--or bumped--the table, causing materials to move from the feeder to the opposite end. The table was also set at a slight angle on its long axis, the waste side being lower. Sands were fed continuously and worked along the long axis of the table while water was washed across the riffles and down slope. As the machinery oscillated the table with a series of short movements, the heavy minerals settled into the riffles and moved to the opposite end of the table. The water washed the lighter materials across the riffles and off the low side (International Library of Technology 1902:27.2; Hayward 1952:7; Thrush 1968).



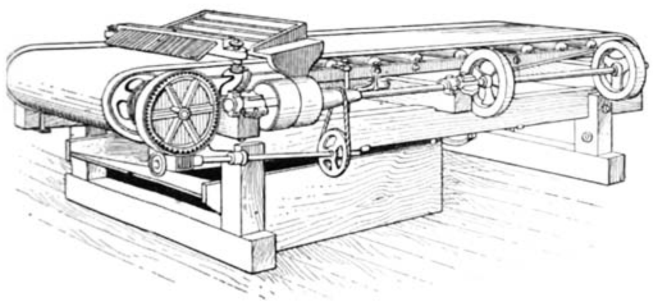
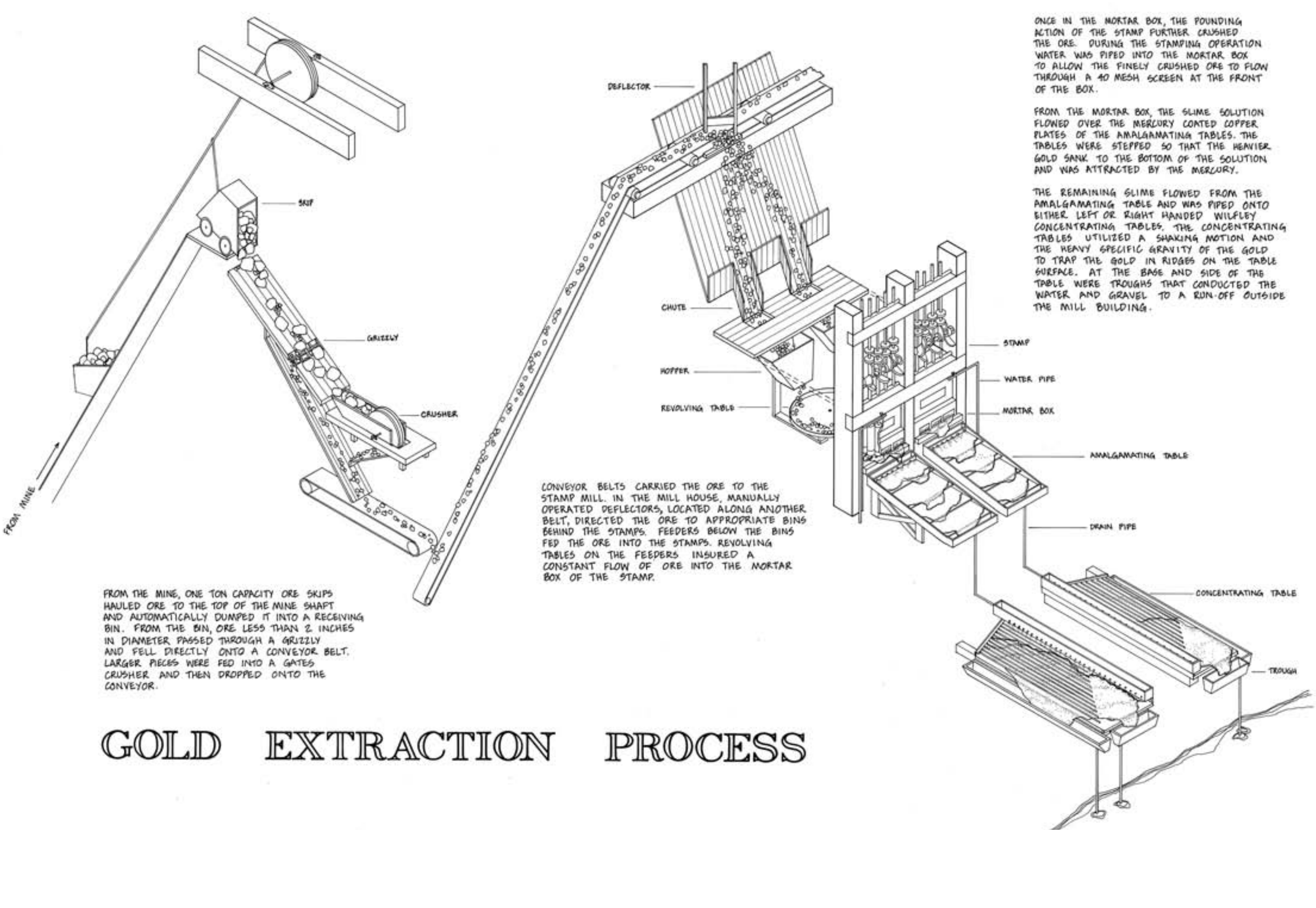


Figure 30. "Vanner" or Belt Concentrator (Louis 1902).

Belt concentrators or "vanners" consisted of a rubber belt traveling up a slight inclination (Figure 30). Ore separation took place as a constant flow of water washed across the crushed ore while the belt was simultaneously shaken side to side to agitate the particles and keep them in suspension. Pulp was fed onto the lower end of the belt while wash water came in from the upper end to carry away the lighter materials. The heavier particles settled onto the belt and were dropped off at the upper end (International Library of Technology 1902:27.5-6; Richards 1909:350; Thrush 1968). Concentrates obtained through these methods consisted of enriched pulps containing higher proportions of gold to waste material. These went on to further processes to remove the gold from the residual gangue.

Concentration, as noted, was typically used in conjunction with other processes. The tailings from amalgamation went through concentration and the resulting concentrates then proceeded on to hydrometallurgical procedures, usually chlorination or cyaniding in the Carolinas. Figure 31 diagrams the flow of materials from breaking through amalgamation and concentration.

Figure 31. Diagram of the Ore Handling Process from Crushing Through Stamping and Concentrating, Coggins Gold Mine, Montgomery County, North Carolina (Lewis 1977).



HYDROMETALLURGY

Hydrometallurgy involved the treatment of ore, concentrates, and other metal-bearing materials by wet processes, usually involving conversion of one component to solution and its recovery from the solution (Thrush 1968). Variations of two methods were used at Carolina gold mines: chlorination and cyanide.

CHLORINATION

Considered obsolete by the mid-twentieth century, the chlorination process involved converting the gold to chloride, leaching it out with water, precipitating it, and then refining it (Hayward 1952:417). The process was developed in 1848 by Carl Frederick Plattner and introduced in California in 1857 (International Textbook Company 1902:34.1; Hardesty 1988:47-48, 2010:80). The method was common in the Carolina goldfields. Technical advancements to the process included changing the containers in which chlorination took place and improving the preparation and introduction of the chlorine.

Roasting

Before the ore went through chlorination, it was roasted. Roasting could take place either in bulk as the ore came from the mines or after it went through stamping and concentrating (Eissler 1900:258). The purpose of roasting was to drive off sulfur, arsenic, and other volatile substances that were combined with the metals and to form metallic oxides, leaving only metallic gold that could combine with chlorine during the subsequent chemical treatment (Rose 1898:234). The process also changed the character of soluble salts such as ferrous sulfate or chloride so they would not act on the gold in solution (International Textbook Company 1902:34.4).

Roasting could take place in the open, a technique known as “pile roasting” or “heap roasting.” Although essentially this involved piling the ore on a bed of fuel and firing it, the method of arranging the pile was important to achieve certain results. Ideally, larger fragments of ore were placed in the center of the pile with smaller sizes towards the exterior. The whole was covered in a layer of fines or concentrates. Moreover, the bed was specially constructed of layers of slag, clay, and calcined ore with channels to allow air to circulate. The mound of ore could measure between about 6-8 feet and were built in the shape of a truncated square pyramid and could range from 25-85 feet on a side (Schnabel 1898:29-30). The most common practice was for the pile to measure about 24x18x6 feet high. A pile this size would burn 30-40 days (Eissler 1900:278)

In the Carolinas, roasting was mostly accomplished in furnaces or reverberatories. The process began with a low heat that freed the sulfur of the sulfides and combined it with oxygen to produce volatile sulfuric acid. Known as an “oxidizing roast,” this stage required the introduction of excessive air into the furnace as the ore was heated. As the metals in the ore lost part of their sulfur, they were converted into oxides and sulfates, consisting predominantly of iron sulfates. Because these would precipitate the gold from a solution of chloride of gold, they required elimination by gradually increasing the roaster heat to decompose the sulfates and form oxides, a process called a “dead roast” (Wilson 1897:20-21; Eissler 1900:258-260; International Textbook Company 1902:34.4). For “chloridizing roasting,” salt was added during the roast if certain substances, such as lime, magnesia, or lead, were present in the ore. The heat released chlorine from the salt. The free chlorine then combined with the metals to form metal chlorides that would not absorb chlorine during the subsequent treatment (Rose 1898:242; International Textbook Company 1902:34.4-5). In sum,

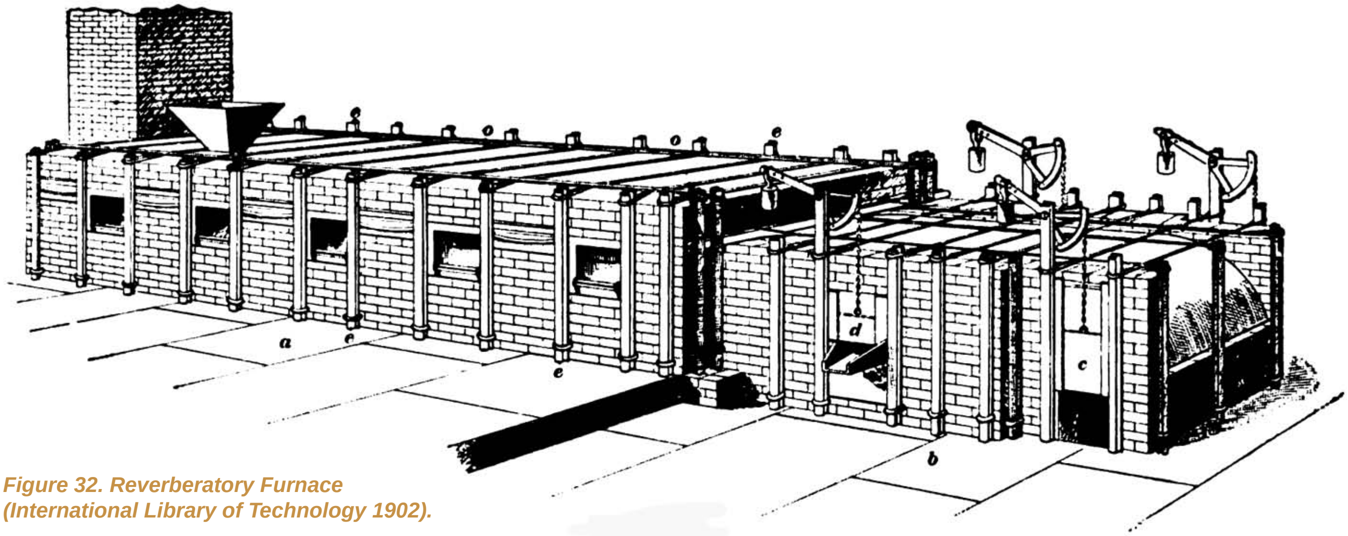


Figure 32. Reverberatory Furnace (International Library of Technology 1902).

roasting freed the gold so that the chlorination gas or solution could act on it most effectively and eliminated substances that would interfere with chlorination.

Various models of roasting furnace existed, with several being experimental models that never went into widespread use. The basic form of furnace was a reverberatory, so called because the roof of the hearth reflected heat back onto the surface of the ore charge (Figure 32). The key features of a reverberatory furnace were a shallow hearth, a low roof that gradually sloped downward from the firebox end to the stack end, and a raised wall (the “bridge”) separating the flame from the ore that also directed the flame and heat toward the arched roof. Additional features included a hopper to load ore and apertures in the sides for spreading and stirring the ore (Wilson 1897:41-42; Rose 1898:235; Thrush 1968:920). Furnaces might also possess archways underneath the hearth that allowed ore cars to pass below and be loaded with the roasted ore. Construction of the furnace was brick, with firebricks used where necessary, and the entire structure was secured with iron bands to prevent expansion (Rose 1898:235; Eissler 1900:288). A tall chimney provided a draw. Wood was the preferred fuel because it did not contain sulfur and ash that might reach and contaminate the ore (Wilson 1897:41), although Rose (1898:235) indicated that length of burn was most important, with either long-flame coal or wood being acceptable as fuel.

Among the variations of the basic single furnace was the double furnace, built with one hearth above the other with return flues that allowed heat to move from the first furnace up and back across the hearth of the second. Wilson (1897:43) noted that this type of structure was used to dry one charge of ore in the upper furnace, while another charge roasted in the lower furnace. Once the lower hearth was cleared, the dried ore above was dropped to the lower hearth. In a different process described by Eissler (1900:290), the ore in the upper hearth lost most of its sulfur, after which it was drawn to the lower hearth to finish roasting. A third hearth built above the first two was used for drying by drawing the heat across it before venting through the chimney. This kind of roaster required hand rabbling, or stirring, the ore as it is roasted to expose various surfaces of the ore to the heat and keep it from fusing (Wilson 1897:24).

Additional types of furnaces were classified as mechanical furnaces, designed to save the labor necessary for operating a reverberatory. Mechanical furnaces were classified into four classes: stationary hearth furnaces with mechanically moving hoes for rabbling; rotating-bed furnaces with stationary hoes or stirrers; rotating cylindrical furnaces that tumbled the ore while it was roasted; and shaft furnaces arranged to have powdered ore fall in a shower through an ascending column of hot air. Numerous brands and variations on these basic types were available and put into use with varying degrees of success (Rose 1898).

As roasting was completed, the ore was moved to a cooling floor. From here, it went to the chlorination plant.

Chlorination Procedure

The basic chlorination procedure involved exposing roasted ore to chlorine gas and then leaching the ore in a water solution to produce gold chloride. Ferrous sulfate was added to the solution to precipitate the gold, which was then filtered out (Hardesty 2010:79). The precipitated gold was then melted into bars (Thrush 1968).

The Plattner chlorination process, developed by Karl F. Plattner in the 1850s, took place in airtight pitch-coated wooden vats (Figure 33). Chlorine gas was produced outside the vat in a separate process and introduced to the roasted ore via a pipe at the base of the vat. The gas was allowed to permeate the ore over several days. At the end of this time, water was added to leach out the trichloride of gold and this solution was drawn off to precipitating tanks, built of wood staves in the same manner as the chlorination vats and also sealed with lead, pitch, or other material. A solution of iron sulfate was added to the tanks before the gold solution entered, causing the gold to precipitate into a brown powder that settled to the bottom of the tank. The residual solution was siphoned off and the process

Figure 33. Chlorination Tub Used For the Plattner Process (International Textbook Company 1902).

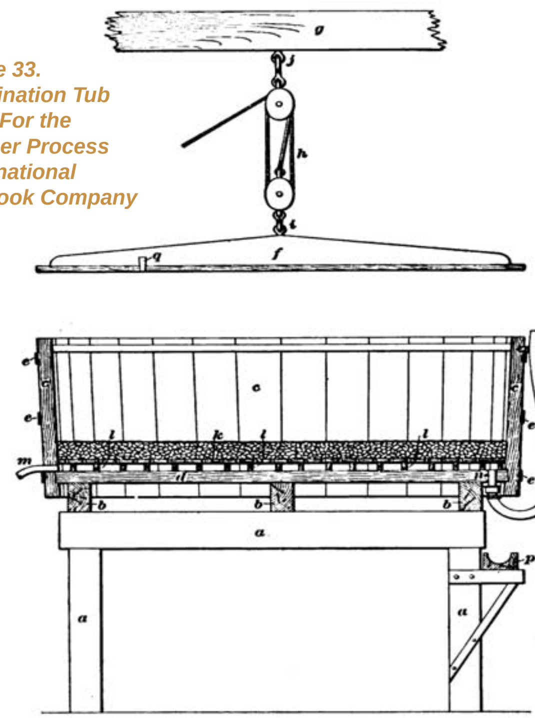


FIG. 1

of adding ferrous sulfate and a fresh solution from the leaching vat was repeated several times until enough gold precipitate accumulated to warrant cleaning it from the tank. The precipitate was gathered, washed, dried, melted in crucibles, and formed into gold bars (Eissler 1900:345; International Textbook Company 1902:34).

Modifications to the basic process related primarily to ways the chlorine was introduced to the ore and how the chlorination was handled. The first innovation was the substitution of revolving barrels for the vats, as in the Delacy process (patented 1864). This improvement shortened the time required to chlorinate a charge of ore. Also, the barrels had a larger capacity than the vats. Another modification was the Mears process (patented 1877), which exchanged the wooden containers with lead-lined iron barrels and modified the gas-introduction procedure to admit it under pressure, which was thought to speed the rate of chlorination (Eissler 1900:382; International Textbook Company 1902:34.2).

Carl Thies developed important innovations to the chlorination process that he probably worked out during the 1870s and 1880s at the Phoenix Mine in Cabarrus County, North Carolina and then implemented at Haile Gold Mine, Lancaster County, South Carolina when he took over there in 1888. Thies' major innovation was eliminating the production of chlorine gas outside the barrel along with the equipment for pumping it into the ore barrel under pressure. Instead, the chlorine was created in the same barrel as the ore (International Textbook Company 1902:34.1-2). Thies also made changes to barrel size and the number of rotations to achieve optimal results (Rose 1898:302; Wilson 1897:99).

Barrels used in modern (ca. 1900) plants varied from 5-15 tons, had outer shells of 0.5-inch thick steel, and measured nine feet long and five feet in diameter. Manholes were added to allow access to the interior and steam-powered gearing rotated them. The barrels contained filter bottoms consisting of perforated iron sheets covered with asbestos cloth and wooden grating (Figure 34). The rotation was stopped so that the barrel assumed a particular position with the filter at the base and the manholes at the top. The trichloride of gold solution was drawn off from the bottom, with pressurized air helping to force it through the filter. Once this step was finished, the barrel was rotated 180 degrees to put the manholes to the bottom and the spent ore was removed (International Textbook Company 1902:34.18-19). Despite these improvements, the general process of chlorinating ore remained roughly the same, with the leached ore passing from the barrels to precipitating tanks and then to smelters (Figure 35).

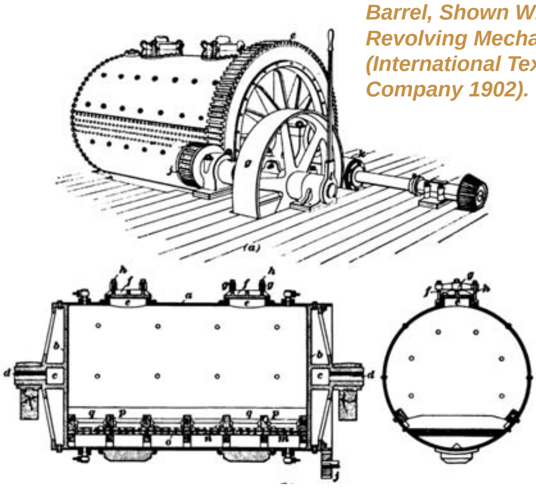


Figure 34. Metal Chlorination Barrel, Shown With Revolving Mechanism (International Textbook Company 1902).

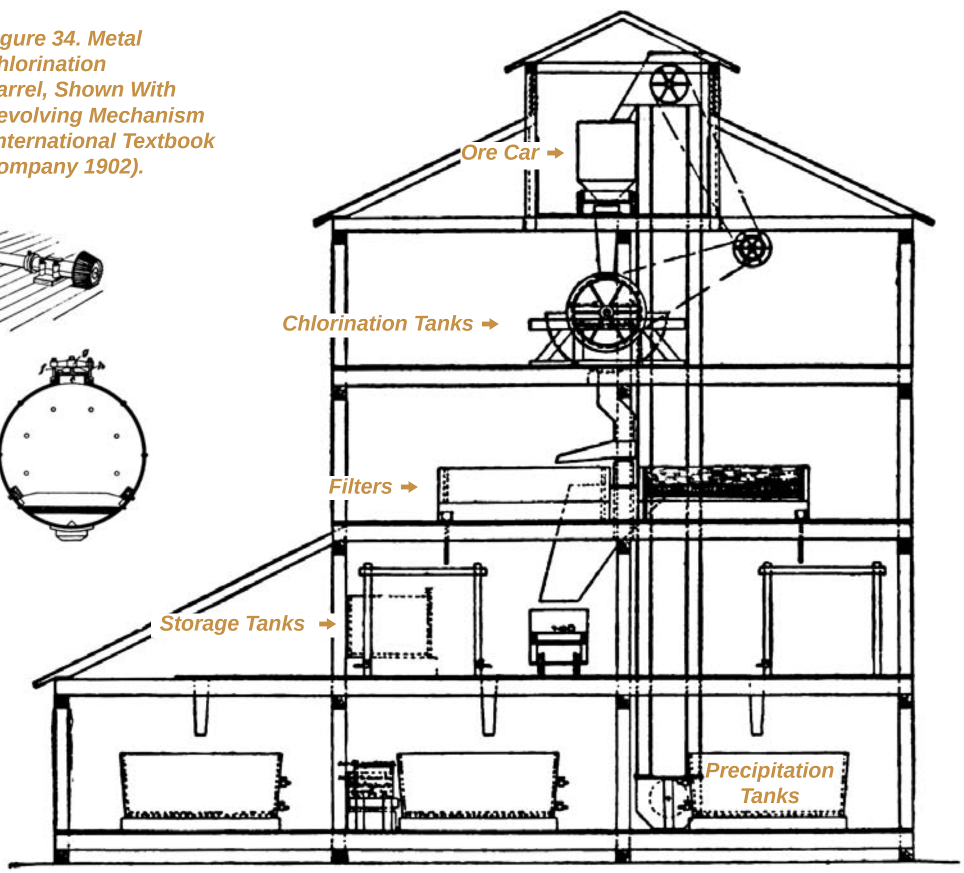


Figure 35. Cross-Section of the Chlorination Plant at Haile Gold Mine, Lancaster County, South Carolina, circa 1880s-1908, Illustrating the Chlorination Process (Nitze and Wilkens 1897).

