The Silver Hill Mine: First Silver Mine in the United States And Supplier of Lead to the Confederacy

By L. Michael Kaas

The Silver Hill Mine is located in the gently rolling hills of the North Carolina piedmont about ten miles southeast of Lexington in Davidson County. It has the distinction of being the first important silver mine in the United States.[1] The initial ore discovery in 1838 was very rich in native silver and lead and also contained small amounts of copper and gold. As mining progressed it encountered large amounts of lead and zinc sulfide ores. In the mid-1840s, the complexity of the ore caused the owners to undertake an extensive period of experimentation on smelting technologies.

Failing to solve its metallurgical problems, the mine shut down in the early 1850s. During the Civil War, it reopened to supply lead to the Confederacy. Production continued after the war until the mine closed for good in 1882. Since its closure over a century ago, the mine has repeatedly been the target of exploration and development groups. This article distills the unique story of Silver Hill from many local sources, original company documents, and the technical literature of the mining industry.

Discovery and Early Development at Silver Hill

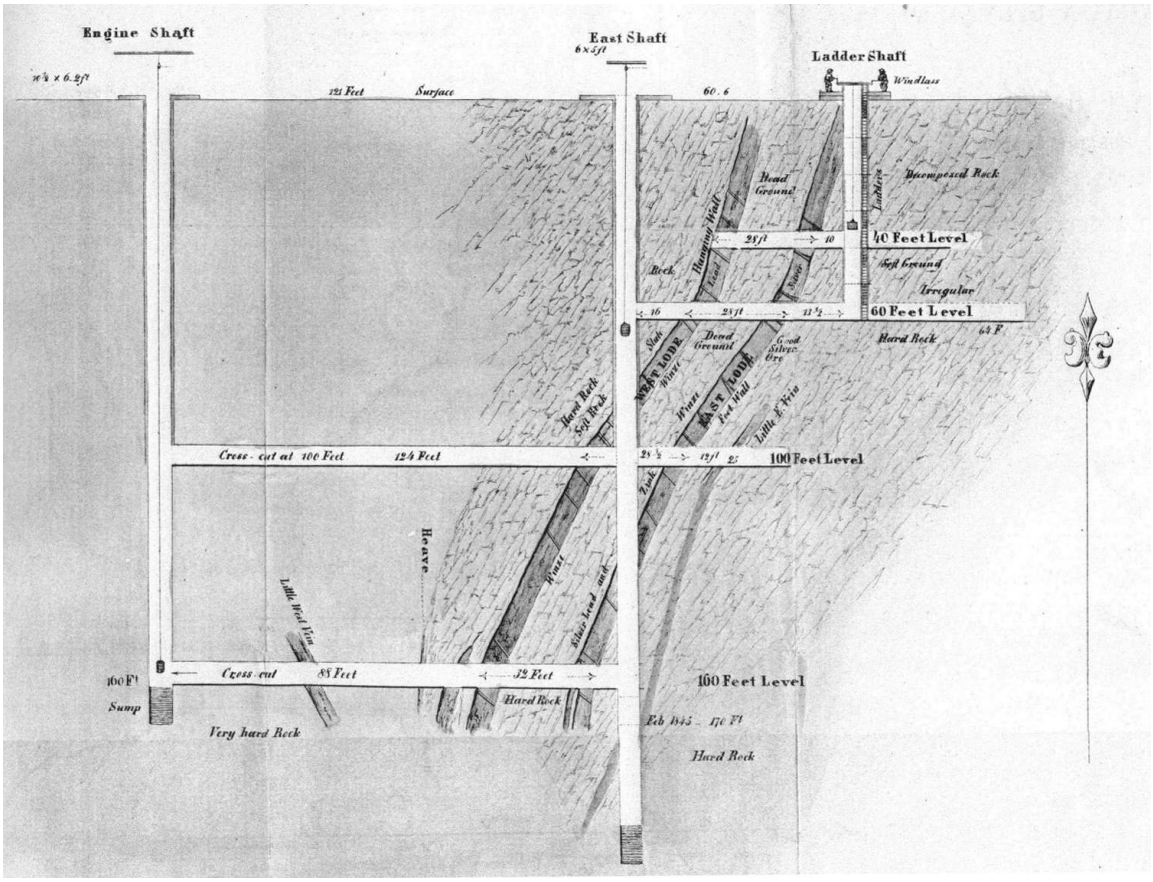
In 1799, gold was discovered on John Reed's farm in Cabarrus County, northeast of Charlotte. By the 1820s, farmers and prospectors had discovered placer gold in creeks and gold-bearing quartz veins in farm fields and in the banks of streams in several counties. Thousands flocked to the area and America's first gold rush was under way. By the 1830s, mining had become an established industry in central North Carolina, second only to agriculture,[2] and prospectors had expanded their search northward into the Lexington area.