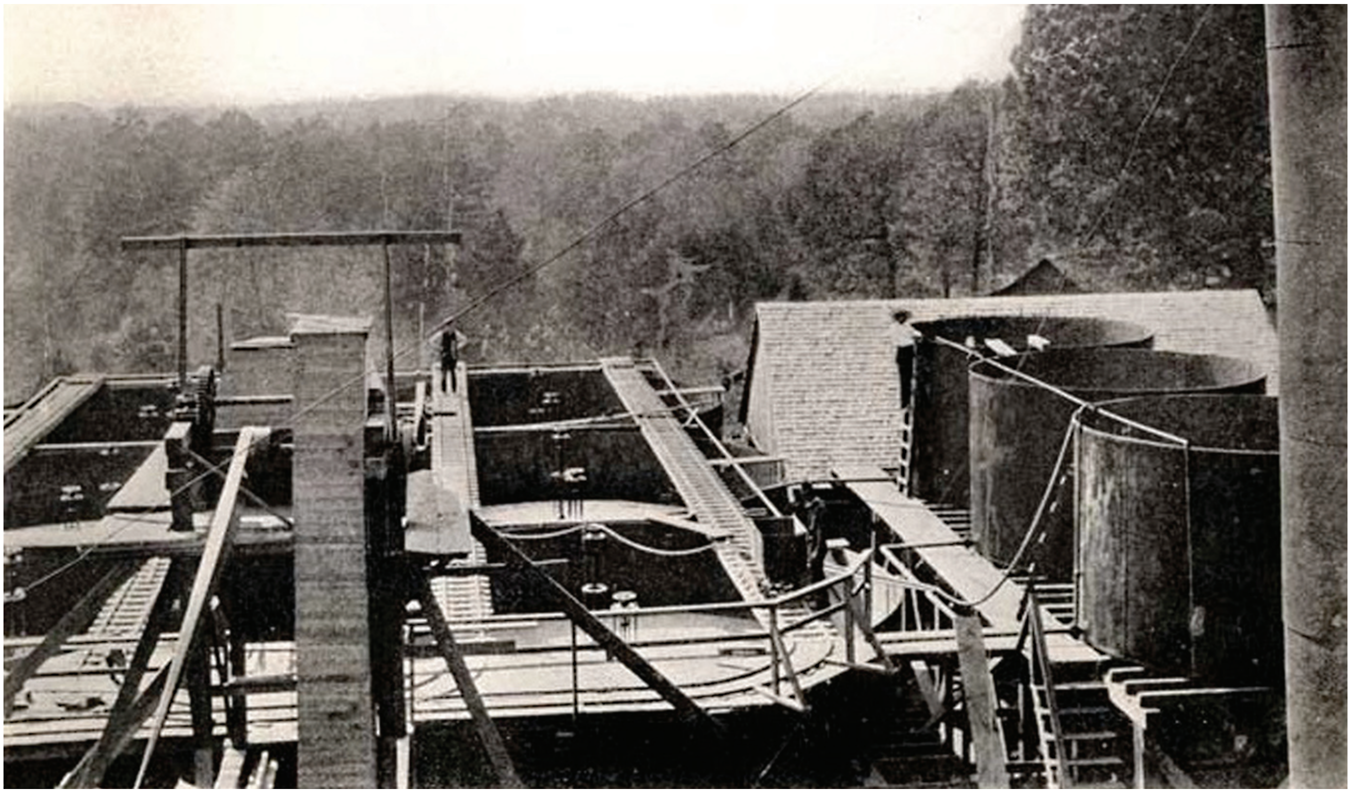


Figure 36. Howie Mine Cyanide Tanks, Union County, North Carolina, circa 1906. Six 190-Ton Leaching Tanks are to the Left with Tracks That Allowed Access For Ore Cars to Load Them. The Three Tanks at Right Contained Cyanide Solution (Howie Mining Company 1906).

CYANIDE

Cyaniding is the process of treating ground gold and silver ores with a solution of sodium or potassium cyanide. The method was developed in the 1880s and began to replace other methods soon afterwards. The first American cyanide mills were built in 1891 and used for gold. The method was not applied to silver ores until after 1900 (Hardesty 1988:51, 2010:84). Cyanide processes in combination with improved milling procedures helped create a resurgence of gold production in the Carolinas between 1900 and World War I (Knapp and Glass 1999:140) (Figure 36).

The cyanide process could vary in specific steps and procedures depending on the nature of the ore and materials, but there were three principal stages to the process: dissolving, precipitation, and smelting (Hayward 1952:437; Thrush 1968; Hardesty 1988:51). Roasting was not usually required except to remove an element that prevented or hindered the gold's solution in cyanide (Clennell 1910:286). Cyaniding worked best on fine concentrates because the smaller particles dissolved fastest (Eissler 1900:485).

Clennell (1910) described the process as it was generally practiced. Typically, sands and slimes were treated separately with different techniques. Sands went through percolation methods and slimes through agitation. Some plants only processed very fine concentrates using the "all sliming method," which required finely pulverized ore (Hayward 1952:437-438). By 1910, "all slime" plants achieved the desired texture with ball and tube or rod mills (Hardesty 1988:41; 2010:69). The detailed descriptions provided below indicate the processes along with equipment and materials.

Cyaniding was applied to the tailings of amalgamation, which removed the coarser gold particles. Wilfley tables or other concentrators separated and enriched the gold-bearing ores before further treatment. The amalgamation tailings then went through a hydraulic separation process in a device known as a “spitzlutte,” which used water jets to separate the slimes and sands. Sand then went through percolation to ready it for cyaniding. Percolation involved distributing the sand in a collecting vat that was continually flushed with water to float off residual slimes. The sand might be treated with lime at this point to reduce acidity. Next, the sand went to a filter or leaching tank where dissolving took place. This stage required a series of washes, typically including 1-2 baths in a weak cyanide solution, one in a strong solution, and several more in increasingly weaker solutions. Finally, a water wash completed the process. The solution was drawn off from the bottom of the tank so that the filter, a mat of coconut fiber and canvas, ensured the clarity of the liquid. Sometimes, additional settling was required to make certain that the liquid sent to the precipitation boxes was clear (Clennell 1910:33ff; Hardesty 2010:88).

To this point, slimes were handled differently. Once separated from the sand, the slimes went to a spitzlutte or other vessel to remove superfluous water. Lime was added to help the slimes coagulate and settle. Alternatively, slimes were processed on concentration belts before going to collection tanks for settling. The dissolving stage took place in agitation tanks where mechanical stirrers or pressurized air injections suspended the tailings long enough to be dissolved. The slimes might go through additional procedures such as decantation, during which additional settling and agitation took place before the water and moist residue were separated, or filter presses, in which compressed air or vacuums separated the liquid from the solid residue. The important point in treating the slimes was to ensure that the liquid sent to the precipitation boxes was as clear as possible (Clennell 1910; Hardesty 2010:89-90).

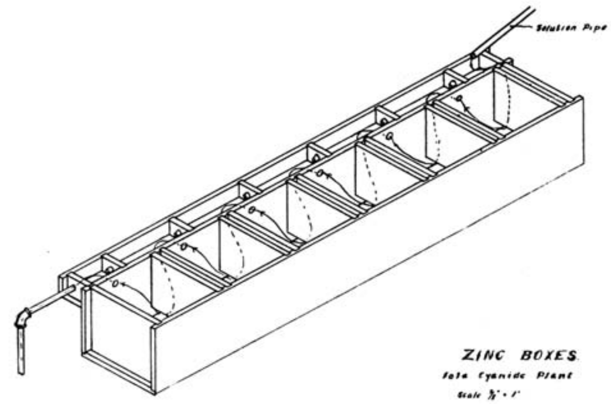


Figure 37. Zinc Boxes Used at the Iola Mine Cyanide Plant, Montgomery County, North Carolina (Platt 1907).

The solution from the sands and slimes went through the same processes of precipitation and smelting. Precipitation took place in zinc boxes, consisting of trough-like containers with internal dividers that allowed the solution to flow under and over them as successive boxes were filled (Figure 37). Zinc shavings were added to the solution to precipitate the gold. At this point, a metallic deposit formed on the zinc, which if done properly would be brownish black and would be most prevalent in the first compartment of the zinc box but decrease thereafter. The gold precipitate was collected and put through an additional acid treatment to convert the zinc to water-soluble zinc sulfide and eliminate other impurities that could be washed out. This process was sometimes aided by stirring or heating, or the precipitate was roasted instead of being subjected to acid treatment. The final step in the process was smelting. The precipitate was mixed with a flux and sometimes an oxidizer, heated in crucibles or reverberatories, and the bullion cast into molds (International Library of Technology 1902:32:11; Clennell 1910).

GOLD MINING PRACTICE

It is important to note that while gold mining involved several steps from extraction to producing bullion, individual mining operations could include or omit particular steps, or combine them in different ways,

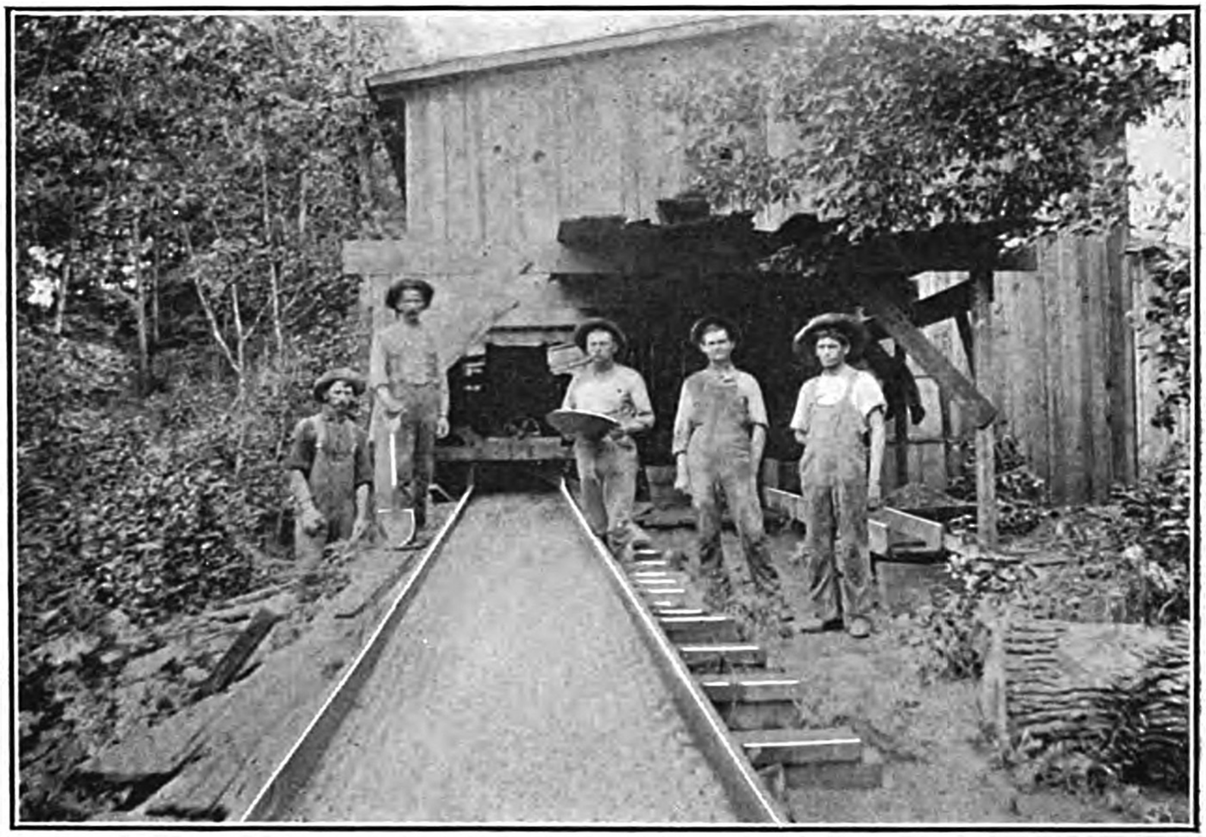


Figure 38. Gold Mining Could Involve Varying Levels of Technology. One Miner is Holding a Pan to Check Tailings of Mechanical Log Washers. Shuford Mine, Catawba County, North Carolina (Pratt 1907).

depending on the nature of the ore, the chronological period, or the preferences of specific mine operators. The preceding descriptions reflect general practices for gold ore handling as conducted in the Carolinas, insofar as they are known. Different individual steps and equipment types could be combined in various ways. For example, panning or log rockers, both representing relatively simple concentration methods, might be used as a final procedure on ore tailings that had already passed through more elaborate and mechanized crushing and concentrating processes. Thus, these "earlier" and "more primitive" techniques could be found in direct functional and chronological association with extensive underground workings, stamp mills, and concentrating plants. Also, steps might be omitted altogether. As noted, hydraulicking systems in the Carolinas were often used to re-work tailings from other processes. A hydraulicking operation, then, might possess elaborate and possibly extensive water management features but would not necessarily have associated stamping and crushing machinery. Finally, different methods could be used in combination, for example cyaniding was sometimes used in conjunction with amalgamation (McCauley and Butler 1966:4). Some mine operators, on the other hand, could not afford to build chemical treatment plants and so performed only the stamping and concentrating and then sent the concentrates elsewhere for treatment (Brenner 1977:2).

Another point to consider is that there is no precise correlation between site complexity and chronology. Although the preceding overviews of mining history and processes imply a trajectory toward more elaborate mining operations as easy to reach and process ores played out, some of the simplest gold recovery methods persisted through the nineteenth and twentieth centuries. As noted, for example, pans and log rockers could be used in combination with larger operations (Figure 38). They were also associated with smaller mines and prospecting even as some mines expanded tremendously and employed elaborate systems and equipment. Moreover, around the turn of the century, a few North Carolina mines installed older types of equipment, such as log washers, to handle ore from saprolites (Pratt 1907:18). (Log washers were trough-like containers containing a central rod with paddles. As water and saprolite were added, the paddles agitated the mixture and released the rock from the clayey saprolite.) During the Great Depression of the 1930s, people tried to find gold at many abandoned mines using these techniques (Knapp 1975:17). Smaller and less elaborate mines could thus date more recently than larger ones and therefore, researchers dealing with individual mines, mills, and plants must consider a range of possible configurations and chronological associations.

V. Gold Mining Property Types

Interpreting and evaluating gold mining sites in the Carolinas requires accurate identification of numerous individual sites and features. Identification establishes the historical and functional contexts of properties and therefore is necessary to evaluate their historic and archaeological significance. In addition, knowledge of resource types and how they functioned together can help delineate individual processes on sites with multiple or overlapping activities. Finally, correct identification can generate important data for studying historic gold mines, even when the site at hand lacks significance under the NRHP. The preceding overview of gold mining processes in the Carolinas indicated the range of activities that produced cultural resources and how they related to one another. The following discussion provides guidance for identifying specific resource types and linking them to particular mining processes.

Hardesty and Little (2009:27) referred to property types as the "key link between the historic context of a property and the property itself." Property types are groupings of individual properties that share physical and/or associative attributes. Physical attributes may encompass style, structural type, size, scale, proportions, design, method of construction, spatial arrangement, or others. Associative attributes are the property's relationship to important persons, activities, and events (Lee and McClelland 1999).

Approaches to defining and categorizing property types related to mining typically focus on their functional associations. For example, Noble and Spude (1997) organized properties into the three principal activities of extraction, beneficiation, and refining. They also included property classes associated with mining but not directly related to the extraction and handling of ore, such as landscapes, as well as buildings, structures, or systems that support mining operations. Property types might occur in various combinations. Small-scale, simple mines might include only extraction-related activities, while types associated all aspects of extraction, upgrading, and refining ores, along with support activities, might be present at larger mining operations (Noble and Spude 1997:10; CALTRANS 2008:81).

CALTRANS (2008) developed a historical context and archaeological research design for mining properties in California that provided an excellent reference for identifying, classifying and describing historic resources associated with mining. Although the authors of the CALTRANS study organized property types by functional categories like other guides, their concern with accuracy in identification led them to provide detailed descriptions of different types of archaeological resources. This approach is useful to emulate for historic gold mining properties in the Carolinas because it would contribute to greater consistency in site descriptions, as well as encouraging archaeologists in the Carolinas to closely observe and record the forms and functions of the resources they find and evaluate.

Types are divided into five categories: (1) prospecting and extraction; (2) ore processing; (3) intra-site ancillary features; (4) domestic remains pertaining to social, non-technical elements of mining; and (5) large regional linear properties that support the mining operation. With certain modifications, these five general categories are applicable to Carolina gold mine sites. [It should be noted as well that CALTRANS was able to draw on relatively well defined, documented, and visible resource types, but archaeologists and historians in the Carolinas have not always had these kinds of resources in mind when conducting surveys or dealing with gold mine sites. Consequently, the resource types proposed here are partly speculative and subject to revision as investigators put more emphasis on identifying and studying them.]

PROSPECTING AND EXTRACTION PROPERTY TYPES

Prospecting and extraction property types reflect the activities related to the discovery, assessment, development, and working of gold mines. An extensive range of property types fall into this functional category and the types can be divided and subdivided depending on the type and scale of mining involved. CALTRANS (2008) separated resources into types related to placer mining and those associated with hard rock/lode/vein mining. These different resource types produced distinctive and characteristic material remains that might be distinguishable in the Carolinas.

PLACER MINING

Different resource types and morphological variation of placer mining can be indicative of different time periods, technologies, and methods. Resource types that CALTRANS (2008:82) placed under placer mining included:

- Tailings piles, subdivided into small piles of placer tailings, oblong piles of placer tailings, long lines of placer tailings, pits with placer tailings, and surface exposures of placer rock;
- Cut banks, channels, and placer tailings;
- River diversion;
- Dredge tailings; and
- Drift mining remains.

Tailings piles are waste rock left from prospecting or mining. At placer mines, they consist of water-worn rocks with little soil located on creek drainages, along bars and riverbanks, or at locations of ancient exposed river deposits. They can be various shapes and sizes, depending on the methods and equipment that produced them. For instance, a tailing pile produced using a rocker would have an undulating ground surface composed of uniform-sized gravel and cobble deposits where the hopper was emptied. Long toms produced similar remains but the piles would be linear or oblong and measure up to 15-20 feet long, reflecting the longer apparatus used to separate the gold. Sluice boxes produced similar shaped but longer tailings piles (CALTRANS 2008:83-84). Tailings related to placer mining along stream valleys may be the most difficult to identify in the Carolinas because of their ephemeral nature and potential post-occupation disturbance. These features reflect relatively transient and small-scale mining operations, and there might be comparatively little documentation to help predict their occurrence in a given locale, as opposed to later mining operations. Surveyors should watch for linear piles of cobbles and pebbles as evidence of placer mine tailings.

On the other hand, activities related to prospecting and mining older placers from ridges or slope sides might be more readily identified. Pits with placer tailings reflect small-scale prospecting. The associated landscapes tend to undulate with mounds and shallow pits and are located on hillsides, and ridges. Pits are less than 10 feet in diameter and have piles of cobbles and river rock adjacent to them. Numerous pits could be evidence that gold was found and the workings were expanded (a process known as ‘coyoting’). Hydraulic systems would also produce visible archaeological features. These should include massive water runoff chutes and steep cut faces. Features such as ground sluices cut into bedrock might also exist (CALTRANS 2008:85, 87) (Figure 39).

Figure 39. Hydraulic Placer Mining Produced Distinctive Features Such As a Washed Out Bank and Sluice. Unknown Location, Carolinas or Gerogia (Source: Nitze & Wilkens 1896).

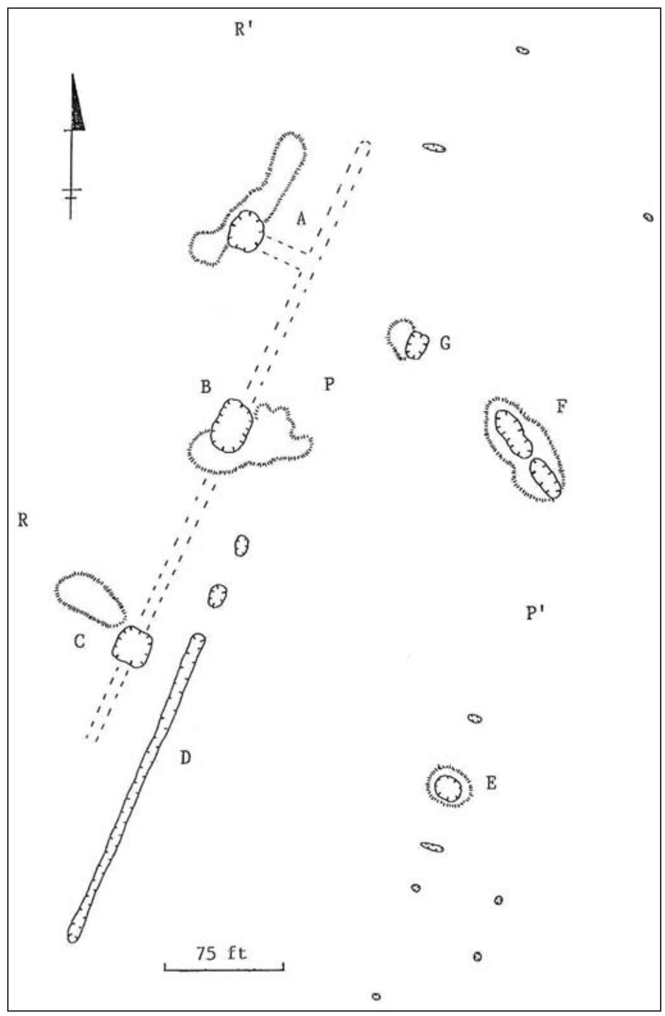


Figure 40. Map of Site 31GS120, Long Creek Gold Mine, Gaston County, North Carolina. Showing Typical Archaeological Manifestations of Prospecting Pits. Features Lettered 'E,' 'F,' and 'G' are Prospect Pits. Features 'A,' 'B,' and 'C' are Shafts (Baker 1991).

Features identified as prospecting pits have been documented in North and South Carolina. Typically, they occur in small clusters of shallow or sometimes deep oval or circular depressions, and often with a discernible spoil pile around the perimeter (Benson 2006:153) (Figure 40). They are typically within quartz outcrops. Prospecting holes can be difficult to distinguish from old, large tree falls, unmarked graves, and military training foxholes. One way to potentially clarify the identification of these features would be to look more closely at their settings, associations, and content. For example, checking the spoil piles might indicate if they reflect placer or hard rock tailings.

Drift mining involved burrowing underground to obtain placer deposits from landforms containing old riverbeds. Resource types would include waste piles of cobbles resembling placer tailings. Tunnels, adits, and shafts might have collapsed, but their presence might be projected from tailings locations. Traces of ore car routes might also exist (CALTRANS 2008:92).

Certain site types known in California, such as river diversion and dredge tailings, are not expected in the Carolinas. Some form of water management should be observable, however, because certain methods required water to be carried over long distances and retained in reservoirs. These should be located adjacent to cuts and other hydraulic system features, and should be at a higher elevation in relation to them. Channels and ditches necessary to fill the reservoirs might be present.

HARD ROCK/LODE/VEIN MINING

Extraction and handling of vein sources of ore produced distinctive resource types. This method of mining involved working primary rock deposits, often underground, and required more complex and advanced technologies, as well as larger applications of capital. In addition, the minerals produced with this type of mining required further processing to separate the valuable ore from the waste rock. CALTRANS (2008:92) divided hard rock mining properties into six types:

- Small pits and surface vein workings;
- Overburden piles;
- Shafts, adits, and inclines;
- Mills and other processing units;
- Underground workings; and
- Open pit mines.

Small pits and surface vein workings dealt with hard rock outcrops. Property types include pits with adjacent quarried rocks (not stream cobbles) or exposed host rock outcrops with excavated-out veins. Adits, shafts, and other evidence of mining and exploration might be found nearby. A small mill might also be present at larger operations to break and crush the rock (CALTRANS 2008:93).

Figure 41. Mine Overburden or Ore Dumps Consist of Broken Rock Piles and are Sometimes Recognized as Unnatural Contours on Hill Sides. Howie Gold Mine, Union County, North Carolina (Howie Mining Company 1906).

Overburden piles consist of host rock excavated from the mine that was immediately discarded near the mine site. Characteristic property types include piles of broken rock with little or no topsoil. They should be visible as unnatural contours on hillsides or as long, flat-topped ridges beginning at the mine portal and extending away from it (at larger mines) (Figure 41). They probably also mark the locations of mine shafts and adits, which would lie uphill from the pile and possibly be collapsed and no longer visible. Overburden piles might be affected by post-deposition processes, such as re-working the material using different separation techniques, or robbing it for use as fill (CALTRANS 2008:94-95). Erosion may also obscure overburden pile locations.

Shafts, adits, and inclines refer to elements of underground mines. The entrance to an underground mine is called a portal, which opens to either an adit or shaft. Adits, or drifts, are openings that run horizontally or nearly so to the lode, while shafts are vertical openings that extend to the lode deposit (Figure 42). Shafts can be identified as square, often caved in or partly filled, holes in the surface and may have footings for head frames and hoists around them. Adits typically lie on slopes and appear as collapsed trenches. Both types of features should have waste

Figure 42. Adit. Note the Ore Dump Immediately Outside the Mine Opening and the Wooden Tracks. Near High Point, North Carolina. Unknown Date (Rowan County Government 2008).

rock piles associated with them. If no waste piles are present, the openings might reflect air vents, drains, or other types of features. Additional features that might be associated with portals reflect transportation (tramways, paths), footings for hoisting, hauling, and power generating equipment, and remnants of wooden shoring or collaring (CALTRANS 2008:95-96).

The presence of shafts, adits, and waste piles would indicate the existence of underground mines. These features might also become exposed where open-pit methods were used at the sites of earlier underground workings (Griffin 1974:19) (Figure 43). For mine studies in California, CALTRANS (2008:96) specifically prohibits exploration of underground features, stating that they should be studied only with documents. This policy was adopted in Georgia as well (Botwick et al. 2011) and should be applied to the Carolinas because the potential consequences of entering an unsafe underground mine far outweighs any potential data that could be collected.

Gold mining in open pits appears to have been a later phenomenon in the Carolinas and evidence of them should be relatively easy to identify. As with underground mines, there should be waste rock piles and evidence of transportation, hoisting, and other equipment for accessing the works. In some instances, the open pit might have openings for trams or roadways. At twentieth-century mines where excavation was done with mechanical excavators and hauled with trucks, roads and garages might be present as well (CALTRANS 2008:97). Although they might leave very

Figure 43. Abandoned Underground Works (Drifts and Stopes) Exposed in an Open Cut. Haile Gold Mine, Lancaster County, South Carolina, 1904 (USGS Photographic Library).

clear surface remains, open mines could become obscured by vegetation, caving, and slumping, making them more difficult to delineate.

PROCESSING

Processing refers to the operations required to remove gold from overburden rock and convert it into a useful commodity. It includes the various steps of beneficiation and for gold mines would sequential steps to reduce ore size, sort them, and separate gold from the waste. These steps varied in complexity and location, depending on the ore type, time period, technology, individual operators, and other factors. Based on preceding overviews of mining practices, the property types related to processing in the Carolinas include mills and mill tailings.

There could be considerable variation in mineral processing plants. Extant processing structures are rare, given their specific uses, the salvage and relocation of equipment, and the passage of time since mining activities ceased. One prominent North Carolina exception being the Coggins Gold Mine stamp mill in Montgomery County, built in the early 1900s and still standing in the late 1970s (Brenner 1977) (Figure 44).

Figure 44. Coggins Gold Mine Stamp Mill, Montgomery County, North Carolina, 1978 (Photograph by JoAnn Sieburg-Baker; Brenner 1977).

This structure suggested some of the characteristics of stamp mills and probably other processing buildings. The Coggins Mill was a large open plan industrial building built of wood. Photographs of other plant buildings from the Carolinas (e.g., Haile Gold Mine in South Carolina) indicate wood was typical for construction, regardless of building function and size. Documentation of the Coggins Mill did not provide specific information about foundations and machine mounts, but in general, because the equipment used for breaking and crushing rock was so heavy, foundations and footings should be relatively large and solid. This is particularly true for older operations, where gravity was employed to move materials through beneficiation. These plants required heavy equipment to be placed in upper stories of the mill and so required substantial foundations (Kantor and Saeger 1939:76-77; Noble and Spude 1992:12).

In addition, mills were often placed on or adjacent to a slope to take advantage of natural contours for loading and support. In Carolina gold mills, the differences in elevation might be slight, however. Investigations of the Coggins Gold Mine (Brenner 1977) and Haile Gold Mine stamp mills (Botwick and Swanson 2011), for example, indicated that the stamps were raised only a half story above the concentrating floor.

Gold mills were arranged to allow a progression through the successive stages of beneficiation. Building foundations, machinery mounts, and footings should indicate this interior organization. The size and arrangement of features should also reflect the technology in use because the plants were usually designed around the interior equipment and flow.

Plants using special handling methods would have distinctive features. In particular, gold mines using chemical processes to separate the gold from the waste rock would contain distinctive features, potentially including furnaces, vats, tanks, and other equipment.

The locations of mills and processing facilities with respect to extraction points varied. While they might be adjacent or nearby, they could also be located in central locations to service multiple extraction sites (CALTRANS 2008:99).

In sum, property types that reflect mills are expected to include large buildings or building remains, often on hillsides (which might be terraced), with heavy foundations and footings. If buildings were no longer extant, various pads and machinery mounts would represent support structures and equipment locations. A water source and means of transporting ore to and from the mill might be present. The spatial arrangement of these features should reflect the use of gravity, or later belts and cranes, to move materials through the plant.

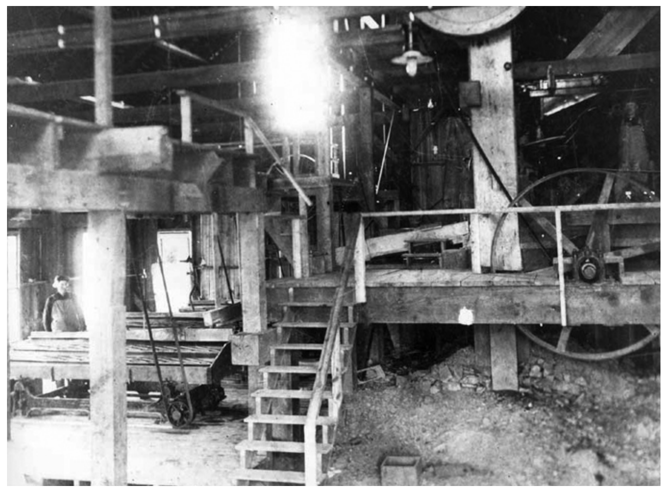


Figure 45. Interior of the Phoenix Gold Mine Stamp Mill Showing Stamps and Amalgamation Tables (Center) and Concentration Room (Left.). Cabarrus County, Circa Late 1800s (North Carolina Office of Archives and History).

Tailings could also indicate processes and organization of activities. For instance, larger waste/uneconomic rock would be expected near the upper levels of the plant where larger fragments of waste rock were discarded, while mill tailings would be at the lower levels of the plant where concentrating was done (CALTRANS 2008:99).

Other processing feature types are arrastras and Chilean mills. These were documented in the North and South Carolina gold industry. Features representing arrastras would be indicated by shallow, flat-bottomed circular depressions. They were normally less than 20 feet in diameter and lined with stones on the edges and floor (CALTRANS 2008:98). CALTRANS did not provide specifications for Chilean mills. Trinkley (1985) examined features at Reed Gold Mine (31CA18**1) in Cabarrus County, North Carolina, that he thought could represent Chilean mills but could not conclusively identify distinguishing archaeological characteristics. Summarizing literature on the subject, Trinkley (1986:38) concluded that the setup and operation of these devices was idiosyncratic and subject to the preferences of individual operators and availability of local materials. Based on how they functioned, however, it is probable that early Chilean mills would resemble arrastras. Later mechanized versions were mounted on masonry bases and might not look distinctive (Figure 46).

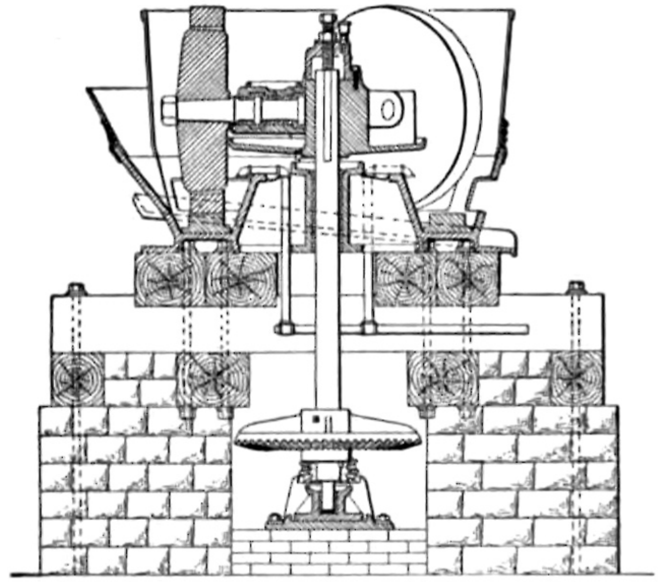


Figure 46. Modern Chilean Mill. The Masonry Foundation Might Not Be Functionally Diagnostic If the Mill Was Removed (International Library of Technology 1902).

Mill tailings constitute a distinctive type of feature associated with mining landscapes. Tailings reflect the waste portion of the ore discarded after the valuable materials were extracted. They were usually finely crushed and/or ground in the form of slurry that was allowed to run off into creeks and ravines near the mill (CALTRANS 2008:102). Property types could include retention ponds, which archaeologically resemble broad, meadow-like formations. The soils within them would be fine material with color and vegetation that was distinct from the surrounding soils (CALTRANS 2008).

ANCILLARY MINING PROPERTY TYPES

Auxiliary structures and features that comprised elements of a mining operation included the infrastructure directly related to mining as well as housing, external transportation facilities, water management structures, material movement and others (Noble and Spude 1992:14). CALTRANS (2008) divided these diverse property types into three broad categories: ancillary types, mining community types, and inter-site support types.

Cultural resources placed into the ancillary types include structures, site-specific transportation features, and site-specific water conveyance systems. These resource types reflect site-specific internal components that assist in mining and milling (CALTRANS 2008:103).

STRUCTURES

Structures, or structural remains, include buildings related to mining and milling operations. Specific functions might be identifiable by documentary sources, artifact content, construction techniques, and/or location. Functions or structure types that are placed into this category include offices, changing rooms, blacksmith/mechanic shops, cooperages, sheds/stores/warehouses, garages, and stables (Noble

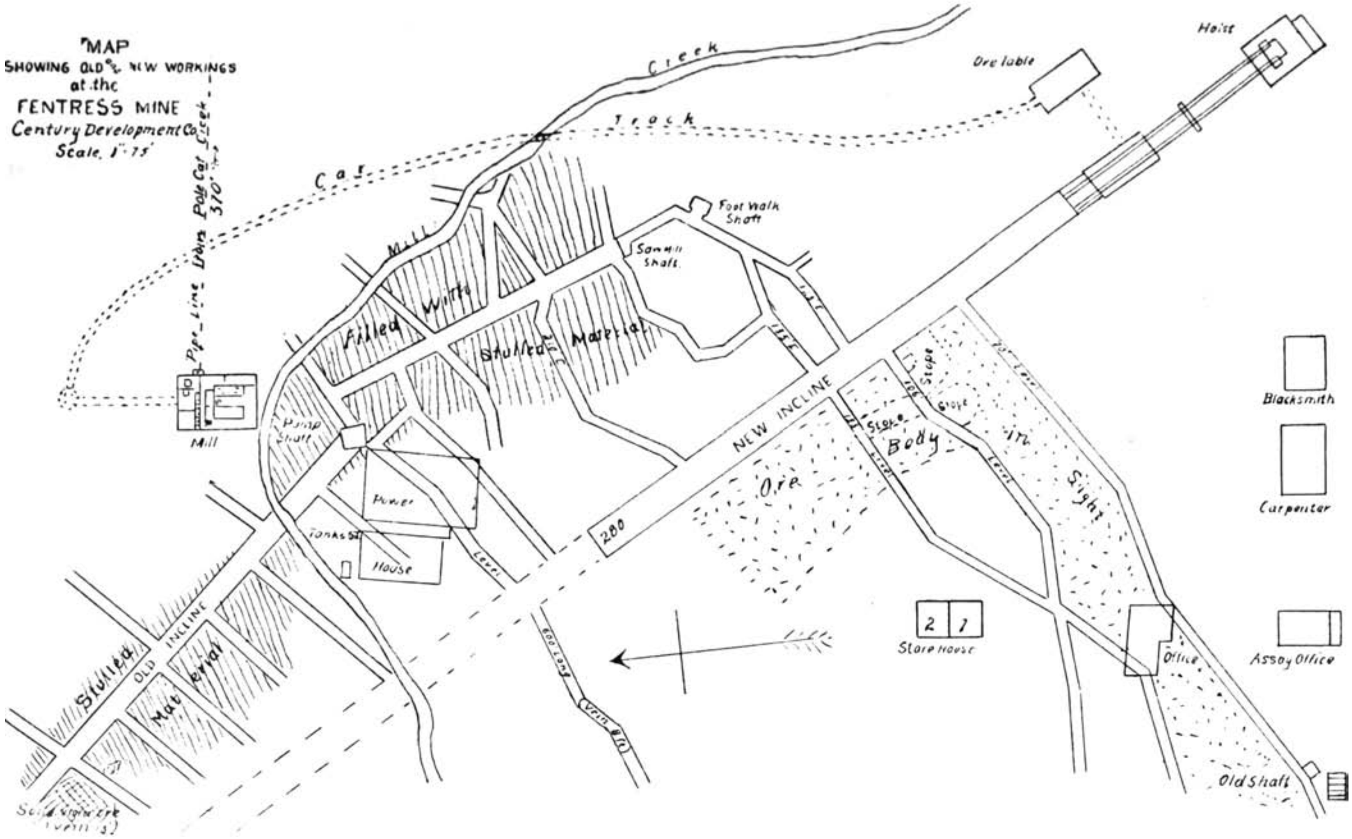


Figure 47. Map of the Fentress Mine, Guilford County, North Carolina, Showing the Types of Auxiliary Structures Typical for a Gold Mining Operation, Early 1900s (Pratt 1907).

and Spude 1992:14; CALTRANS 2008:103) (Figure 47). Mine sites in operation over a long period of time might have more than one of a particular structure type as a result of replacement, moving buildings, or rearrangement of the site. In the absence of extant structures, archaeological remains would most likely consist of foundations and artifact scatters associated with the mine or mill (CALTRANS 2008:103-104).

TRANSPORTATION FEATURES

Site-specific transportation features can or may include trails, roads, and tramways used to move ores, waste rock, people, and equipment around the mine site. Roads or trails were always present at mines, while other transportation features varied, depending on the type of mining, scale of operations, and other factors. Archaeological manifestations of these systems consist of linear, continuous grades leading between main areas of the mine or mill. Tramways would be distinguished by uniform grades, possibly trestles, and rails and ties, which might be removed after the mine closed. Aerial tramways would be represented by cables, head frames, gondolas, and buckets (CALTRANS 2008:104).

Figure 48. Water Conveyance Systems Might Leave Distinct Archaeological Traces. Parker Mine, Stanly County, North Carolina (Nitze and Wilkens 1897).

WATER CONVEYANCE SYSTEMS

Water was an integral element of nearly every kind of mining and had to be available as long as the mill or processing plant operated. Features related to water supply included rivers, reservoirs, cisterns, and tanks, which would typically be located uphill of the mill to permit gravity feed. Ditches, pipes, and penstocks moved water through the mining site and plant, while drains removed spent water from the area (CALTRANS 2008:105). Remnants of these systems might include earthen berms, ditches, and channels. In addition, footings for aboveground water tanks, penstocks, or other conveyance structures could exist (Figure 48).

MINING COMMUNITY PROPERTY TYPES

Mining community property types include domestic residential activities of miners, mine-support staff, and their families. Mining communities were often transient but were distinctive. Associated property types can be classified into three groups: domestic structural remains (including service buildings), domestic artifact deposits, and domestic landscape features. To be considered a residential site associated with mining, the domestic property types must be physically and historically associated with the mineral industries and must exhibit one or more of the following attributes:

- They must have quantities of domestic artifacts,
- They must contain distinctly domestic features such as hearths, or
- Documents should identify them as domestic-residential structures (CALTRANS 2008:106).

DOMESTIC STRUCTURE REMAINS

CALTRANS (2008) and Hardesty (2010) described the types of structures and related archaeological remains expected in mining communities of the western United States. It is not known how well these apply to the Carolinas but future research should be able to characterize trends. In general, the simplest houses for miners were tents and lean-tos, with improved housing consisting of full or partial enclosures with walls of logs, lumber, or fieldstone and a canvass roof. Other shelters consisted of partially subterranean pits or enclosures dug into hillsides. These simple structures were mostly associated with early mining and most likely would relate to placer mines. They would be expected near the mines and might include earthen pads (raised or obviously prepared in some way), foundations (pier or perimeter), dugouts (squared pits cut into the ground or slopes), hearths, drainage features, and sheet refuse or scatters of domestic artifacts. Structures 30 feet or more in length could represent barracks or dining halls, which would be further distinguished by the presence of large refuse deposits containing tablewares, food containers, and faunal remains (CALTRANS 2008:106-108).

Houses or miners' cottages existed in some districts. These might have represented more substantial and permanent structures than some of the types described for the western states, although the type of construction might have varied. For example, at the Pioneer Mills Gold Mine in Cabarrus County, North Carolina, a former miner's cabin dating to the 1850s was described as consisting of a one-story, saddle-notched log structure that stood until 1989 (Huffman 1990). Where such structures are no longer extant, archaeological remains might include more obvious foundations or piers with substantial chimney mounds, such as Feature 15 at the Haile Gold Mine Stamp Mill Site (38LA383). This feature represented a workers' house supplied by the gold mining company and was reflected by brick piers, a central chimney, and deposits of domestic artifacts (Botwick and Swanson

Figure 49. Brick Chimney Base and Pier, Site 38LA383 Workers House, Haile Gold Mine, Lancaster County, South Carolina (Photo: New South Associates, Inc.).

2011) (Figure 49). Brick, nails, and window glass might be more prominent among the construction materials.

DOMESTIC ARTIFACT DEPOSITS

CALTRANS (2008:109-110) characterized the artifact deposits associated with mining residential sites as sheet refuse and filled features. These would resemble those at any domestic site. Sheet refuse occurs in the vicinity of a dwelling and reflects materials discarded or lost on the surface by site residents. It might occur throughout the living area of a dwelling or adjacent to and downhill from the dwelling area. Filled features, or "hollow-filled features" consist of concentrated artifact deposits reflecting disposal into features such as trash pits, cellars, prospects, privies, or other abandoned subsurface openings.

DOMESTIC LANDSCAPE FEATURES

Landscape features associated with mining sites generally fall into two groups: plantings and stonework (CALTRANS 2008:110). Plantings reflect the efforts of mining households to create domestic environments featuring orchards and vegetable and ornamental gardens. Features reflecting planting holes and beds might be discernible archaeologically and in some instances, plants might remain growing at the site. Domestic landscape features could also include paths, retaining walls, and terraces.

INTER-SITE MINING SUPPORT PROPERTY TYPES

CALTRANS (2008:110) described inter-site mining support properties as "separate, distinct sites that may extend many miles, creating a link between the mining site and the outside world. They represent linear systems for delivery of services or access and are recorded as individual and distinct entities." They were linked to particular mining sites, however, and should be viewed as functional elements of those sites. Resource types included in this category include inter-site transportation features, inter-site water conveyance systems, and inter-site utilities.