In 1838, cerussite (lead carbonate) was discovered near Lexington on a hilltop owned by a Mr. Byerly.[3] Roswell A. King purchased the land and sank a shaft directly into the deposit, initially called King's Mine. The near-surface oxidized ore was rich in lead and also contained large quantities of native silver.[4] In 1839, King and John W. Thomas received a charter from the General Assembly of North Carolina to form the Washington Mining Company,[5] and renamed their property the Washington Mine.

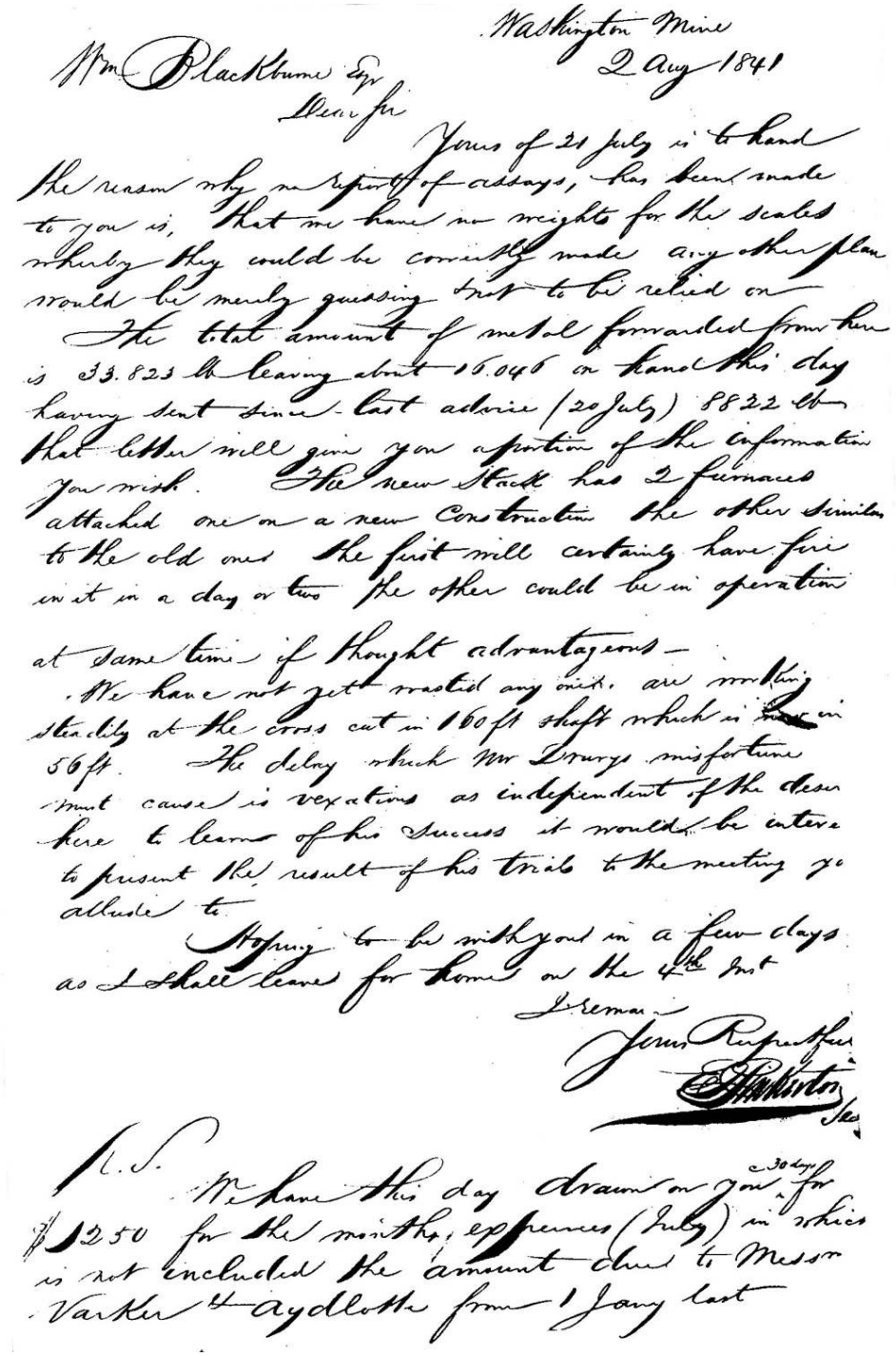
The ore deposit at Silver Hill was primarily composed of two parallel veins that ran approximately north 20 degrees east, and dipped approximately 63 degrees to the west.[6] The veins were named the East Lode and the West Lode. The width of the veins varied from a few inches to around fifteen feet. They were typically separated by twenty-eight to thirty-two feet of country rock. As the mine deepened, two smaller veins were discovered, one east of the East Lode and running parallel to it and the other west of the West Lode and running at an angle to it.