INTER-SITE LINEAR TRANSPORTATION FEATURES

Transportation features connecting Carolina gold mines to the outside consisted of trails, roads, and railroad

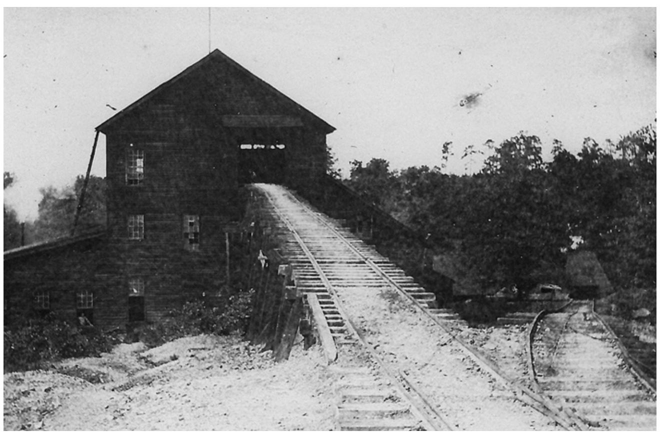
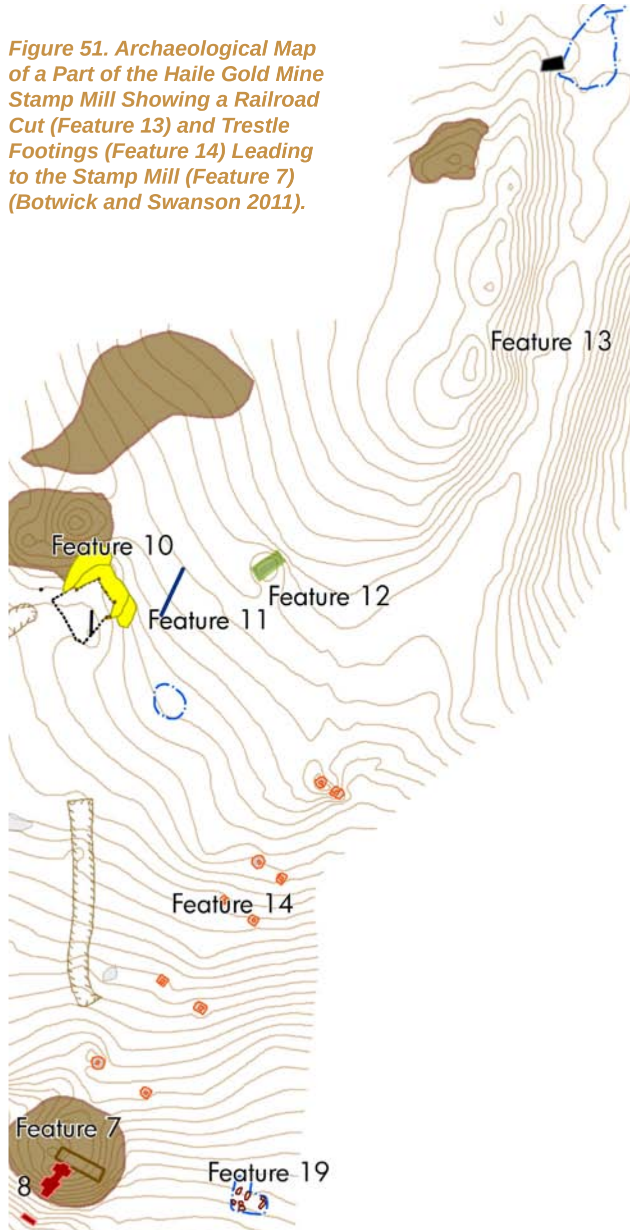


Figure 50. Small-Gauge Railroad at Haile Gold Mine, Lancaster County, South Carolina. A Trestle Carried the Line to the Third Floor of the Stamp Mill to Deliver Ore (Photo, John C. Jenkins, Courtesy of Tom and Dorothy Gregory).

sidings and spurs. Early transportation routes in the mining regions were likely rough trails. CALTRANS (2008:111) described early mining trails as narrow and often having downhill retaining walls on hillsides. More formal roads for wagons and, later, motor vehicles replaced the trails. These were wider, less steep, and ultimately improved with various paving methods. Improved roads were particularly associated with larger capitalized operations.

Railroads could be significant components of gold mines. Often, larger mines built small- or regular-gauge railroads to haul materials to the main depots. It is reasonable to assume that these would resemble standard railroads and have the same components

Figure 51. Archaeological Map of a Part of the Haile Gold Mine Stamp Mill Showing a Railroad Cut (Feature 13) and Trestle Footings (Feature 14) Leading to the Stamp Mill (Feature 7) (Botwick and Swanson 2011).



of rails, fasteners, ties, ballast, and built sub-grade, trestles, and other features. Railroads associated with mining sites, however, might also include special loading facilities, such as elevated tipples above railroad lines to dump ore directly into cars (Figures 50 and 51).

INTER-SITE CONVEYANCE SYSTEMS

Water was necessary for mining and especially ore processing. Identifying the source of water for a mining operation would be important for understanding the mine's history and interpreting its development (CALTRANS 2008:111). Hydraulic mining systems used elaborate canal and ditching systems to bring water to the site-specific reservoirs. These systems were notable for their length and substantial features, although it is not clear how common they were in the Carolinas.

These systems should have distinctive archaeological remnants that can be linked to particular mines or to mining in general. Components of inter-site water conveyance were ditches/canals, flumes, reservoirs, and pipes. Ditches and canals would be excavated across the landscape, following contours, and often have berms on downhill sides that might be reinforced with rock. Flumes were often made of wood and most likely would no longer remain extant, although their remains might include stone or concrete footings in line with a projected water delivery system. Remains of gates, pipes, or penstocks might consist of metal and poured concrete structures, but large metal components of these were likely salvaged for scrap. Reservoirs and other water control structures were typically stone or earth and lay upslope from the mine or mill, with the water being delivered via penstocks (CALTRANS 2008:112).

INTER-SITE UTILITIES

Power generation was important in the operation of mining operations. Many plants had generated their own power to run site-specific operations. By the twentieth century, however, mines and quarries operating near urban areas might have had access to municipal power as well as telephone service. Under this category of property type, CALTRANS (2008:112) listed utility poles and glass and ceramic insulators as identifiable features. The category should also include waterpower mills, boiler houses, engine houses, and related features such as fuel yards and storage areas.

Figure 52. Masonry Equipment Mounts for the Corliss Steam Engine, Haile Gold Mine Stamp Mill (Site 38LA383), Lancaster County, South Carolina (Botwick and Swanson 2011).

Remains of at least one boiler shed and engine room were found in association with the Haile Gold Mine stamp mill (38LA383) in Lancaster County, South Carolina (Figure 52). Additionally, a later brick structure was interpreted as a possible boiler shed associated with pyrite mill that was built at the property (Botwick and Swanson 2011). Investigations at the Reed Mine in Cabarrus County, New Carolina also produced evidence of a boiler pit associated with the site's engine/mill house (18CA18**1) (Babits 1974; Trinkley 1986).

HISTORIC MINING LANDSCAPES

Historic mining landscapes are one type of rural historic landscape, which may "contain significant areas of vegetation, open space, or natural features that embody, through past use or physical character, significant historical values. Buildings, industrial structures, objects, designed landscapes, and archaeological sites may also be present" within them (McClelland et al. 1999:3). Noble and Spude considered landscapes a historic mining property type, characterizing them as evidence of a human activity that modified the natural features of the earth. Historic mining landscapes "evoke images of time, place and historical patterns," and may include various components that embody historical and traditional land use practices associated with the extraction and handling of mineral products (Noble and Spude 1997:13-14). Although this study of historic gold mining in the Carolinas is focused on archaeological resources, landscapes are a valid concept to consider because archaeological sites may make up or contribute to a historic landscape.

Landscapes related to mining could encompass various resources associated with particular types of mining (e.g., strip or placer mining), the spatial organization of mining, typical natural and cultural landforms related to mining activity (e.g., pits, waste dumps), distinct types of buildings and structures, transportation and circulation systems, and specific vegetation patterns caused by mining (Noble and Spude 1997:14). They may also incorporate communities shaped as a result of mining activity (McClelland et al. 1999:27).

In dealing with archaeological sites as sole or contributing elements of historic gold mining landscapes, researchers should consider the way the various features, objects, artifact scatters or concentrations, and other residues of past activities represent broader systematic patterns of land use. For example, a historic landscape related to placer mining might consist of distributions of prospecting pits, excavated areas, tailings, and water management features dispersed through a specific natural drainage area. A more complex mining landscape could include a series of excavated and eroded ridges and valleys from which gold bearing ore was removed, combined with features such as mine and mill tailings, remains of hoisting, crushing, and other ore handling buildings and structures; traces of roads and tramways that reflect circulation systems; and possibly archaeological remains or extant houses and other buildings representing communities whose establishment or growth was related to gold mining.

INTEGRATION OF PROPERTY TYPES

An important determination, beyond identifying archaeological remains of mining activities, is how individual properties relate to one another, a step that Noble and Spude (1997:9) referred to as "property analysis." This consideration requires linking separate, sometimes widely spaced features, artifacts, and contexts and understanding the spatial, chronological, and functional aspects of their associations. The preceding descriptions of individual property types are intended to facilitate identification and inventory of various archaeological elements. The following discussion provides concepts for understanding how they interrelated as components of complete mining operations and how they reflect those operations.

The concept of "feature systems" (Hardesty 1988:9, 1990:45, 2010:16) provided a framework for understanding how archaeological remains of mining relate to one another within specific functional systems over time and space. They also help link disconnected remnants of these systems to historic contexts (Hardesty and Little 2009:121). Feature systems comprise groups of features, objects, and structures that functioned together in the extraction, processing, and shipping of mineral resources. They include components that may be isolated or spaced at a distance from one another but still form part of a single specific mining operation. The resources that make up feature systems are linked chronologically and they may encompass not just mines and processing plants, but also the infrastructure, administrative, and community activities associated with mining. Because a single operation could potentially spread widely across and through a geographical area and include numerous parts with different specific functions, the concept provides a useful tool for understanding that certain disparate resources were part of a single dispersed operation.

Hardesty (1990:45) described feature systems as "an interface of the spheres of history, archaeology, and ethnography," by which he meant that combinations of archival sources, oral information and recollections, and archaeological materials provided the data necessary to define particular feature systems. Hardesty's application of the concept indicates it has various dimensions. At one level, it provides a conceptual device for understanding the links between geographically dispersed resources, as described above (Hardesty 2010:17). At another level, documentary and ethnographic sources yield information necessary to construct models of the morphology and activities associated with a particular feature system, which in turn provides a guide to identify and understand archaeological resources (Hardesty 1988:9-10; 2010:16-17). Finally, individual archaeological properties can reflect more than one feature system. For example, a trash dump containing both household and industrial refuse would be part of a domestic feature system and an industrial process feature system (Hardesty 1988:10, 2010:19-20).

Feature systems thus constitute analytical units for understanding how individual and multiple resources related to one another and to particular processes (CALTRANS 2008:81). With respect to evaluating historical or archaeological significance, feature systems provide a framework for understanding how complete a resource is, a determination that is important in conveying its historical function and associations, as well as its research value. Hardesty pointed out that assessments of significance could reasonably be expected to involve consideration of complete feature systems instead of individual properties. Evaluating archaeological significance this way would rate a resource in terms of its overall research value (in other words, the information it could provide about an entire process or system) rather than the information potential of several individual features (Hardesty 1990:45-46).

To summarize the preceding chapter, it is important to note that the purpose of defining gold mining property types for the Carolinas is to ensure precise identification, or at least begin a process of developing consistent terms to describe and interpret archaeological features related to mining. Clearly, as more archaeologists conduct survey and evaluation of these mining-related sites, the typology will become more precise and applicable to Carolina gold mining. Accurate identification and description is also critical in sorting out various activities and time periods that might be represented at a single mine site, where reactivation of older mines or the application of new technologies and procedures can overlap and cut through the archaeological remains of previous operations (Noble and Spude 1997:9). Clear identifications of chronological and functional associations are also important considerations in evaluating historical and archaeological significance because the site must be able to convey its relations to particular historical contexts (CALTRANS 2008). Features with indeterminate or ambiguous functions and dates, or that only reflect "general mining activities," would not contribute substantial research data.

A second consideration is to understand and interpret individual features in terms of the wider geographical, chronological, and functional contexts they relate to. Put another way, this consideration is intended to encourage archaeologists to look beyond individual or groups of isolated sites and try to link them to the broader mining operations they were part of. This is important not only to better understand how individual properties, features, and objects operated together, but also to ensure that entire systems or related groups of resources are considered together for interpretation and significance evaluation.

VI. The Archaeology of Gold Mining in the Carolinas

To date, archaeological investigations of gold mining in North and South Carolina have been limited. There are comparatively few recorded archaeological sites and few studies of these sites beyond the survey and evaluation level. Additionally, detailed investigations have been limited in scope and generally emphasized preservation and reconstruction goals, with broader research topics being secondary considerations. This chapter reviews the archaeological database of gold mining sites in the Carolinas to illustrate work that has been completed, identify preservation and management needs, and suggest potential opportunities for research.

ARCHAEOLOGICAL DATABASE

Review of archaeological site inventories and National Register of Historic Places (NRHP) files in each state yielded a total of 36 properties (Table 1). Roughly 50 mine sites have been recorded in Sumter National Forest, South Carolina (Benson 2006), some of which are included in Table 1, but site files were not available for inspection and the specific types of mineral resources could not be verified. Furthermore, at the present time, site inventory files in both South Carolina and North Carolina have limited search capabilities, making it difficult to develop a complete inventory of all gold-mining sites. The following data should therefore be viewed as a sample representing recorded historic gold mine sites in the Carolinas.

The site files revealed trends in site location, age, project type (compliance, research, etc.), and the types of extant remains. Because of the small sample size and the manner sites are recorded, it is difficult to make strong inferences about overall patterns. For example, of the 18 sites in North Carolina, six are in Cabarrus County and four others are in Mecklenburg County. These counties were among the most important gold producing regions in the State. However, of the 10 sites recorded in these counties, nine are associated with only two different mines. The locations of these mine sites, therefore, did not indicate significant patterns in site distribution but more likely reflect the way mine sites have been recorded. In some instances, related resources are grouped together into a single site and in others they are split apart and recorded separately.

On the other hand, the South Carolina sample is made up mostly of sites in Abbeville and McCormick counties, which were important gold-production areas in the nineteenth century. The sites included in the table mostly represent separate individual or groups of prospecting pits and mineshafts and more accurately reflect the importance of mining in these districts. Other parts of the State where mining was important, however, such as Lancaster County, are barely represented in the sample, probably as a result of differences in survey coverage. The large number of sites in Abbeville and McCormick counties are associated with the Sumter National Forest, which has been subject to extensive archaeological survey.

Dates for the sites in the sample mostly began in the nineteenth century with end dates in the twentieth century. This span roughly corresponds to the known gold mining era in the Carolinas. One eighteenth-century site was the home of John Reed, owner of the first working gold mine in the region. More significant is that most sites have beginning dates that fall into two general periods: the 1830s and the 1850s. These dates

Table 1. Recorded Archaeological Sites Representing Historic Gold Mines in North and South Carolina					
SITE	NAME	CHRONOLOGY	LOCATION	MINE ELEMENT	REFERENCE
North Carolina					
31CA18	Reed Gold Mine Upper Hill	1852-1920s	Cabarrus		Babits 1974; Sacchi 1980; Trinkley 1986, 1988
31CA18**1	Reed Gold Mine Engine House	1852-1920s	Cabarrus	Engine House	Trinkley 1986, 1988
31CA18**2	Reed Gold Mine Boiler Pit	1852-1920s	Cabarrus	Boiler House	Sacchi 1980; Trinkley 1988
31CA19	Reed Gold Mine Stamp Mill	1854-20th C	Cabarrus	Stamp Mill	Robertson and Robertson 1975a
31CA23	Reed Gold Mine Stirewalt Site	18th-19th C	Cabarrus	Domestic	Robertson and Robertson 1975b
31CA24	Reed Gold Mine Reed House Site	1790-?	Cabarrus	Domestic	Site Form
31DV381	Conrad Hill Gold Mine	1832-1920	Davidson	Indeterminate Mining	Site Form
31GF191	McCulloch's Gold Mill	1832-19th C	Guilford	Mill	Site Form
31GF328	Gardner Hill Gold Mine, Sedgefield	1830-1935	Guilford	Mine, Kiln	Hargrove 1992
31GS120	Long Creek Gold Mine, Sloan Gold Mine, Paysour Mountain Gold Mine	19th-20th C	Gaston	Indeterminate Mining	Baker and Hall 1985; Baker 1991
31MK543	N/A	Unknown	Mecklenburg	Mine (Shafts, Tailings)	Hargrove 1990
31MK544	N/A	Unknown	Mecklenburg	Mine (Shafts, Tailings)	Hargrove 1990
31MK581	Black Cat Gold Mine Complex	19th-20th C	Mecklenburg	Mine (Pits)	Ayers et al. 1993
31MK616	Black Cat Gold Mine Complex	19th C	Mecklenburg	Mine (Pits)	Ayers et al. 1993
31MK617	Black Cat Gold Mine Complex	19th C	Mecklenburg	Mill (Dam)	Ayers et al. 1993
31MK959	N/A	Unknown	Mecklenburg	Mine (Pits)	Bamann and Lautzenheiser 2000
31RF157	Bechtler Mint	1830-1850	Rutherford	Industrial, Domestic	Trinkley and Hacker 1995; Site Form
31RF86	Albert Keeter Mine	19th-20th C	Rutherford	Mine (Pits)	Site Form
31RF87	Hotel and Mine Shaft Site	1840-20th C	Rutherford	Mine (Shafts)	Site Form
N/A	Coggins Gold Mine	1882-1925	Montgomery	Stamp Mill	Brenner 1977(HAER Record)
N/A	Morrison Farm and Pioneer Mills Gold Mine	1830s-1850s	Cabarrus	Mill, Shaft, Miners Cabin	Huffman 1990
South Carolina					
38AB352	N/A	19th C	Abbeville	Mine (Shafts, Adit, Tailing)	Elliott 1984
38AB360	N/A	Unknown	Abbeville	Mine (Pits)	Elliott 1984; Braley 1988
38AB417	N/A	Unknown	Abbeville	Mine (Pits)	Castille 1988
38AB418	N/A	Unknown	Abbeville	Mine (Pits)	Castille 1988
38AB419	N/A	Unknown	Abbeville	Mine (Pits)	Elliott 1984
38CT118	Horton Hill Gold Mine	19th C	Chesterfield	Mine (Pits), Railroad	Site Form
38LA383	Haile Gold Mine	1880-1919	Lancaster	Stamp Mill	Pluckhahn and Braley 1993; Botwick and Swanson 2011
38MC1452	N/A	Unknown	McCormick	Mine (Pits)	Adams et al. 2001
38MC1501	N/A	Unknown	McCormick	Mine (Pits)	Adams et al. 2001
38MC1525	N/A	20th C	McCormick	Mine (Pits)	Adams et al. 2001
38MC231	N/A	20th C	McCormick	Mine (Shafts)	Elliott 1983
38MC710	N/A	Unknown	McCormick	Mine (Pits)	Smith 1989
38MC711	N/A	Unknown	McCormick	Mine (Pits)	Smith 1989
38OC237	Cheohee Mine	1850s-1860s	Oconee	Mine (Shafts, Adit, Tailing)	Bates 2008
N/A	Dorn Mine	1852-1888	McCormick	Mine (Pits)	NRHP Nomination Form

were important milestones in the history of regional gold mining. Mining activity increased substantially in the 1830s after a period of slow development. This period was also one where mining began to take on a more professional and industrial character. The 1850s saw generally low production but was a period of greater speculation and efforts at reviving the industry. Although again, the sample size is too small to strongly suggest any conclusions, it is worth noting that there appears to be a correlation in the visibility of archaeological sites and periods of greater gold mining intensity and changes in the organization of mining in this region.

Looking at the circumstances of site recordation, the sites were identified and investigated mainly in the context of compliance surveys or heritage projects. This indicates that gold mine site investigations have been dealt with mainly on an incidental basis (i.e., when they are discovered in the course of a survey) or when they are well-known and obvious enough to warrant site preservation, often in the context of historical museums and parks, such as is the case with Reed Gold Mine in North Carolina and the Dorn Mine in South Carolina. Although some of the work conducted at Reed Mine has been oriented toward research (Trinkley 1986), it was still completed for purposes of preservation and interpretation rather than purely to address questions regarding gold mining, mining technologies, miners, or similar topics. This emphasis on preservation-driven discoveries and studies indicates a need for an archaeological context that can facilitate discovery, evaluation, and research goals.

Finally, with respect to the extant remains or mine elements that have most often been recorded, unspecified pits are the most common, having been recorded at 21 of the 36 sites. Pits at mine sites have generally been interpreted as reflecting prospecting activities. Additionally, the roughly 50 mine or mineral extraction sites recorded at Sumter National Forest are predominantly prospecting sites (as noted, inventory forms for many of the sites at Sumter National Forest were not available for this study) (James Bates, Sumter National Forest Archaeologist, personal communication, 2011). There is a considerable range of mine elements in the group, however, including elements related to the extraction of ore (pits, shafts), transportation (railroad), ore processing (mill, stamp mills), and power generation (boiler house, engine house, milldam). Further, three sites contained domestic components related to residents of the mine site. One of the domestic sites (Bechtler Mint), moreover, was related to an activity that was auxiliary to mining: coining the gold generated by regional mines. Thus, the site files indicate considerable richness and diversity among gold mining sites in the Carolinas.

LITERATURE REVIEW

A review of archaeological survey, investigation, and management reports indicates the way archaeologists have handled gold mining sites in the Carolinas. As stated above, virtually all the archaeological data on gold mine sites in these states has derived from compliance or heritage projects. In the absence of state or regional guidelines for evaluating these kinds of resources, most of the effort to deal with the research and historical value of these sites has been done in an ad hoc way and often with a narrow view that does not consider individual sites or site elements within broader landscapes or historical developments.

An example of this is the work completed to date at Reed Gold Mine (31CA18) and related properties, which now comprise a North Carolina Historic site (Figure 53). Several archaeological studies were undertaken here after the State acquired the property in the early 1970s (Babits 1974; Robertson and Robertson 1975a, 1975b; Sacchi 1980; Trinkley 1986, 1988). Nearly all the work focused mainly on the engine/mill house on Upper

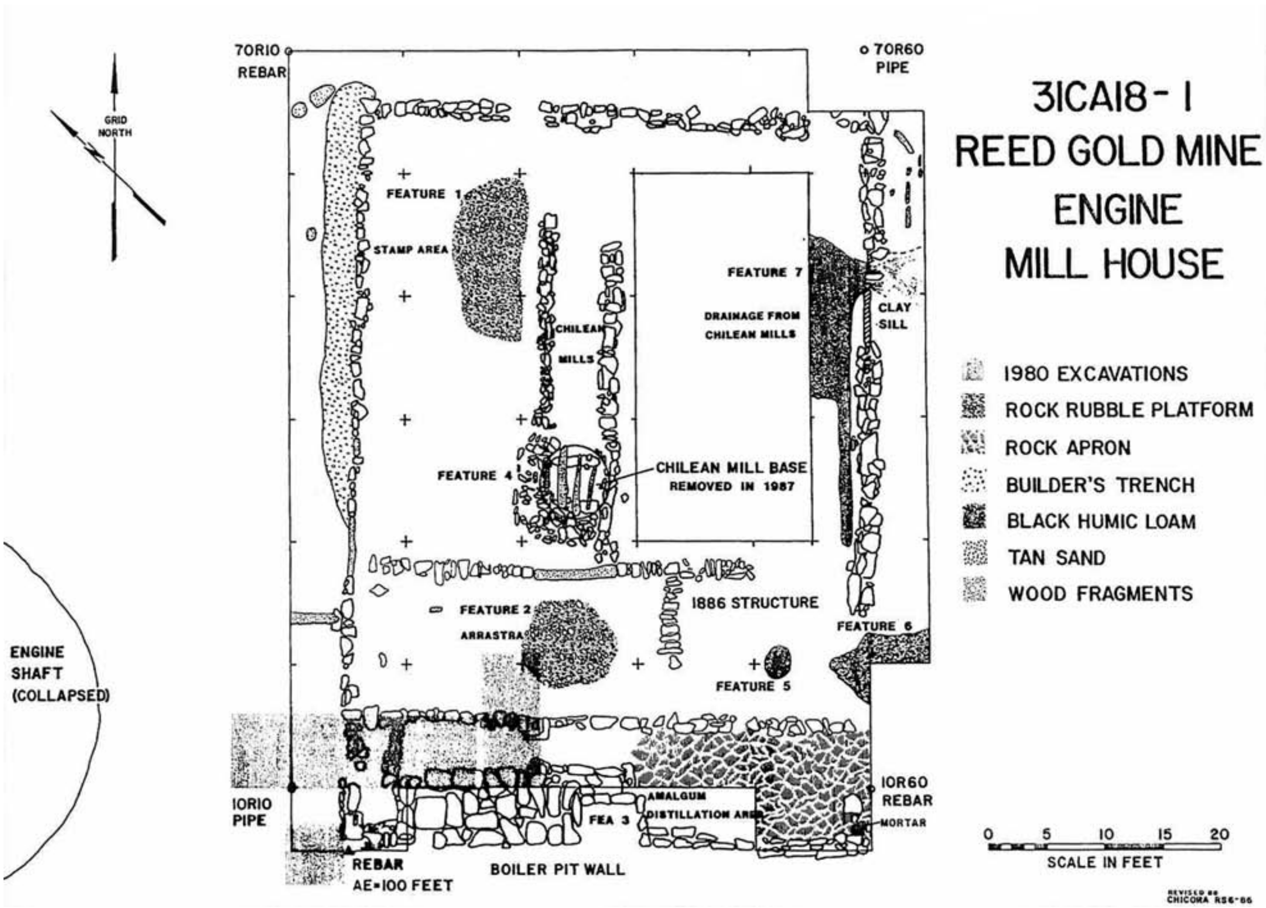


Figure 53. Archaeological Plan of the Reed Gold Mine Engine/Mill House, Cabarrus County, North Carolina (Trinkley 1988).

Hill, which contained the steam boiler and engine, Chilean mills, and other ore processing equipment (Babits 1974; Sacchi 1980; Trinkley 1986, 1988). Other test excavations took place at the stamp mill located on Middle Hill (Robertson and Robertson 1975a). In addition, Robertson and Robertson (1975b) surveyed planned construction locations at the historic site and in the process inspected two sites, 31CA23 and 31CA27, that were possibly associated with the gold mine.

These investigations provided information necessary to identify the functions of certain archaeological resources and interpret them to visitors, as well as assisting in their management. However, they did not provide very strong bases for understanding the overall organization of the site, how it operated, and how it developed over time. For instance, although Trinkley (1986) sought to examine aspects of the lives of mine workers, his efforts were constrained by a principal focus on delineating the structure and use-life of the engine/mill house. The goals of his project did not allow for a broader exploration of workers' housing areas. Sacchi (1980:29) described the work on Upper Hill to that date as "piecemeal" and claimed that it did more harm than good. His critique related to excavation of the engine/mill house, but the same could be said regarding the site as a whole, especially if portions of the overall site were neglected at the expense of more visible or imposing archaeological remnants.

Additional archaeological surveys and investigations in North Carolina illustrate general management and research approaches to historic gold mine sites. In 1985, Baker and Hall conducted a survey of proposed alternatives for the Gastonia Municipal Airport in Gaston County, North Carolina. The survey resulted in the identification of Site 31GS20**, representing the Long Creek Gold Mine. Baker and Hall (1985:36, 45) recommended further documentation of the site as a means of mitigation.

Subsequent work included photographic documentation and mapping of the site. Baker described the site as consisting of "several enormous holes that are distributed across the slopes of several upland terraces" (Baker 1991:16). These reflected partially filled shafts. Related features included spoil, a trench, a roadbed, and a loading chute. In assessing the significance of the site, Baker (1991:20) stated, "gold mining was prominent in its day. The historical significance of the gold mining sites that remain today, however, has not yet been established." He judged the site to have little historical importance and did not consider its archaeological significance.

Hargrove (1990) identified two gold mines in Mecklenburg County during a highway survey near Charlotte. The sites (31MK543 and 31MK544) included shaft remains and associated mine and mill tailings. No evidence of mining, processing, or other equipment was found. The specific mines these sites represented could not be identified and the dates of operation were uncertain. Beyond the identification of the sites, an important outcome of this survey was that Hargrove created a formal approach for evaluating the archaeological significance of gold mining sites in North Carolina based on research potential. The need for such guidance, as Hargrove (1990:39) stated, was due to the fact that no standards for determining significance had been developed for small, short-lived gold mining operations, which comprised a majority of the regional industry. Using Hardesty's (1988, 1990) criteria for western mines, Hargrove suggested that significant gold mining sites would provide information about a range of topics or research domains, including environment; technology of mining; household consumption; organization of households, settlements, and social groups; demography of mining communities; ideology; and chronology. Hargrove judged 31MK543 and 31MK544 as having limited research potential because they consisted of only shafts and tailings. These features might offer information on the subject of environment, particularly the selection of mining locations, but they would be uninformative about the other six topics (Hargrove 1990:40).

Hargrove (1990:40) also drew on Hardesty's (1990) "significance evaluation matrix," which considers three contextual levels or geographical scales as a basis for evaluation. As Hargrove summarized it, questions to ask of a mining site included:

> *How does the site fit into a world system? (i.e., How does it reflect its connection with the broader world at the time it operated? Does it contain information about how the mine and miners related to the wider society)?*
>
> *How does the site relate to its district (the community that might grow up around a mine or set of mines)?*
>
> *Does the site contain information about "feature systems" (consisting of isolated, separate features related to one another as part of an individual mining system [Hardesty 1990:45])?*

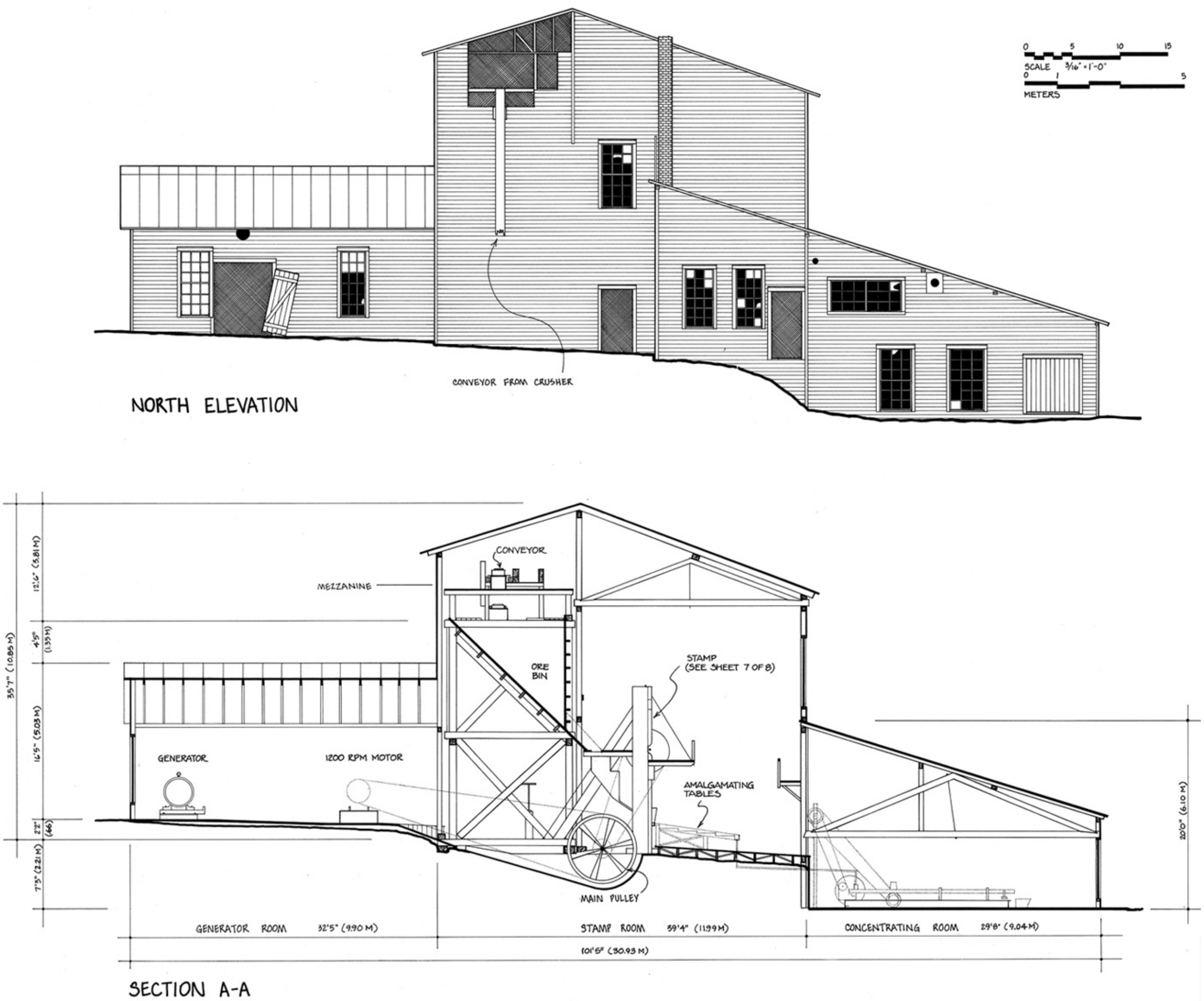
For sites 31MK543 and 31MK544, Hargrove felt that the sites had little ability to provide archaeological information about their place in broader economic, commercial, or social systems. Similarly, they were not good examples (because of poor preservation) of the mining operations typical in the Charlotte area. Finally, the absence of most of the features, buildings, and equipment associated with gold mining meant that the sites did not illustrate their feature systems (Hargrove 1990:40).

Hargrove's (1990:40) last basis for evaluating gold mine sites borrowed from Noble (1989), who combined a historic landscape perspective and aspects of archaeological integrity. Historic landscapes consist of geographical areas that have been used, shaped, or modified over time by human actions, occupation, or intervention and that possess a concentration, linkage, or continuity of historic buildings, vegetation, roads, waterways, and natural features. Archaeological sites can be viewed through the concepts of visibility, the above-ground physical site elements, and focus, consisting of the patterns in the ground that remain observable when above-ground elements are gone. Combining these concepts, Noble (1989:2) asserted that a site with both visibility and focus would be eligible. A site with focus but no visibility might be eligible. A site with visibility but no focus would not be eligible nor would a site lacking both visibility and focus. With respect to the Mecklenburg County sites, Hargrove (1990:40) stated that they had focus, indicated by pits and tailings, but no visibility (standing structures) and they could not provide information about mining and milling technology.

Hargrove (1992) applied the same evaluation criteria to the Gardner Hill Mine (31GF328) in Guilford County, which was associated with the NRHP-listed Gardner House property and historically produced gold and copper. A survey of the property identified two stone kilns probably used for copper production as well as a mineshaft and associated ore dump (Hargrove 1992:8). To assess this site's historical and archaeological significance, Hargrove (1992:10-11) applied the evaluation framework he developed for the two sites in Mecklenburg County. Hargrove felt that the existence of archaeological information on two other mining sites, the Reed mine and McCulloch mill, helped establish a context for 31GF328 as part of Piedmont mining district. Hargrove also felt that site 31GF328 had the potential to provide information about environment (particularly the selection of mining locations) and technology (through examination of the kilns). In evaluating the site's NRHP eligibility, Hargrove (1992:12) concluded that it contributed to the historic significance of the Gardner House property although it lacked individual distinction.

These two studies by Hargrove provide the first efforts at developing evaluation criteria for the archaeological significance of gold mining sites in the Carolinas. Hargrove's work pre-dates the National Register Bulletin *Guidelines for Identifying, Evaluating, and Registering Historic Mining Properties*, released in 1992 (Noble and Spude 1997). A factor that complicated Hargrove's effort was the absence of a gold-mining context that would help identify these site types and their role of in the Carolina gold industry. By way of gauging the significance of these sites, Hargrove (1990:39) referenced better-preserved examples with greater visibility and/or focus than the ones he was dealing with. However, a stronger argument for or against archaeological significance could be made with a more general understanding of how these sites were created, how they fit into overall mining systems, and what they represented in terms of technological development and general mining practices.

Subsequent investigations of gold mine sites in North Carolina did not build substantially on Hargroves' work although they occasionally referenced it. The 1993 survey of the East Mecklenburg Quarry in Mecklenburg County resulted in the identification of three sites (31MK581**, 31MK616**, 31MK617**) that represented elements of the historic Black Cat Gold Mine. The group of sites represented five pits, probably dating to



the mid-nineteenth century, and a dam. In assessing their archaeological significance, Ayers et al. (1993:54-55) considered that the sites reflected a common type in the region and would not yield significant information regarding the various topics that Hargrove (1990) suggested. Further, Ayers et al. (1993:55) considered Black Cat to lack historical significance because it had not produced demonstrably substantial gold yields, it was not associated with historically important people, and it was not a particularly well-preserved example of a gold mine in a region that contained numerous other examples.

Figure 54. The Extant Coggins Gold Mine Stamp Mill was Recorded in 1977 (Arnold 1977).

Survey of a planned sewer line west of Charlotte in Mecklenburg County resulted in the identification of site 31MK959**, a rectangular depression with associated rock piles that was interpreted as a gold mine feature. Because its age was not known and it lacked associated features or archaeological deposits to provide it with a context, the site was judged not eligible for the NRHP (Bamann and Lautzenheiser 2000). Another survey in Mecklenburg County for a force main produced a similar outcome. The survey identified site 31MK972**, a five-meter wide pit interpreted as a gold prospect. The site was judged to have a low research potential because of the absence of machinery and other technological features. Consequently, no further investigations were recommended (Edwards 2001:28-30).

Although it was not investigated archaeologically, a particularly noteworthy site in North Carolina is the Coggins Gold Mine stamp mill in Montgomery County (Figure 54). In 1977, the early twentieth-century stamp mill remained standing and received Historic American Engineering Record (HAER) documentation. Most of the equipment had been removed and the building was in disrepair, but the documentation illustrated the scale, arrangement, and operation of this plant, which was deemed to be representative of North Carolina stamp mills (Brenner 1977). Documentation indicated the large size of the building, approximately 111x70 feet with two rear ells for power generation, needed to house the 50 stamps. The plant was an open plan industrial building with a mezzanine where ore was delivered and conveyed to the bins that fed the stamps. Drawings and photographs show the structure was heavily framed with exterior clapboard and no interior paneling. The documentation did not provide detailed information on aspects of the structure that could be expected at an archaeological site, however, such as the construction of stamp or machine mounts or building foundations.

In South Carolina, most gold mine sites have been documented during surveys of Sumter National Forest, which contains three ranger districts that overlap historically important mining regions. Most of the work in the Sumter National Forest at mine sites has involved only identification (Elliott 1983, 1984; Braley 1988; Castille 1988; Smith 1989). In general, the sites reflect prospects and shafts or adits for underground mines. Additionally, archaeological remains of placer mining have been noted on Townes Creek in Cherokee County (Andrew Pickens Ranger District) (Bates 2008:5). No substantial remains of ore handling or transportation facilities have been recorded in the national forest yet.

In most cases, individual researchers have evaluated the Sumter National Forest sites on the basis of integrity, basing judgment of their potential research value and historical significance on their state of preservation and how it compared to other sites in the region. Bates (2008) provided a more detailed evaluation of two mid nineteenth-century mine sites, 38OC237 and 38OC277 (a lead mine) in preparation for filling of deep shafts. Noting that the sites were more complex than most mineral industry sites in the Sumter National Forest, Bates judged them to have significant research potential because of their archaeological content and historic associations. Specific questions that the sites could provide data to address were drawn from the Sumter National Forest Overview (Benson 2006; Bates 2008:27-28):

- *What is the period of greatest mineral prospecting and mining in each ranger district?*
- *Were prospectors and miners local men? Did outsiders flock into the region or were miners brought in? What ethnic groups were represented?*
- *Were specialists involved? Were these large sophisticated operations?*
- *What kinds of remains do gold mine exploration and mining leave behind on the Sumter National Forest? What types of features? What types of sites?*
- *What kinds of historic/archival records exist related to mineral prospecting and mining?*

Benson (2006) developed an overview of cultural resources of the Sumter National Forest. He noted that evidence of mining (all minerals), consisting of adits, shafts, creek dredging, flumes and “probable smelting furnaces" was extensive along Tamassee, Townes, Cheohee, Moody, and Cantrell creeks in the Andrew Pickens Ranger District (Benson 2006:75). In describing the sites associated with mining and prospecting in the Sumter National Forest, Benson (2006:153) noted that prospecting pits are often in small clusters, vary in depth and shape (from round to oval), commonly have a visible spoil pile around their margins, and typically occur within quartz outcrops. Benson further observed that these sites can be difficult to identify because they sometimes resemble tree falls, unmarked graves, or military training foxholes, among others.

Although little detailed work has been conducted at gold mine sites in the forest, Benson demonstrated the potential of viewing these sites together as a reflection of patterned behavior. He correlated site locations with certain environmental and cultural variables to generalize about distributions. Breaking down the distributions by ranger district, Benson found that in the Andrew Pickens Ranger District gold prospecting and mining sites were mostly within 1,200 meters of Moody, Cantrell, and White Oak creeks. Sites were in both upland and bottomland positions, with upland sites often being on slopes. For the Enoree Ranger District, the mining and prospecting sites were most often found on knolls, but also occurred on ridge slopes and one saddle. The knolls were most likely underlain by resistant quartz, and therefore would have been likely places to prospect for lode gold. Another pattern for this ranger district was that all eight of the mining sites lay within 500 meters of a historic residence. At the Long Cane Ranger District, 36 sites were distributed nearly evenly between ridge noses, steep ridge flanks, and knolls. Sites on ridge flanks took advantage of the access to rock outcrops. Residential sites were often within 500 meters of the sites in this district as wells (Benson 2006:220-221).

A recent study at Haile Gold Mine in Lancaster County comprised an example of a documentation project that examined a single resource in relative detail (Botwick and Swanson 2011). Additionally, the work dealt with the nineteenth- to twentieth-century stamp mill that operated here, and thus was one of the few processing sites studied. The site was initially identified during a Phase I survey but never formally evaluated (Pluckhahn and Braley 1993). As part of the resumption of mining at the site, Haile Gold Mine knew of SHPO's interest in the stamp mill and volunteered to perform the mitigation data recovery (see Botwick and Swanson 2011). However, the study was conducted as part of a "creative mitigation" and so rather than a full excavation, due to the lack of actual remains, the fieldwork was limited to documenting surface features with limited subsurface investigation. While production of this archaeological context served to compensate for the lack of more extensive fieldwork, incorporating the Haile Gold Mine into the history of Gold Mining in the Carolinas was part of this approach.

The Haile Gold Mine study produced important data on gold mining in South Carolina and raised questions that could potentially be addressed at other sites. Historical research indicated that it was significant in the development of gold processing technology, being the location where Carl Thies implemented an improved system of chlorination. The site once was included in a large operation of several open pits, extensive underground works, breaking plants, the stamp mill and concentration house, and the chlorination plant, along with support facilities (e.g., machine shops, power houses), workers' housing, and a small-gauge railroad. Except for the stamp mill, archaeological remains of the historic gold mine were enveloped and/or destroyed by later (1930s and 1980s) operations. Archaeological work at the stamp mill documented the general organization of this operation, as well as, features related to the support and operation of machinery, a workers's house, and a possible boiler house dating to the World War I conversion of the stamp mill to a pyrite mill. This work also indicated the way the mill's designers utilized and modified natural terrain to facilitate milling. Among the results of the study was the discovery that the mill and associated structural features were relatively insubstantial in their construction. Similarly, the footings of the worker's house were inconsistent in construction. These findings led to questions about how the mine approached construction and maintenance of facilities, and whether this approach was typical of Carolinas mining operations (Botwick and Swanson 2011).

In addition to sites directly related to gold mining, limited archaeological study of auxiliary sites has been conducted. Trinkley and Hacker (1995) conducted a survey and prepared a preservation plan for site 31RF157**, representing the Bechtler Mint site in Rutherford County, North Carolina. As with other studies reviewed here, this one was performed in the context of a heritage project at a site whose location was well known to historians and the general local public. The archaeological survey was conducted to assess the site and evaluate its NRHP eligibility. The study also discussed preservation issues and potential interpretation opportunities. The archaeological site was interpreted as the Bechtler residence and workshop. Trinkley and Hacker's analysis of the finds emphasized their similarity to southern plantations or farmsteads, which was one aspect of the site. Aside from noting the discovery of crucible fragments used in gold working or assaying, there was no consideration of the site as a type of industrial or commercial operation.