By the mid-1840s, the mine had three shafts. King sunk the first, the Ladder Shaft, at the discovery site, where the East Vein was exposed at the surface. It reached a depth of sixty feet with levels at forty and sixty feet. It was equipped with a hand-operated windlass. Drifts and crosscuts on all levels provided access to each vein. Winzes and raises provided connections between the levels.

A second shaft, the East Shaft or Whim Shaft, was sunk from a point 61 feet west of the Ladder Shaft to a depth of nearly 170 feet. It had levels at 60, 100, and 160 feet. Both ore and water were hoisted through this shaft by means of a horse



Washington Mine cross-section, 1845. (From Taylor, Reports on the Washington Silver Mine.*)*



Washington Mine
2 Aug 1841

Wm Blackburne Esqr

Dear Sir

Yours of 21 July is to hand
the reason why no report of assays, has been made
to you is, that we have no weights for the scales
whereby they could be correctly made any other plan
would be merely guessing but to be relied on
The total amount of metal forwarded from here
is 33.823 lb leaving about 16.046 on hand this day
having sent since last advice (20 July) 8832 lb
that letter will give you a portion of the information
you wish. The new Stack has 2 furnaces
attached one on a new Construction the other similar
to the old ones the first will certainly have fire
in it in a day or two the other could be in operation
at same time if thought advantageous —
We have not yet reached any ore but are working
steadily at the cross cut in 160 ft shaft which is in
56 ft. The delay which Mr Drury's misfortune
must cause is vexatious as independent of the desire
here to learn of his success it would be interesting
to present the result of his trials to the meeting you
allude to
Hoping to be with you in a few days
as I shall leave for home on the 4th Inst
Yours Respectfully
E. J. Pinkerton Sec

P.S. We have this day drawn on you at 30 days for
$1250 for the months expenses (July) in which
is not included the amount due to Messrs
Parker & Aydlotte from 1 January last

Letter from E. J. Pinkerton, secretary, to Wm. Blackburne, 2 August 1841, reporting lead production and shipments. (From "Washington Mine Letter Book." Courtesy of the Davidson County Historical Society.)

whim.

A third shaft, the Engine Shaft, was sunk 121 feet west of the East Shaft to a depth of slightly more than 160 feet. It connected to the East Shaft through crosscuts on the 100-foot level and the 160-foot level. The sizable quantity of water hoisted from this shaft was used for ore processing and domestic purposes. In 1845, the company negotiated the purchase of a steam engine for pumping, hoisting, and other purposes.

Cerussite, argentiferous galena (lead sulfide), and native silver were the principal ore minerals in the upper portion of the ore body. Sphalerite (zinc sulfide) was also present but was not recovered until later in the mine's life. In general, as the mine deepened, sphalerite increased and galena decreased. The ore contained small amounts of pyrite (iron sulfide), chalcopyrite (iron-copper sulfide), pyromorphite (lead phosphate), and even smaller amounts of gold. A variety of other minerals appeared in the gangue.[7]

Silver Hill was a high-grade orebody. Early analyses of selected samples of various ore types from the richest parts of the veins showed metal contents as high as 12 percent silver, 62 percent lead, 29 percent copper, and 27 percent zinc.[8] While these were not representative of more typical run-of-mine ore grades, they did illustrate the diversity and complexity of ore types within the deposit.