The literature review highlights aspects of the current state of gold mine archaeology in the Carolinas. In general, sites have been identified on the basis of large, very visible features or else they were already known from other sources, such as historical information or local custom. In addition, none of the sites identified in the region has been studied purely for scholarly purposes with previously developed research objectives applied to them. Instead, sites have generally been examined only to aid in reconstruction or management as part of a Section 106 compliance undertaking. Evaluations of research potential have mostly been made with reference to integrity but rarely with reference to broader research topics or themes. Although some efforts have been made to introduce explicit evaluation criteria, notably by Hargrove (1990, 1993), there has been little consistency in this regard.

In addition, the work up to now has illustrated the relatively piecemeal manner in which archaeologists have dealt with gold mining sites in the Carolinas. This is to say that archaeologists appear to have recorded individual features associated with specific mines but not taken into account the larger sites that these kinds of features might relate to. Historic mining sites can cover expansive areas, with extraction, processing, and other facilities located at great distances from one another. Several reports noted the absence of associated features, but it is not clear if these were sought beyond surveying the adjacent area. Admittedly, mine sites pose challenges that are difficult to integrate into standard cultural resource surveys, but evaluating individual or groups of prospects or mine shafts without reference to the larger mining operation makes it difficult to accurately interpret and evaluate these resources.

VII. Archaeological Identification and Recording of Gold Mining Sites

Historic gold mine sites are common in portions of the Carolinas but their unique attributes make them challenging to identify and record during surveys and evaluation studies. This chapter outlines suggested survey, identification, and recording procedures. Many of the recommended methods are applicable to other mineral resource sites as well.

SURVEY/IDENTIFICATION

As noted in the previous chapter, archaeological remnants of historic gold mines might be encountered during National Historic Preservation Act Section 106 cultural resource surveys or heritage projects. Archaeologists working in the Carolinas have done a good job of identifying the more obvious physical remains of gold mine sites, but site delineation studies as part of a NRHP evaluation require accounting for all components of a site. The majority of identified property types associated with gold mining in the Carolinas are prospects and shafts, although it is likely that other feature types survive above and below ground.

Archival research is more important in identifying mining properties than it is for most cultural resources surveys. Site-specific or study area-specific documentary research prior to conducting fieldwork is necessary to determine the general mining practices used in a region and specific mining sites that might occur in an individual survey area (Hardesty 1988:108; CALTRANS 2008:156). Maps and other archival sources, such as historic aerial photographs and local histories, can indicate the presence of mines in a project area and the types of mineral extraction and processing activities involved. Documents also provide information for developing preliminary models of mines and their probable locations (Hardesty 1988:108; 2010:21). This preliminary knowledge familiarizes surveyors with the feature types expected and helps to accurately identify any found during the fieldwork (Noble and Spude 1997:7). Sources that are useful for identifying specific gold mine locations in the Carolinas include Nitze and Wilkens (1897), Pratt (1907), Sloan (1908), Carpenter (1999), and McCauley and Butler (1966).

Historical documents that indicate potential site locations are limited, however. Aside from providing only general information on site locations, they could exaggerate the size of particular mines and the scales of production, leading surveyors to look for features that were planned but never built. Moreover, while they could indicate the location of a mine and its major components, they did not always provide details about mundane features, such as shafts, adits, outhouses, and trash scatters (Hardesty 1988:108-109, 2010:22). Many of these kinds of features, however, are visible either at the surface or through archaeological methods and can be located through fieldwork. Moreover, it is apparent that some mining operations were well documented with descriptions, maps, and photographs while many were small-scale or exploratory operations having few or no documentary records useful for locating them.

Consideration of the types of mining prevalent in an area can also help to develop preliminary models of site locations. Placer mining typically follows drainages. Lode mining was oriented with respect to geologic structures (Noble and Spude 1997:6). Hardesty's (1988:108, 2010:21-22) study of Nevada mines suggested that mine locations were mainly related to ore distributions, while factors such as water, towns, and transportation venues provided secondary influences, and, what is more, were often established with respect to the mine locations.

Regarding fieldwork, the nature of mining sites requires different survey and identification strategies than more discrete resources. For example, fixed-interval shovel test surveys (typically at 30-meter intervals) may identify individual mining properties only as isolated features, if they are recognized as cultural resources at all. Archaeologists should visually inspect survey locations for features (such as those discussed in Chapter V) that may indicate the presence of gold mining. Components of mining properties, such as shafts, adits, and other structures, are often visible at the ground surface as distinct excavations, and hence, visual survey is capable of recognizing them. Having found individual components, it is important to expand the survey area and record nearby associated properties in order to document and understand the context of individual features. Pedestrian survey for mining properties is best completed during winter months when ground cover is minimal. At other times of year, tighter interval pedestrian spacing and/or the use of zigzagged transects may be used to identify surface remains (Figure 55).

Different sets of features and activities at mine sites require varied approaches to identification and documentation. Shovel testing, while not as effective for identifying or delineating mines, can be used in locations where historic mapping or field conditions suggest that mill remains, administrative structures, worker housing, and other activities may be present. In instances where these kinds of activities were known to exist, systematic archaeological surveys should be used to supplement the intensive pedestrian survey. In areas containing large features associated with the

Figure 55. Gold Hill Mine, Rowan County, South Carolina, Circa 1880s to 1890s. Archaeological Remnants of Site Such as This Could Include Large Surface Features but Few Artifact Deposits That Could Be Found With Shovel Tests (Nitze and Wilkens 1897).

major mining activities, however, subsurface testing is generally not necessary and would not justify the effort put into it. This is particularly true for features like tailings and waste rock piles (CALTRANS 2008:156). The unused spaces between areas of intensive activity generally do not contain substantial cultural resources related to mining either. Nevertheless, some form of sampling should be applied to these areas. Hardesty (1988:109, 2010:23) recommended dividing the areas into transects and surveying a percentage of them.

Metal detector survey, or the use of a magnetometer, is recommended for the identification of remnant architectural and landscape features, including railroad rails and spikes in potential rail beds, structural remains from processing areas, and nails from residences and other structures. Metal detector survey should be used judgmentally on mining sites to aid the determination of integrity; for example, if rails do not appear to remain in railroad bed locations, then is it likely that the mining site has been salvaged after abandonment, which effects the site's integrity. A magnetometer can be used to map the subsurface placement of metal remains, such as rails, as well as buried metal processing facilities and equipment. Ground penetrating radar (GPR) can also be used to record the subsurface elements of mine structures. Light Detection and Ranging (LIDAR) data, if available, is extremely useful for identifying mining site features and their locations. LIDAR records subtle differences in surface contours, and can be used on mining sites to reveal excavation locations

In addition, involving industrial historians, historians of technology, landscape architects, mining engineers, and geologists in the field can help in identifying and interpreting properties (Noble and Spude 1997:9; McClelland et al. 1999:7). These professionals can also provide important assistance with pre- and post-survey archival research.

The expansive and discontinuous nature of mining sites is another consideration in identifying and delineating them. Mining sites often do not consist of a continuous scatter of artifacts and features like "traditional" sites but instead they may contain components that are widely separated from one another (Figure 56). Identifying these dispersed features and deposits is necessary to completely reconstruct and understand an individual mining operation. Field searches must therefore be comparatively intense and wide-ranging to ensure that all related features and activity areas are identified (Hardesty 1988:109, 2010:21; McClelland et al. 1999).

The underground components of mine sites (shafts, drifts, and other structures) must be considered, although these kinds of features present significant obstacles to survey and recordation. Hardesty seemed to be of two minds on the subject of underground workings. On the one hand, he noted that they could contain significant information about chronology and activities associated with particular mines (Hardesty 1988:25-27, 2010:46). At another time, however, he stated the opposite position, stating that they rarely yielded useful information (Hardesty 1990:49-50).

Regardless of their research potential, because of the unstable nature of underground features, they should never be entered except under the supervision of mine-safety experts (Hardesty 1988:27, 2010:49; CALTRANS 2008:177). The locations of these features can sometimes be determined on the basis of surface remains or where they have been exposed during later open pit excavations (Griffin 1974:18-19; Noble and Spude 1992:9). Remote sensing techniques such as GPR can be used to detect the presence of filled mine openings but should be used with caution (Noble and Spude 1997:9). Archaeological geophysical prospecting techniques typically have a limited depth range of 1-3 meters, depending on soil conditions, giving them limited usefulness for locating deeper

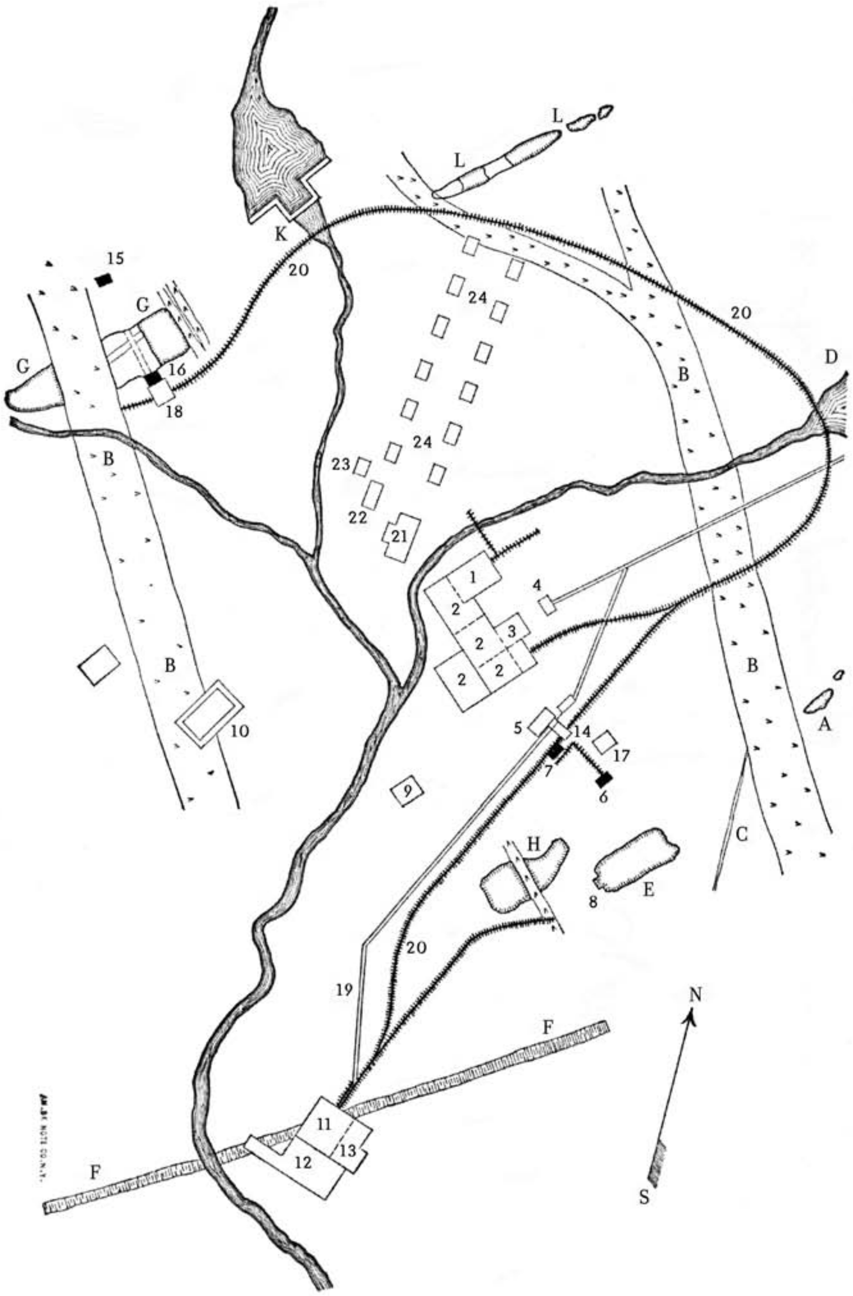


Fig. 21.—Mines and Plant, Haile Gold Mining Co., Lancaster County, S. C. Scale, 1 inch=400 feet.

A, Red Hill pits; B, Diabase dikes; C, clay dikes; D, outlet of large reservoir; E, Bumalo pit; F, quartz-vein; G, Beguelin mine; H, Haile pit; K, small reservoir; L, Chase Hill pits; 1, chlorination house; 2, roasting furnaces; 3, boiler house; 4, pump; 5, machine shop; 6, No. 2 shaft; 7, new shaft; 8, No. 3 shaft; 9, offices; 10, superintendent's residence; 11, mill; 12, concentration house; 13, boiler and engine; 14, crusher; 15, new Beguelin shaft; 16, Beguelin slope; 17, boiler house; 18, crusher; 19, flume; 20, mine railroad; 21, commissary; 22, church; 23, school; 24, village.

Figure 56. Mining Sites May Spread Widely and Include Areas of Empty Space. Components of the Haile Gold Mine in Lancaster County, South Carolina, Covered Nearly a Mile but Many Areas Were Never Used (Nitze and Wilkens 1896).

structures. Given the dangers of entering and exploring historic underground mines, an accurate understanding of their technology and features can only be obtained after subsequent mining operations or collapses exposes them (Hardesty 1990:49; Heritage Victoria 1999:3).

Other hazards that must be accounted for during survey and recordation include covered, unmarked, or obscured shaft openings. The ground surrounding mine openings can be unstable and care should be used in their vicinity. Low spots or depressions should not be entered because they can be thinly covered shafts. In addition, any blasting devices or materials found at a site should be considered highly dangerous, regardless of how old. In addition, ponds located at mining sites might be flooded shafts or old leaching pits containing dangerous chemicals. As with other low spots, care should be taken around ponds because their edges can be unstable. Mine sites might also contain hazardous materials such as mercury, cyanide, and arsenic, which were used for certain processes. They may be present in the ground or in unmarked containers (Noble and Spude 1997:6; CALTRANS 2008:177). Historical documentation can provide information on the types of procedures that took place at a mine site, which in turn can suggest if certain hazardous materials

Figure 57. The Interior of any Standing Mining Structures Should Be Carefully Documented With Particular Attention Given to How the Equipment Was Arranged. Coggins Gold Mine Stamp Mill, Montgomery County, North Carolina (Photo: JoAnn Sieburg-Baker; Brenner 1977).

were used there. If excavation will be undertaken, then a hazardous materials assessment should be performed.

Historic architecture found on mining sites should be photographed and recorded. It is important that the surveyors recognize and record all of the features of mining structures, with an emphasis on interior processing equipment and machinery (Figure 57). Surveyors should be cognizant for the presence of bolts or other fasteners in the structure's floor that could indicate the location of equipment that was salvaged and removed after the mine's closure. Mining companies moved from place to place as the deposits were exhausted in one location and new resources were sought, and hence the removal/relocation of equipment is part of the history of mining in the State, and not necessarily an adverse effect on integrity. Nevertheless, while a site can be significant while missing certain components, it must still illustrate the overall system and procedures employed for mineral extraction and processing that took place there. Consequently, individual feature or resource types that appear to have been salvaged should not be discounted as lacking significance.

The scale of mining properties, the variety of resources they contain, and their setting in cultural landscapes all mandate the use of Geographic Information Systems (GIS) to record, map, and interpret their remains. It is important to correctly identify specific feature types to assist in accurately characterizing the mining processes being identified and their chronologies (CALTRANS 2008:156). Features should be recorded by GPS along with property type in the data dictionary field. Locations should include each property's boundaries. GIS overlays should be developed, including property limits/boundaries as identified through archival research, historic maps or plats showing structure locations, historic aerial photographs, LIDAR data, and other resources, as available.

MINING PROPERTIES AS CULTURAL LANDSCAPES

Historic gold mine sites are unusual cultural resources and encompass a variety of historical and cultural properties. They might cover expansive areas and include diverse features, sites, and cultural deposits including the obvious vestiges of mineral extraction, such as mines and waste piles, an array of processing and transportation facilities, and support structures such as powerhouses, offices, and blacksmith shops. They can also include extensive underground components, broad areas of unused space, and housing for workers and their families. Additionally, seemingly isolated structures and features may have historical relationships as discrete parts of a single mining operation. Moreover, the location and functioning of mining sites often have close connections with the physical environment. Because of these qualities, and the difficulties in identifying and delineating them, the survey of historic gold mines is sometimes best accomplished through a cultural landscape approach that identifies and records all properties, both sites and structures, associated with a mining operation.

The National Register Bulletin *Guidelines for Evaluating and Documenting Rural Historic Landscapes* defines a historic rural landscape 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 continuity of areas of land use, vegetation, buildings, and structures, roads, waterways, and natural features" (McClelland et al. 1999:1-2). Historic gold mines can be identified, evaluated, and studied with reference to a geographical area rather than to individual features, sites, or structures.

Viewing historic gold mines as rural historical landscapes can link isolated features and structures that appear to have no significant historical or functional associations. Rural historic landscapes may include industrial types and "contain significant areas of vegetation, open space, or natural features that embody, through past use or physical character, significant historical values. Buildings, industrial structures, objects, designed landscapes, and archaeological sites may also be present" (McClelland et al 1999:3). A classification system of 11 characteristics of a rural landscape helps in reading and interpreting the natural and cultural forces that acted on it. McClelland et al. (1999:3) defined the landscape characteristics as "tangible evidence of the activities and habits of the people who occupied, developed, used, and shaped the land to serve human needs." Further, they might reflect beliefs, attitudes, traditions, and values of the people who created them.

The 11 characteristics are divided into two groups: processes that have shaped the land, and physical components that are visible in the landscape. The four characteristics classified as processes are: Land Use and Activities; Patterns of Spatial Organization; Response to the Natural Environment; and Cultural Traditions. When addressing historic gold mining properties, these characteristics can help in understanding how and why a mining landscape developed over time. The seven characteristics that make up components of the landscape are those features that illustrate the way a historic landscape was developed and organized. These include Circulation Networks; Boundary Demarcations; Vegetation Related to Land Use; Buildings, Structures, and Objects; Clusters (of buildings, structures, and other features); Archaeological Sites; and Small Scale elements. The National Register Bulletin Guidelines for Evaluating and Documenting Rural Historic Landscapes described these concepts in detail and provided specific examples (McClelland et al. 1999:4-6, 15-18). Components of mining landscapes in the Carolinas could include, among others, underground workings, open cuts, tailings, roads, railroads, stamp mills, processing plants (e.g., chlorination or cyanide), retort and assay buildings, storage bins, retaining ponds, water delivery and drainage systems, shops, stables, offices, and houses.

In identifying and evaluating historic gold mine properties as historic landscapes, it is suggested that consideration be given to how the land was shaped and manipulated to extract, process, and deliver mineral resources. Mining landscapes should show evidence of specific land use practices, transportation networks, vegetation patterns, large and small elements that are distinctive of mining, buildings, and structures, as well as illustrating how these functioned together within a geographical area. It should be said as well that not all historic gold mines or properties would necessarily be considered historic landscapes, and decisions as to how to categorize a property or groups of properties would have to be made during survey and evaluation.

DELINEATING AND RECORDING HISTORIC GOLD MINES FOR EVALUATION STUDIES

Procedures for recording gold mine sites overlap those of survey but call for greater detail and consideration of how the various structures, features, and deposits relate to historic contexts and convey historic significance. After the initial Phase I survey identified mining features at Humbug Creek in Arizona, for example, researchers from Dames & Moore returned and intensively resurveyed the site to record it (Ayres et al. 1992). Although Phase I survey for mining sites involves considerable archival research, the recordation phase might include additional documentary study combined with fieldwork.

Historical research at the recording stage is intended to contribute more detailed information about what activities took place at a particular site as well as providing information necessary for establishing a site's period(s) of historic significance and what historic contexts it might relate to. Chain-of-title research should be conducted to determine the property's ownership and associated mining companies, which often leased mineral rights but did not own the mine. This information also indicates the historical boundaries of the mine. Secondary sources are also useful documents if they describe particular sites (CALTRANS 2008:156). Historic maps and photographs are also good resources for documented sites.

Fieldwork at this stage should include more detailed recording methods, including photography, preparation of architectural plans and elevations (if structures are present), sketches of machinery and other objects, narrative descriptions, and preparation of scaled maps (Noble and Spude 1997:9). Detailed fieldwork, mapping, and recording are particularly important in establishing the content of a site and its boundaries. Gold mining sites may be recorded as either a set of sites within a complex or district, or a series of features within a single site. The determination as to which of these options is appropriate depends on the size of the resource, its complexity, and its associations, chronology, and the types of features and elements involved (CALTRANS 2008:157). It is important, however, that in either case, individual or groups of features are related to a broader mining operation.

Evaluation fieldwork should also emphasize collecting information necessary to assess integrity and significance and should employ methods appropriate for making these determinations. The total site, including both structures and archaeological materials, must be assessed to determine how well it conveys a sense of time, place, and historical patterns or themes, as well as how well it might address important research questions (Noble and Spude 1997:9). Detailed recording will help with this by providing the information necessary to identify individual features and interpret how they related historically.

Finally, the physical remains of the site must be analyzed to link them to the mine during its period(s) of operation and to the social and economic systems in which it functioned. The analysis and interpretation can be complicated by the actual life cycle of the mine. Mines may be abandoned and then re-opened at a later time, or new technologies and processes can be applied, which can damage or destroy older features and deposits. The site structure that emerges from these sequential episodes of development and abandonment often consists of sets of overlapping features, depositional strata, and objects that can be viewed as "horizontal stratigraphy." Remains from various time periods may be damaged or destroyed by later developments, and chronologically or functionally related features could be widely spaced (Hardesty 1990:48). Hardesty (1990:48) cautioned against viewing a mine site as a continuous accumulation of historic debris, stating that its structure more likely represents disjointed remnants of multiple uses and activities. It is important to determine the temporal relationships of individual features in order to accurately interpret engineering and other systems (Noble and Spude 1997:9).

The use of a geodatabase is encouraged at this stage. A geospatial database (geodatabase) consists of a GIS with an associated database in *Access* or similar software. The database should contain feature descriptions, functions, ages, and images. González-Tenant illustrated the use of GIS and geodatabases to map and interpret gold mining sites in the Otago Goldfields of New Zealand (González-Tenant 2009), and his study showed the utility of this approach in mapping resources by function, age, and landscape. Preparation of a geodatabase would include detailed recording of mining property types with GPS, preparing descriptive analyses of each property as well as its age of construction for use in mapping and displaying mining landscapes over time, georeferencing historic maps of the mining site, and comparing the spatial distribution of the site with other recorded mining properties. Use of geodatabase analysis will facilitate the evaluation of several aspects of integrity, including location, setting, and design.

VIII. Evaluating Carolina Gold Mine Sites

Historic gold mines in North and South Carolina may have significance because they reflect important aspects of history. Determining the significance of a historic gold mine site requires working through a number of steps and considering how a site relates to historic contexts, what its research value is, the anticipated use of the site, including resumption of mining activity, and how its physical condition affects its ability to convey its significance. The following sections discuss the factors to consider in evaluating the archaeological significance of historic gold mines in the Carolinas and suggest research topics that can be used in determining a site's study potential.

HISTORIC CONTEXTS AND AREAS OF SIGNIFICANCE

Historic contexts are patterns or trends in history that provide a framework for understanding specific occurrences, properties, or sites. They provide a means for relating specific sites to broad historical patterns and thus interpreting their meanings and evaluating their significance.

The historic context of this project can be stated as "Gold Mining in the Carolinas," encompassing the historical, technological, economic, labor, and cultural developments related to producing gold bullion in this region. Gold mining in the Carolinas ranged from small-scale workings to industrial operations using various mechanical and chemical processes to remove gold from waste rock. Gold mining had important impacts on the historic development of the Carolinas, and especially the North Carolina Piedmont, where it impacted settlement and landscape, introduced industrial practices and organization, and affected the regional economy. Additionally, some aspects of gold mining technology developed or improved in the Carolinas were later put into use in the more renowned western gold fields. The Carolina region was also the site of important innovations in chemical processing of gold ore. Gold mining directly impacted settlement, as new communities emerged or older ones expanded and reoriented as new gold regions opened. Gold attracted foreign-born specialists and employed laborers in small and large-scale industrial settings for the first time in the southeast, and thus had important impacts on demography and labor. Also, gold mining led to the introduction of northern and foreign capital being invested heavily into the region as well as the introduction of corporations.

Historic contexts can encompass one or more "themes" or "areas of significance." The National Park Service (1990) defined a theme as a means of organizing sites into coherent patterns based on certain concepts or subjects, such as environment or technology, that have influenced the historic or cultural development of a region. A theme is considered significant if it can be demonstrated through scholarly research to be important in American history. Evaluating a historic gold mine site requires determining how the theme of the context is significant in the history of the local area, the state, or the nation (National Park Service 1990:8). A single site could relate to more than one theme. The preceding summary of the historic context and significance suggests that significant themes or areas of significance for gold mining in the Carolinas include:

- Archaeology
- Historic--Non-Aboriginal
- Commerce
- Community Planning and Development
- Economics
- Engineering
- Ethnic Heritage (Primarily European, African-American)
- Exploration/Settlement
- Industry
- Invention
- Labor
- Landscape
- Science
- Social History
- Transportation

AREAS OF SIGNIFICANCE: NRHP CRITERIA FOR EVALUATION

The significance of a historic property is evaluated with respect to four NRHP Criteria found at 36 CFR Part 60.4. In addition, sites must be assessed in light of their relationship to historic contexts. Finally, a site's NRHP eligibility is a function of its integrity or its physical ability to convey its historic significance. In other words, it must not only be a good representative of its historic context, but must also be in a condition that clearly demonstrates its relationship to the context.

The four NRHP Criteria for Evaluation require that districts, sites, buildings, structures, and objects possess integrity of location, design, setting, materials, workmanship, feeling, and association, and meet one or more of the criteria of evaluation.

Criterion A. Refers to properties that are associated with events that have made a significant contribution to the broad patterns of our history;

Criterion B. Covers properties that are associated with the lives of significant persons in the past;

Criterion C. Relates to properties must embody the distinctive characteristics of a type, period, or method of construction, or represent the work of a master, or possess high artistic values, or represent a significant and distinguishable entity whose components may lack individual distinction; or

Criterion D. Deals with properties that have yielded or are likely to yield information important to prehistory or history.

Assessments under the first three criteria are made with reference to particular historic processes, events, and people associated with specific gold mines in the Carolinas. Hardesty (1988:109) referred to them as mainly the province of historians, architects, and engineers, although archaeologists would be expected to deal with them given that most gold mining sites in the Carolinas are presently archaeological resources. The important historical developments and trends of gold mining in the Carolinas were discussed in Chapter III and should be referenced in determining how individual sites reflect historical developments, people, or types. For Criterion C, Hardesty (1988:110, 1990:50) also suggested that representativeness and 'rarity' are important considerations. Specific questions to consider are whether a site is the first of its kind, is it the last survivor of a type, or does it represent an important change in technology, new or innovative practices, or experimental approaches?

Evaluating archaeological sites under Criterion D requires asking what important research issue(s) could the site provide information about? To make such a determination, it is helpful to identify the relevant research questions in advance. Hardesty noted that the lack of clearly identified research topics was a major impediment in evaluating the historical and archaeological significance of mining sites. The practice of evaluating sites with site-specific and ad hoc questions led to trivial research questions and vague topics that were difficult to apply (Hardesty 1990:42-43). The following discussion suggests research topics for assessing the information potential of gold mining and other mineral industry sites in the Carolinas.

RESEARCH TOPICS FOR ARCHAEOLOGICAL EVALUATION

Historic mining sites reflect industrial workplaces and in some instances also the domestic world of the workers, managers, and other people involved with mines and miners. A recent historic context for Georgia mining sites provided topics for evaluating the archaeological research potential of these resources (Botwick et al. 2011:Appendix 4). Many of the research topics that deal with gold mines can be addressed with a combination of archival, architectural, and archaeological sources (Hardesty 1988:12, 2010:23), although archaeology provides a unique means to study intimate and poorly documented aspects of past behavior at mining sites. The research topics for Carolina gold mining sites were adapted from the CALTRANS (2008) research design for California mining sites. Appendix A contains specific questions that can be addressed at gold mining sites in the Carolinas to help establish research potential. The general topics of concern are summarized below. The topics include the following:

1. Technology and technological development of mining	4. Gender and family aspects of mining
2. Historical ethnography/cultural history of mining	5. Economic aspects of mining
3. Ethnicity of distinct culture groups and ethnic interactions	6. Policy, law, and regulation of mining and self-governance

Remains of technology are often the most visible remnants of historic mining (Hardesty 1988:12, 2010:23). Research into the technology of mining generally deals with what equipment and techniques were used at individual mines, how they were implemented, and how they changed over time. These topics can also be studied at the regional level. Additionally, the effects of general technological advancements on mining can also be examined.

Studying the technology of mining can encompass not just the equipment used to extract and process ore, but also the byproducts of these activities. Studying waste handling and management at the Standard Mill, Bodie, California, and tailings outside Butte and Anaconda, Colorado, Quivik (2003, 2007) demonstrated varying technological approaches that mill operators developed to reprocess tailings and more generally to mitigate the environmental effects of mill wastes. Another study of mill byproducts was at the Reed Gold Mine in North Carolina. Here, Trinkley (1986:83) suggested that plotting the particle sizes of tailings deposits could be indicative of different activity areas.

Historical ethnography/cultural history of mining can encompass topics such as mining settlements. Hardesty (1988:13) cast the residential settlement or mining camp as one of the principal units of study in the archaeology of mining, stating that it is the shape and activity of settlements are expressions of the interactions that take place within the social sphere of mining regions. Research topics dealing with settlements concern how they become established and develop into communities, and what social, economic, and political forces shape them. This topic also deals with individual households and groups of households (community) and is concerned with such topics as the composition and nature of households, permanence, demography, shelter types, and variation over time and mine type/organization.

The topic of ethnicity is concerned with identifying cultural markers in the archaeological record of mining. Additionally, the process of socializing various ethnic or national groups is a topic of concern (Gray 2009). Cultural differences or distinctions might be present in both the workplace, for example in the methods or equipment used, or in the domestic sphere. Carolina miners included whites, African-Americans, and Europeans who brought and/or developed varying approaches to gold mining and associated practices. Addressing this topic would require clear evidence of miners' ethnicity, the mining methods used, and/or archaeological deposits associated with domestic occupations.

Gender and family aspects of mining also may include the workplace and domestic world. Women and children participated in certain mining operations in the Carolinas and were certainly present in mining settlements. Because archaeology handles the more intimate aspects of households and communities, it can provide important information about the presence of women and children in mining communities, attitudes toward them, and the nature of their lives (Moore 2009; Prangnell and Quirk 2009). Because so little is known about the gender and family aspects of mining in the Carolinas, research into this topic at this point involves determining how women and children can be identified at mine sites and what effects the presence or absence of families had on mining communities.

Consideration of the economic characteristics of mining considers the production and consumption of commodities (Noble and Spude 1997:17). This theme covers topics ranging from individuals and households to how mines and mining regions related to the outside world. Specific issues include what mines produced, how mining generated income for various individuals, how mining was capitalized, and how these influenced material culture. Additionally, the topic considers how mines and mining influenced other economic activities and infrastructure in the region. Issues of consumption can cover the materials that different social, occupational, and economic classes purchased.

Finally, topics related to policy, law, and regulation of mining and self-governance deal with the nature and influence of federal, state, and local regulations on mining activities. These issues are typically handled by historians but archaeology has a potential to contribute information on how laws and legislation influenced land use and water rights, efforts to adapt mining/quarrying practices to environmental and labor regulation, and the effects of mineral industries on the physical environment (Quivik 2007).

Beyond the topics suggested by the CALTRANS (2008) research design, investigations of mining sites in the Carolinas and elsewhere raise general and region-specific questions. Investigations at the Haile Gold Mine stamp mill site (38LA383) in Lancaster County, South Carolina, raised additional topics about regional gold mining. At Haile, aspects of construction observed at a railroad ramp and a worker's house suggested a haphazard approach to facilities maintenance. Another finding was the lack of substantial building foundations associated with the stamp mill, a building type whose function required strength and durability. The building seemed to have used wood pilings, although this was not strongly confirmed by archaeological evidence, and the reason for the absence of stone or masonry was not clear. This result has implications for understanding the economics of industrial gold mining operations as well as the ideologies affecting their organization, construction, and appearance. For example, mining sites, and industrial buildings and landscapes in general, can portray cultural ideologies (Hardesty 1988; 2010); social and aesthetic principals, both at the corporate and social levels (Alanen and Bjorkman 1998; Greenwood 1998; Malone and Parrott 1998); corporate identity (Slaton 1996); and business or management styles (Heite 1992). Many of these topics are manifested in phenomena such as the layout, appearance, and use of space at individual sites. Further research at other sites could focus on the specifics of mine structure design in the Carolinas to look for patterns and determine if the finds at 38LA383 were typical or anomalous (Botwick and Swanson 2011).

Looking beyond individual sites, Benson's (2006) analysis of mine distributions in the Sumter National Forest, South Carolina indicated a potential for regional analysis. Benson, as noted, correlated site locations with specific environmental variables, showing that they refect patterns of human behavior. What was lacking from Benson's investigation, however, was detail on the site types and chronology, forcing him into making only very general statements about mine sites and their environmental or other associations. More precise information would yield more informative and robust information about the development and variation of mining practices in the Carolinas. For example, site data from Alaska revealed that different types of placer mines were associated with distinct artifacts, features, and landscape modifications (Hovis 1998:29). This example also highlights the importance of accurate identification of sites and features for generating useful archaeological data (CALTRANS 2008).

Hardesty (1988:1; 1990:44-45) pointed out that archaeological research into historic mines can be viewed at different scales or "contextual levels," which include the world system, the mining district, and the locality. Questions about mines that take into account the world system deal with variability and change at national and international scales and may include processes such as the impact of industrialization on the mining workplace. The mining district is a smaller geographical scale for studying mining. Hardesty (1990:45) generally equated it with the community level of analysis. Research topics include population dynamics; the roles of ethnicity, gender, class, and kinship; patterns of mining technology and workplace in the district; and the district as an economic system. Finally, the smallest analytical levels are individual mining settlements or households, mills, or mines. Hardesty (1990:45) suggested that questions concerning variability and change in the social organization, ethnicity, economics, and demography of individual households would be an important topic. Additionally, reconstructing the technological processes of particular mines would be topic to consider. In sum, all of the topics described above can be viewed at each of these levels.

Hardesty (1988, 2010) advocated an evolutionary perspective to structure the study of change and variability in mining regions. In this framework, "mining frontiers" consist of networks of "islands" subject to boom and bust cycles. Islands represent areas within a landscape where ore deposits have been found. They are colonized by miners and supplied and administered from external sources, most likely in urban centers (Hardesty 1988:1). Boom-bust cycles occur as a result of local conditions (e.g., exhaustion of ore bodies) and outside influences (e.g., fluctuating ore prices, technological limitations). Hardesty's interest is how miners cope with these cycles as well as how they deal with the island structure of the frontier.

Hardesty (1988:112-114, 2010:180-183) provided a theoretical framework to understand and explain these coping strategies and their material correlates. Summarizing Kirch's model of adaptation, Hardesty characterized the process of adaptation as a predictable three-stage sequence that should be observable in the archaeological and documentary record. Colonists first enter a new environment, bringing with them adaptations developed in the previous environment. This period is typified by limited variability and poor adaptation. Second, colonists enter a period of coping during which experimentation and innovation increase, leading to greater variability. The final stage reflects the fully adapted colonists. The most appropriate adaptive strategies will have emerged, leading to less variability but greater environmental fit.

Coping strategies, moreover, are divided into two classes: opportunistic and resilient. Opportunistic strategies refer to activities or conduct for maximizing resource gains. These strategies might be expected to arise in response to unexpectedly abundant ore bodies or market opportunities and could include movement to new geographical areas, intensification of activities, or cooperation to gather together more resources. Behavioral correlates might include radical settlement shifts and household organization as well as reduced variability and increased population growth (Hardesty 1988:112, 2010:180).

Resiliency coping strategies tend to be more flexible and are useful for dealing with unpredictable or uneven ore sources. Not only are ore sources apt to be variable, but their extraction and milling requirements can vary as well, making flexibility important. Resiliency strategies involve experimentation and may increase behavioral variability among mining settlements and households, as well as population decline. Tactics for dealing with uncertainty or change may include searching for new markets, cutting costs, and geographical contraction. Failed efforts at dealing with opportunities can lead to shifts to new resources or abandonment of an area (Hardesty 1988:113, 2010:182-184).

Hardesty's proposed research agenda for the western mining regions has applicability for research into the Carolina gold fields. It provides a broad-scale regional approach to examining individual sites and investigating widespread patterns of change and variability. Hardesty (1988:111) was explicit that he was not trying to force a single research program onto the field of mining archaeology and the same point should be taken here. The objective of the preceding discussion was to suggest general research themes and analysis frameworks to assist archaeologists in evaluating the NRHP eligibility of gold mine sites in the Carolinas. As researchers become more familiar with the existing database, it is expected that modifications to the above topics or new topics will arise.

INTEGRITY

In addition to determining the type of significance a site possesses, the National Register Criteria for Evaluation require that its integrity must be assessed. Beyond describing its condition, integrity refers to the ability of a property to convey its association with a particular historic context. It is an extremely important concept in determining historic significance and the nature of historic mine sites can make judging integrity problematic. The formation and structure of mining sites often damage their physical condition and affect their research potential or their capacity to be interpreted. Two points to emphasize in considering the integrity of mining sites are the tendency of these sites to be reused over and over, and the way that their horizontal distributions can affect their condition.

Mining sites often reflect multiple episodes of use and abandonment, with different periods of activity leaving separate overlapping and intersecting features, strata, and objects. The tendency of mining sites to go through alternating periods of activity and idleness can result in damage or destruction to earlier elements. Changing mining technologies often are the cause that can aggravate this phenomenon. Modern operations typically work through surface techniques that involve opening large areas and in the process remove extensive archaeological remains as well as isolating features or site components that were once associated as parts of a functioning operation. For example, at Haile Gold Mine in Lancaster County, early, mid and late-twentieth-century activities removed nearly all remnants of the nineteenth-century operation, leaving only the archaeological remains of the historic stamp mill and other features in its immediate vicinity. Although the stamp mill site (Site 38LA383) possessed some research value, the integrity of the broader gold mining operation was thus compromised.

Mining sites are also unique in that they can be described as having "horizontal stratigraphy." This is to say that objects, features, and other resources related to a given period or occupation might be spatially separated, with later features between them, rather than vertically separated as at more traditional archaeological sites. Because of this condition, mining sites -- or depositional units within them -- must sometimes be viewed as discontinuous remnants of repeated occupations and activities rather than contiguous aggregations of deposits, features, and structures (Hardesty 1988:12, 1990:48, 2010:20). Assessing integrity in this case would have to consider whether or not widely dispersed site elements could be related to one another despite distance and possibly the presence of intervening modern elements.

The preceding discussion implies that the formation and structure of historic mines would make them unlikely to have integrity, in the sense that their current condition would impair their ability to convey their historic associations. However, evaluations of integrity would depend on the nature of particular sites and why they might be significant (National Park Service 1990). If a site were evaluated with respect to how, in its entirety, it embodied a complete mining process, then ideally it would have clear representations of the processes of extracting, processing, and refining ore, along with the auxiliary activities, such as transportation, water supply, power generation, and possibly administration and residential areas. Moreover, it should be possible to relate these to specific historic contexts or themes. Sites that only retain one aspect of the mining process or that have been reworked so often that individual features cannot be related to one another, to a process, or to a historic period would have poor integrity. Clearly, few sites would meet the ideal situation because it is unlikely that all elements of the system would remain intact or even in good shape. However, the key point is not on the specific condition of individual elements making up a property, but whether the overall mining system remains discernable and able to convey its historical associations (Noble and Spude 1997:21; Noble 1998:14).

At the same time, individual properties might also have significance even if properties with functional and/or chronological relationships no longer exist. For example, a processing plant whose overall context no longer existed could be considered significant if it conveyed a sense of its function and how it operated, or if it exemplified the technology in use at a particular time or place, or represented unique or innovative technologies. Moreover, an individual archaeological site could have research potential on technology, miners, or other aspects of gold production. Thus, in evaluating integrity, researchers should be explicit about what makes a site significant and how the site expresses that significance.

The following sections describe the procedures for evaluating Carolina gold mining sites with reference to their historic contexts and integrity. There are seven aspects of integrity: location, design, setting, materials, workmanship, feeling, and association. The NRHP criteria stipulate that a site must possess at least several or most of these aspects. Which of the aspects of integrity a site must have and how important each one is in evaluating a particular site depends on the nature of the site itself and why it might be significant (National Park Service 1990). For historic gold mines, it is important to consider not just individual properties, but the entire mining system and assess its degree of intactness and visibility. An ideal site for the NRHP would clearly reflect the processes of extracting and processing minerals as well as the supporting activities of transportation, water supply, power generation, and possibly administration and residential areas. It should also be possible to relate these resources to specific historic contexts or themes. Sites that only retain one aspect of the mining process or have been reworked so often that individual features cannot be related to one another or to a historic period would be judged to have poor integrity and thus not eligible for inclusion in the NRHP. If clear physical evidence of a complete system remains discernable and can be interpreted, damage or loss of some parts of it may not eliminate overall integrity (Noble and Spude 1997:21; Noble 1998:13-14).

Moreover, in dealing with the archaeological remains of gold mines, integrity mostly refers to the quality of information potential (Little et al. 2000:36-37). Thus, although an overall mining operation might lack integrity because individual elements are missing or disassociated, remaining individual features or loci might still have archaeological research potential and could be considered NRHP eligible. Alternatively, an individual feature or locus of a mine might possess some aspects of integrity, but lack research potential due to its disassociation with the rest of the mine, which may have been destroyed. In addition, it is possible for a site to have integrity but lack significant information potential. For example, information redundancy could render a site with integrity ineligible for the NRHP. Also, a site with integrity might have little information potential. As CALTRANS (2008:158) stated it, sites or features such as these "may provide incremental information that becomes important when analyzed on larger scales, [but] individually they are rarely eligible." The information potential of such sites, if any, would be exhausted through Phase I survey or Phase II evaluation, which would record their salient features for future comparison, but which taken individually would not warrant NRHP listing.

There are seven aspects of integrity: location, design, setting, materials, workmanship, feeling, and association. The NRHP criteria stipulate that a site must possess at least several or most of these aspects. Which of the aspects of integrity a site must have and how important each one is in evaluating a particular site depends on the nature of the site itself and why it might be significant (National Park Service 1990). For historic gold mines, it is important to consider not just individual properties, but the entire mining system and assess its degree of intactness and visibility. If clear physical evidence of a complete system remains discernible and can be interpreted, damage or loss of some parts of it may not eliminate overall integrity (Noble and Spude 1997:21; Noble 1998:13-14). Moreover, in dealing with the archaeological remains of gold mines, integrity mostly refers to the degree of preservation or quality of information potential, but varies with respect to the historic context of the archaeological property (Little et al. 2000:36-37). The seven aspects of integrity are described below:

LOCATION

Location is the place where the historic property was built or the historic event took place. The relationship between the property and its location can be important for understanding why the property was created, and contributes to creating a sense of the property's association with historic events and people (National Park Service 1990). Gold mining sites have integrity of location if the remnants of the mining operation are in their original location. Although a mine cannot be relocated, components of a mining operation could be and the timing and associations of such moves must be considered in assessing integrity (Nobel and Spude 1997:19). Archeological resources with any degree of preservation almost always have integrity of location, although lack of integrity in this regard would not necessarily preclude a site having significance. The importance of integrity of location depends on the historic context (Little et al. 2000:38). For example, if a site's significance was based on the information potential of the milling equipment, which had been moved from its original place of use, then integrity of location would not be critical in determining its significance.