Early Production by the Washington Mining Company

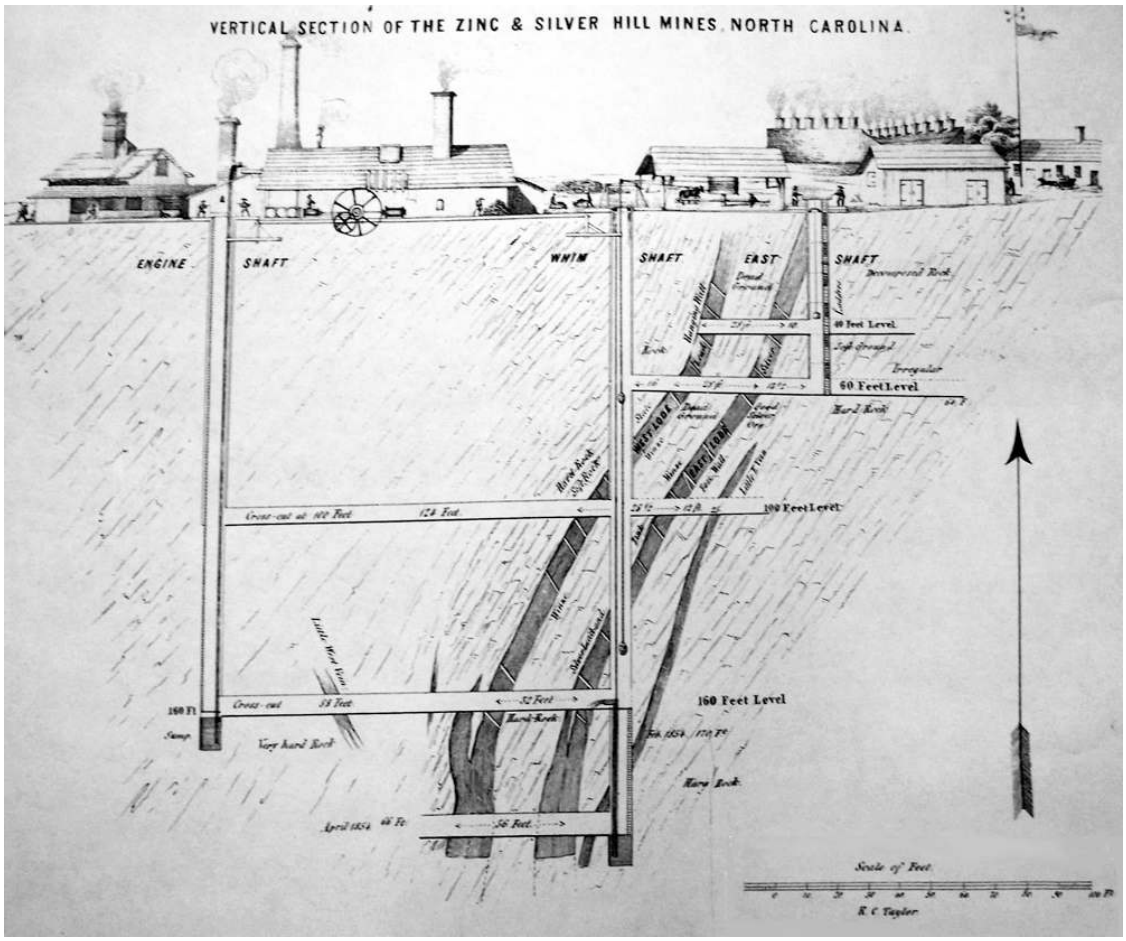
Production data are incomplete. From August 1840 to November 1842, the Philadelphia-based Washington Mining Company produced 2,661 pigs of argentiferous lead containing $13,288 of gold and silver after mint-processing charges.[9] Mine records from May to early August 1841 state that it shipped 33,823 pounds of argentiferous lead, while an additional 16,046 pounds of lead remained on hand at the mine ready for shipment.[10] Mint certificates show that from 13 October 1843 through 31 December 1844, processing recovered $24,009 of silver and $7,253 of gold from 160,000 pounds of lead. The gross total value of production from 13 October 1843 to 9 January 1845 came to just over forty thousand dollars, with a profit of nearly fourteen thousand dollars.[11]

Transportation from mine to market was complicated. Lead pigs weighing seventy-five to eighty pounds each were first shipped to Fayetteville, North Carolina, a one hundred mile wagon trip. From there they went by sloop down the Fear River to Wilmington, North Carolina. The final leg of their journey was by schooner to Philadelphia, where the pig lead was refined and "test bottoms" containing the silver and gold were sent to the U. S. Mint.[12]

The mine's tidy profits masked two ominous signs. On the 60-foot level, mining was taking place along 300 feet of the East Lode. However, as the deeper levels were developed, the minable length of the veins shortened, reaching only about 150 feet along the East Lode and a shorter distance along the West Lode on the 160-foot level. This must have caused concern that the orebody would pinch out at depth. In 1845, a consulting engineer recommended additional surface and underground exploration to determine if the veins continued to the north and south of the existing workings. Fortunately, substantial quantities of ore were then still available in the developed levels.