DESIGN

Design refers to the combination of elements that create the form, plan, space, structure, and style of a property. It reflects deliberate choices made during the original conception and planning of a property (or its significant alteration). A property's design manifests historic functions and technologies as well as aesthetics (National Park Service 1990). Mining sites can be viewed differently because expansion and alteration of the extraction sites, mills, and other features were normal parts of a site's lifecycle. Consideration of integrity of design must therefore look at the site's original layout as well as its ability to illustrate its evolution through time. In addition, to have integrity of design, a mining site should have enough of its original components to illustrate the flow of extracting minerals and turning out a commodity. Underground portions of a mine are usually unstable and should never be entered. Therefore, their integrity does not have to be considered (Noble and Spude 1997:20; Noble 1989).

Integrity of design can also apply to districts, the concept referring to the way buildings, sites, or structures relate to one another (National Park Service 1990). In the case of a historic mining district, integrity of design could consider how extraction locations, mill placement, transportation routes, and other features were arranged with respect to one another and/or within a landscape. Similarly, for archaeological sites reflecting gold mines, integrity of design concerns the patterns of structures, features, and artifact deposits within and/or between sites (Little et al. 2000:39).

SETTING

Setting is the physical environment of a historic property. Unlike location, integrity of setting refers to the character of the place in which the property achieved historical significance. This aspect of integrity deals with how the property is situated and its relationship to surrounding features and open space. Physical features that make up the setting of a historic property can be natural or manmade, and should be examined not just with the boundaries of the property but also between the property and its surroundings (National Park Service 1990). For historic mine sites, the features that make up the setting may include numerous manmade features such as mine and mill tailings, ruins, abandoned machinery, and other debris. Noble and Spude (1997:21) indicate that these kinds of industrial remains can represent important aspects of setting that contribute to the integrity of a mining site. In contrast, modern intrusions detract integrity of setting. These can include more recent mining activities that have destroyed historic resources or left them isolated from their surroundings. Modern development unrelated to mining can also disturb integrity of setting.

Archaeological sites are less susceptible to visual impacts. If a site possesses important research potential, then the lack of historical setting would not automatically detract from its significance (Little et al. 2000:40).

MATERIALS

Materials are the physical elements that were combined or deposited during a specific time period and in a particular pattern or configuration to form a historic property (National Park Service 1990:45). While integrity of materials typically requires the retention of original structural fabric, mine sites often experienced modifications and repair, and replacement of original components was and expected part of their working life. For these kinds of resources, retention of integrity requires the use of complementary or sympathetic materials (Noble and Spude 1997:21). With archaeological sites eligible under Criterion D, integrity of materials is judged by the presence of intrusive artifacts and features, the completeness of the assemblages, or the quality of preservation (Little et al. 2000:41).

WORKMANSHIP

Workmanship constitutes the physical evidence of the crafts of a particular culture or people during a given period of prehistory or history. It reflects artisans' labor and skill in constructing or altering a building, structure, object, or site. Workmanship can apply to an entire property or individual components and may be expressed as vernacular methods and techniques or as highly sophisticated work. Also, it may reflect traditional work or innovations associated with particular periods or movements. It can indicate technologies of craft, illustrate aesthetic principals of a period, and reveal individual, local, regional, or national applications of technological processes and aesthetic principals (National Park Service 1990:45). This aspect of integrity is most often applied under Criterion C, which emphasizes design, construction, and craftsmanship.

Mine sites should retain evidence of original workmanship (Noble and Spude 1997:21). For archaeological sites, workmanship mostly considers the quality of the artifacts or features, as well as the skill required to produce them (Little et al. 2000:41). For features associated with mining sites, this standard provides a useful basis for evaluating integrity of workmanship.

FEELING

Integrity of feeling considers how a resource expresses the aesthetic or historic sense of a particular time period. To have integrity of setting, a site must contain physical features and characteristics that, when considered together, convey the site's historic qualities or enhance its ability to do so (National Park Service 1990:45). Noble and Spude (1997:21) remark that closed down and deserted mines are often more evocative than active ones. Abandoned mines reflect the boom and bust cycle of mining, but encroachment by modern development can affect integrity of feeling by diminishing the sense of isolation and desertion. This sort of impact would not necessarily impinge on the historic feeling of a site significant for its research value, however (Little et al. 2000:42).

ASSOCIATION

Association relates to the direct link between an important historic event or person and a historic property. A resource is considered to have integrity of association if it is the pace where an event or activity took place and is sufficiently intact to convey that relationship. It requires physical features that demonstrate the associations and historic qualities (National Park Service 1990:45). Integrity of association is most important under Criteria A and B. For mine and quarry sites to have integrity of association, they must still contain structures, machinery, and other visible features and these must convey a strong sense of connectedness between properties and a contemporary observer's ability to discern the historical activity that took place at the site. Integrity of association for sites eligible Under Criterion D is judged according to the strength of the relationship between the site's information potential and the important research questions (Little et al. 2000:42).

EVALUATING THE SIGNIFICANCE OF CAROLINA GOLD MINING SITES

The significance of a historic property must be assessed and explained with reference to its historic context. To assess the significance of a property within the Carolinas Gold Mining context, five things must be determined (National Park Service 1990):

1. The facet of history of the local area, state, or nation that the property represents;
2. Whether that facet of history is significant;
3. Whether it is a type of property that has relevance and importance in illustrating the historic context;
4. How the property illustrates that history; and
5. Whether the property possesses the physical features necessary to convey the aspect of history with which it is associated (i.e., integrity).

For archaeological sites, Little et al. (2000:29) list "Five Primary Steps in a Criterion D Evaluation" that cover the same basic process but in an order that more closely follows the way archaeologists often evaluate sites. The five steps require:

1. Identifying the site's data set(s) or categories of archaeological, historical, or ecological information (roughly the same as Step 3 above).
2. Specifying the historic context(s) or the appropriate historical and archaeological framework in which to evaluate the property (Step 1 above).
3. Determining the important research questions(s) the site might address (similar to Step 2 above with some overlap of Step 3).
4. Considering site integrity or whether the site has the potential or known ability to answer the research questions (Step 5 above).
5. Identifying the important information that archaeological study of the site has yielded or is likely to produce (corresponding to Step 4 above).

In evaluating an archaeological site, the first step usually involves determining the type, function, and chronology of a site along with the data sets (artifacts, features, and patterned relationships between artifacts, features, soil stratigraphy, and/or aboveground remains) that the site contains. Once this information is determined, the site can be related to specific archaeological issues. Integrity receives higher priority than for other types of historic properties because archaeological significance, and ultimately decisions as to whether sites or their information content should be preserved, depends upon it. Archaeological contexts (in the sense of the relationships between finds, their proveniences, depositional matrices, and associated materials [Renfrew and Bahn 2000:50]) are extremely important for archaeological analysis. Without a sure context or good integrity, most archaeological sites have little value for analysis, rending further evaluation less important. Therefore, while the evaluation process requires first determining a site's significance and then its integrity, in actual practice integrity is sometimes assessed earlier in the process. Specific research issues to which the site might apply are delineated later in the process. The approach taken by individual researchers may vary depending on the nature of the site and the type of significance it might have and the reason for undertaking the research. The following discussion follows the more general procedure described by the National Park Service (1990).

The first step toward evaluating historical significance is to identify what theme or area of significance, geographical area, and chronological period the property represents. Historic gold mine sites in the Carolinas would relate to the historic contexts provided in this document. Their significance would most likely result from their associations with important events (Criterion A); engineering, technology, or design qualities (Criterion C); or research potential (Criterion D). It is possible that resources could also be associated with historically important persons (Criterion B) if the resource relates to the productive life of the person in the field in which he or she achieved significance.

Table 2. Sample Questions/Topics for Determining Historic Themes Associated with Carolina Gold Mining Sites	
Theme	Guiding Questions/Evaluation Topics
Archaeology	• Does the resource have a potential to provide important information from archaeological study of mining processes, technology, laborers, or related domestic sites?
Commerce	• Did the mine produce commodities for exchange and barter? • What effect did the mine have on regional trade?
Community Planning and Development	• Was there a company town or community associated with the mine, and if so, did it express any corporate or other ideologies or aesthetics?
Economics	• How did the mine effect the economic development of the region or locality? • Did secondary economic activities, e.g., land speculation, develop as a result of mining?
Engineering	• Does the mine reflect (or not) the work of professional engineers? • How does the mine exemplify engineering practices of the time it was in operation? • What engineering innovations are present, if any?
Exploration/Settlement	• Does the site reflect historical events, processes, or people related to the exploration or settlement of a locality or region?
Ethnic Heritage	• Does the site relate to or reflect aspects of ethnic or national identity in mining trades? • Does the site illustrate ethnic, cultural, or national mining practices?
Industry	• Mining properties reflect the processes of managing materials, labor, and equipment to produce goods and services. They also produced materials used in other industries (Noble and Spude 1997:16). • How does the site reflect industrial processes and approaches to producing mineral commodities? • Did the site affect or influence the industrial development of a locality region? • Was the site associated with broader industrial activities, such as producing a raw material used to make of other important products?
Invention	• Was the site associated with the development or creation of new technologies, processes, or products? • Does the site exemplify the application of new technologies, processes, or products?
Labor	• Mining sites were significant in the history of unions, worker safety, and other aspects of labor history (Noble and Spude 1997:16). • Does the site have associations with significant events or developments in labor history?
Landscape	• Do the site and associated area illustrate aspects of distinctive land use practices associated with mining? • Does the landscape exemplify or evoke images of time, place, and historical patterns related to mineral industries?
Science	• Does the site have an association with important developments in geology, metallurgy, and other aspects of mining engineering (Noble and Spude 1997:17)?
Social History	• Does the site have associations with significant social, labor, or corporate movements or events?

Step 2 of the evaluation process is to determine if the theme of the context is significant. Table 2 lists the areas of significance that gold mine sites might relate to along with questions or topics useful for determining if and how sites are significant. Of the applicable areas of significance that Noble and Spude (1997:15-17) suggested for mining sites associated with Criterion A, the ones most relevant to Carolina gold mines include commerce, community planning and development, economics, engineering, ethnic heritage, exploration/ settlement, invention, industry, labor, law, politics/ government, science, and social history. Under Criterion B, gold mines might relate to themes of exploration/ settlement, invention, and labor. Gold mines significant under Criterion C would most likely reflect aspects of architecture and engineering. Sites eligible under Criterion D are likely to have significance in the area of archaeology, although other themes could apply. To be considered significant under this criterion, sites should be evaluated with respect to research questions that identify the data sets necessary to address them (Noble and Spude 1997:17).

Once the site's type and area of significance are determined, the third step in evaluating a historic gold mine is to determine property type and whether it is important in illustrating the historic context. Property types that represent historic gold mines in the Carolinas represent the range of activities associated with extracting minerals and turning them into commodities.

The fourth step in the evaluation process is to determine how the property represents the context through specific historic associations, architectural or engineering values, or information potential. In this case, the property types described previously reflect the mining context. Site-specific archival research and fieldwork would be required to determine how individual properties relate to and reflect the four criteria and areas of significance.

The final step in evaluating properties is to determine if they possess the physical features necessary to reflect the significance of the historic context. This involves considering the ways that the properties can represent the theme. At this stage, the property must also be evaluated with respect to the applicable aspects of integrity. Properties that have the defined characteristics are eligible for the NRHP.

As stated in the introduction of this document, the purpose of this context is to provide guidance for archaeological studies of gold mining in the Carolinas, regardless of whether it is related to compliance with Federal laws, heritage studies, or academic research. This context can be used to aid researchers in conducting historic and cultural resource studies under Section 106 of the National Historic Preservation Act, but does not dictate mitigation efforts or actions, which are negotiated on a case by case basis for eligible properties. It should be noted that any mitigation efforts should be proportionate to the undertaking and provide sufficient flexibility to allow for a variety of creative mitigation options.

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Appendix A: Archaeological Research Topics

The history of gold mining in the Carolinas is known in a general way, although it is uneven. The following discussion provides topics and specific questions useful for guiding research and for evaluating archaeological significance under NRHP Criterion D. Addressing the research themes discussed in this chapter also offers a potential for better understanding the economic history of the Carolinas and its landscape, as well as aspects of mining history, technology, and its social relations.

The following research topics mainly follow the guidelines set out by CALTRANS (2008) for the archaeology of mining in California. While the work that CALTRANS has completed is a good starting point for Carolina gold mines, it requires some modification to account for local history and circumstances. Moreover, as archaeologists in the Carolinas become more familiar with the database of sites and site types, research topics that are formulated to better explore the local situation can be developed.

CALTRANS (2008) put forth six research themes for dealing with mining sites in California. The topics are sometimes interrelated and can be addressed through archival and archaeological sources. They include:

1. Technology and technological development of mining
2. Historical ethnography/cultural history of mining
3. Ethnicity of distinct culture groups and ethnic interactions
4. Gender and family aspects of mining
5. Economic aspects of mining
6. Policy, law, and regulation of mining and self-governance

TECHNOLOGY

Remnants of mining technology comprise among the most visible features of mining sites, and include mine and mill tailings, shafts, adits, mill foundations, machinery mounts, tramways, headframes, and other structures (Hardesty 1988:12). Although written information is available about how various technological processes operated, these sources can be unreliable or misleading for various reasons and the study of actual processes can provide new information about how technological systems functioned (Gordon and Malone 1994:13). Moreover, the study of mining technology in the Carolinas can be informative about how general practices were adapted to local circumstances.

CALTRANS (2008:121) provided a list of technology-related questions for individual sites in California that can be adopted for use in the Carolinas as a first step. Although they refer to individual sites, consistently addressing these questions will help generate comparable data on mines and quarries in the State. As the material record of mining and quarrying in becomes better known, these questions can be modified, appended, or removed as necessary.

- During what time period or periods did the mine operate?
- Who owned, managed, or operated the mine. Was it individual, joint stock, corporate, investment, or other?
- Was the mine operated periodically or continuously and why?
- What processes does the site exhibit? How did they operate/function, and how did they change over time?
- How were processes adapted to specific conditions?
- Is there evidence of equipment reuse or replacement?
- Are the technologies older than those common during the time period the site was active?
- Is there evidence of vernacular innovation and under what conditions did this innovation take place?
- What influenced the choice of certain mining methods (labor costs, cost constraints, limited equipment availability, cultural preference, innovations)?
- Do mining processes evident at the site agree with or differ from those documented in historic records or through oral history? If different, what might be the reason for these divergences?
- How was water delivered for industrial and domestic use? Did miners obtain water by developing sources on site or tapping into a regional system?
- Who made up the labor force and how did it change over time?
- Did changes in technology or management practices influence the layout of the mine, operations, or labor?

HISTORICAL ETHNOGRAPHY/CULTURAL HISTORY OF MINING

CALTRANS (2008:121-122) describes this topic as dealing with the history or culture history of particular mining settlements or individuals. Research is completed by both historians and archaeologists. A benefit of this topic is that it combines historical studies of specific mining communities or individuals associated with mining and archaeological studies that can address more intimate details of mining communities and households. This theme encompasses topics such as settlement, individuals, and households and community.

Settlement in this context refers to attempts to establish mining camps and how they grow into mining communities. Emphasis is placed on how the settlement process takes place and the social, economic, and political forces that shape it. The study of individuals is important when the archaeological or material remains at a site can be associated with the people who worked and lived there. Finally, the topic of households and community covers domestic units, individual or group ("community") associated with mining industries. Individual and groups of domestic units can be compared between different sites (CALTRANS 2008:122-126). Research questions associated with this theme are:

- What activities/events took place at the site?
- What time period or periods are represented?
- Was there more than one occupation?
- Is there temporal variation within or between loci or feature systems?
- Was settlement exclusively associated with mining or did other types of services develop to support the mine and the miners?
- Who lived on the site (numbers, gender, ethnic or cultural groups, class, age, known individuals) and did the demography change through time? If so, how and why?
- What was the duration of occupation and mining activity?
- Are cycles of occupation abandonment evident?
- Is the migration or settlement pattern evident (early transitory or long-term)?
- Is variation in population groups (e.g., family, groups of men, single, class or ethnic segregation) evident within discernible households?
- How did people at this site respond to local, regional, statewide, or national events? Is it possible to distinguish causal relationships with larger societal trends from the archaeological remains?

ETHNICITY OF DISTINCT CULTURE GROUPS AND ETHNIC INTERACTIONS

Issues related to ethnicity have been of particular interest to archaeologists and mining sites in the western United States have provided important sources of archaeological data. In the Carolinas, the presence of European laborers and mining specialists has been documented through written sources. Gold miners also included native-born Whites and African Americans. The archaeological manifestations of these groups is unknown, however, because to date there have been no detailed studies of mines or miners' housing in the region.

For this research topic, CALTRANS (2008:139-140) recommended the following questions for mining sites in the west. These have varying usefulness for the Carolinas because of the potentially different cultural and racial contexts:

- Do archival sources indicate the presence of ethnic, cultural, or national variation at the site or its vicinity?
- Is there a historic context for the presence of this group and identification of their immigration and work history?
- What links did this group maintain with the homeland?
- What is the time period of the occupation and were there multiple occupations of the site and or periods of abandonment in between?
- Who worked at the site and did different ethnic groups work together or sequentially? Is there evidence of interaction between different ethnic groups?
- Are there archaeological markers of different ethnic/cultural groups?
- Is there evidence for how space was organized or the types of structures used, and what does this evidence indicate about ethnic behavior?
- Is there other evidence of this ethnic group in the vicinity or region?
- Was the site isolated or part of a community?
- How does the evidence for ethnic groups on this site compare to similar sites? How does it compare to Euroamerican sites of the same time? Is there evidence that traditional cultural practices were maintained? What cultural practices were adapted from Euroamerican or other cultures?
- Are ethnically distinctive mining methods or technological innovations present?
- Does the site help distinguish types of mining methods that were employed by distinct groups through time, by region, and for different mineral types?
- Were the site occupants independent workers or employed by a mining operation?
- How did they workers organize themselves?
- How did organization change over time and among different groups of workers?

GENDER AND FAMILY ASPECTS OF MINING

Issues dealing with gender and family cover both the work and domestic spheres of mining. While mines would be considered male-dominated places, women and children performed certain tasks. They were also present in the domestic setting associated with mines. These industries, however, could have unique domestic and workplace arrangements. While some mining interests had workers' cottages at the mines to accommodate families, others might have boarding houses that were solely male and institutional spaces. Also, domestic sites associated with placer mines might consist of male-only residential arrangements. The leading questions can help better delineate and understand housing and domestic arrangements associated with Carolina gold mines (CALTRANS 2008:144):

- Is it possible to identify women or children at mining sites in the archaeological record?
- What roles did women and/or children have in mining support services? What are the archaeological manifestations of these roles? Is it possible to extrapolate those indicators to sites without known associations?
- How did mining households or communities containing women and/or children differ from those without? Is it possible to distinguish cultural or behavioral themes in such differences?
- Is there a correlation between numbers of females and stability? Is it possible to distinguish driving forces for stability and could women be the force historically attributed to them?
- Is there a gender disparity in proximity of domestic occupation to mine sites? What does this indicate about the nature of female participation in settlement patterns? Does it differ by mineral?
- What challenges faced women who became sole owners of mines? Can the archaeological record expose differences between female- and male-owned mines?
- Is the capitalization of solely women-owned mines different than male owned mines? In essence could women finance mining operations through stocks or banking institutions or through other means?
- Were women owned mines related to specific minerals or precious metals?
- Did women who were the sole owners of mines/quarries participate in the daily operations of the mine? How might this participation appear in the archaeological record?

ECONOMIC ASPECTS OF MINING AND QUARRYING

This topic relates to the production and consumption of commodities (Nobel and Spude 1997:17). The theme encompasses economics of mining and quarrying at various scales from the household to the world system (CALTRANS 2008:144). One of the topics that can be investigated under this heading is the economic niche of gold mining, particularly how it generated income for various individuals as a full-time profession, seasonal labor, investment opportunity, or other arrangement. With respect to consumption, the topic can deal with the materials different social, cultural, and occupational classes purchased. Additionally, consumption can address the market development and relationships that mining regions had with the outside world. This might include the development of boomtowns or communities that arose to provide services and distribution points for mining areas. For commodity production, this theme includes issues related to how mining operations were financed and how different capitalization strategies influenced operations. Questions that can guide research into the economics of mining and quarrying include the following (CALTRANS 2008:148).

- Who invested in the mine (the miners, joint-stock company, outside capital)? Was the venture heavily capitalized?
- Is there evidence of expensive and/or imported materials and/or technology?
- What types of access to markets was available during different periods?
- At what pace did industrial infrastructure develop?
- What role did the mine play in the region's growth and economic development?
- What other businesses were present and in what phase did they develop?
- Are a variety of socio-economic classes evident at the site? Is class segregation evident?
- How does the material culture of different classes compare? How does the socioeconomic profile of household and the site change through time?
- Was mining only a facet of a more complex survival strategy that included other pursuits such as farming or wage labor?
- Where did the miners get their food and other goods and services? How did this change over time?
- Did miners invest much time preparing food at home or did they eat away from their residences? Did they reside in rooming houses and eat at boarding houses?
- How did the role of mining change over time for individuals, households, communities, or regions?

POLICY, LAW, AND REGULATION OF MINING AND SELF-GOVERNANCE

This theme deals with the nature and influence of federal, state, and local regulations on mining activities. For California, CALTRANS (2008:149) notes that research into this topic had mostly referred to the gold rush and dealt with three principal topics: crime, development of mining law and water rights systems, and the relationship of the state government to federal government. These topics have generally been the purview of historians. However, archaeologists can contribute information to certain topics, such as the effects of mineral industries on the physical environment, the impacts of laws and policies on land use and water rights, and efforts adapt mining practices to environmental and labor regulation. Specific questions to address this theme are (CALTRANS 2008:152-153).

- Are there mining codes covering the site area?
- What environmental changes are visible at the site and can those changes be attributed to a specific phase of occupation or specific occupants?
- Is there evidence of responses to increasing government regulation of mining such as increased environmental restrictions?
- Is there evidence of adaptation to changing water policies, such as reliance on water conserving technologies?
- How many miners worked the site and how were they organized? How did the organization of workers change through time?
- Is there evidence of corporate or individual responses to increasing government regulation of mining such as increased safety requirements?
- Can changes in company policy be correlated to changes of technology or social behavior at the site?
- What type of social order is evident at the site?
- Does the site exhibit a sense of organized community (e.g., a large population of permanent settlers) or was it predominantly a transient male population?
- Were social boundaries established or enforced based on ethnicity, class, or other social or political factors? Is there evidence of social inequality?

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