The second issue was the change of mineralization at depth. At the 60-foot level, miners began to encounter the first occurrences of galena, though cerussite remained the main ore mineral. By the time mining reached the 160-foot level, however, the ore was almost entirely galena. Increasing quantities of sphalerite occurred as the workings deepened.[13] The presence of sphalerite complicated the smelting process, resulting in substantial losses of lead and silver.

In the late 1840s mine development slowed while attention focused on the metallurgical

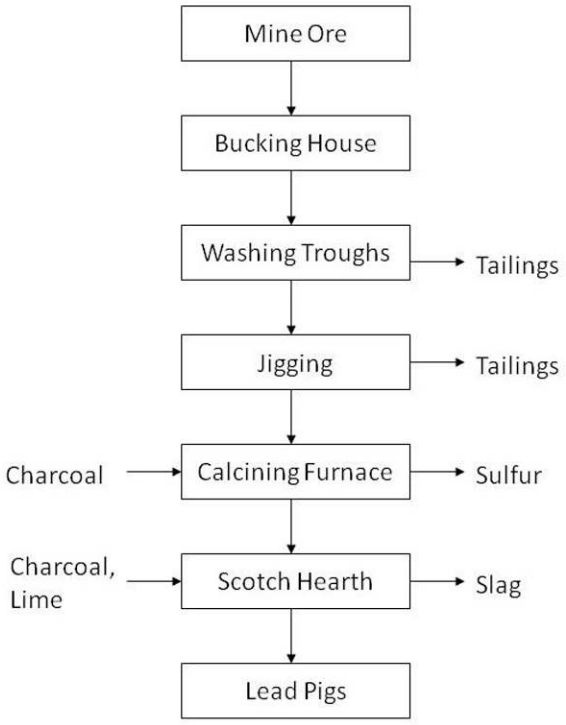


Zinc and Silver Hill Mines (Silver Hill Mine) cross-section, 1854. (From Schoonmaker, Statement of the Condition and Prospects.*)*

problems. East Shaft had only reached the 200-foot level and no additional work occurred in the Engine Shaft after 1845. The company made a few mining improvements, however. It installed a sixty-horsepower steam engine to drive mine pumps, stamps, and the blowing engines that supplied the furnaces, and purchased an iron whim mine hoist to replace the horse whim on the East Shaft. In 1852, the company sank two new shallow shafts, the Symonds East and West shafts, on an exposed mineralized area 320 feet north of the Engine Shaft. These shafts were twenty-six and sixty-two feet deep respectively. Through cross-cuts, they intersected a vein with an orientation similar to that of the East Lode and thought to be an extension of it.[14]

Silver Hill Becomes a Metallurgical Laboratory

The 1842 report of a visit to Silver Hill by a Quaker schoolmaster provides a detailed description of the mine and its early processing methods.[15] Run-of-mine ore first went to the bucking house, where boys used hammers to break it down to a fine size. The broken ore next traveled through washing troughs that removed slimes. Jigs, described as "iron-bottomed sieves," agitated in "vats, similar to those in a tan-yard," caused the heavier and more valuable ore particles to settle to the bottom. The lighter material in the upper layer of the jigs was reprocessed until it contained little material of value and was then discarded. The heavier concentrates from the bottom layer



Washington Mining Company flowsheet, 1841.

of the jigs were processed in "calcining [roasting] furnaces" to drive off sulfur. Calcined ore next went to "smelting cupels" (Scotch hearth furnaces[16]), that separated slag from the metal cast into lead pigs.

Smelting in Scotch hearths was a slow and labor-intensive process. In the summer of 1841, the company constructed new high furnaces on three sides of a common chimney.[17] Roasted ore pulverized by the stamps was mixed with charcoal and iron ore flux and added to the furnace. The air blast was supplied to the furnace through the tuyere. As the molten metal and slag that accumulated in the basin were periodically drawn off, new ore, charcoal, and flux were added. A single furnace could produce one ton of lead every twelve hours. While an improvement over Scotch hearths, high furnaces were still labor intensive and expensive to operate.

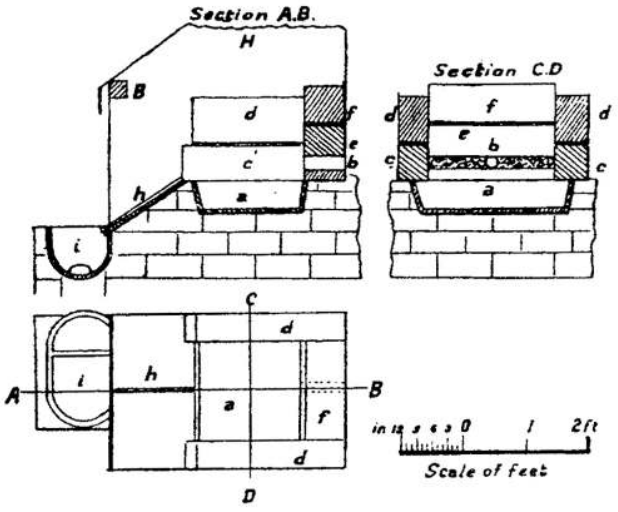
As the mine's ore shifted to the primary sulfides of galena and sphalerite, plus pyrite and chalcopyrite, volatilization of the zinc in the furnaces carried off significant quantities of both lead and silver. In an effort to stem these metal losses and also refine the lead at the mine, the owners embarked on several years of experimentation with other types of furnaces.[18]

English reverberatory refining furnaces were added to the flowsheet to further reduce the molten lead and litharge (lead oxide) from the high furnaces and to produce a higher purity of lead and silver product. In a reverberatory furnace the flame from the firebox passed over the cupel (hearth) to heat the molten material. The oval shaped cupel measured two by four feet and was made from bone and wood ash tamped into an iron hoop. Air from the bellows gently passed over the surface of the melt to reduce the litharge and form the pure lead that flowed out the tap hole.

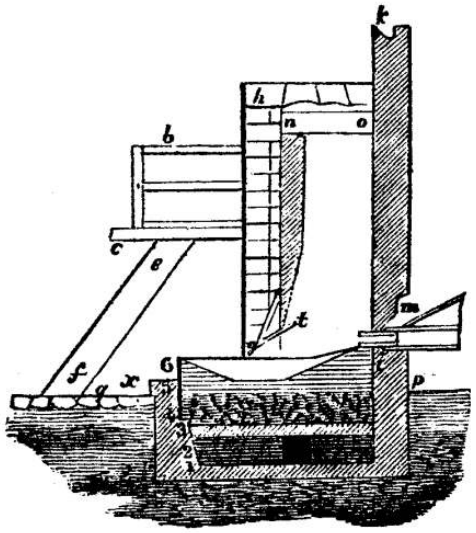
As refined metal was removed, additional molten material was added to maintain a constant level of metal in the cupel. A sliding door on the chimney flue could be closed to prevent some loss of metal fumes. The process cycle was repeated until the molten matter contained a concentration of approximately equal parts of lead and silver. This enriched lead was then drawn off and treated again in a separate cupel to which no fresh lead was added. The lead was cast into pigs and the silver into a cake.

Toward the end of the period of experimentation, the company installed a German refining furnace. Its large, six-foot-diameter cupel held four tons of lead in one heat. As air was blown over the surface of the molten metal, charcoal dust was thrown on the surface to create a froth of impurities that was raked off. Molten litharge and lead then formed and were removed separately. The residual silver that collected in the recessed center of the cupel was cast into a cake.

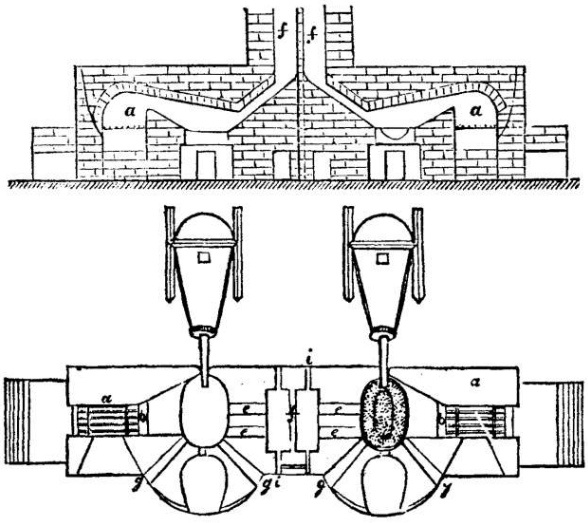
The grade of the ore remained high but the dominant metal became zinc. The assay of a large quantity of ore mined around 1850 showed 45 percent zinc, 21 percent lead, and 8 ounces per



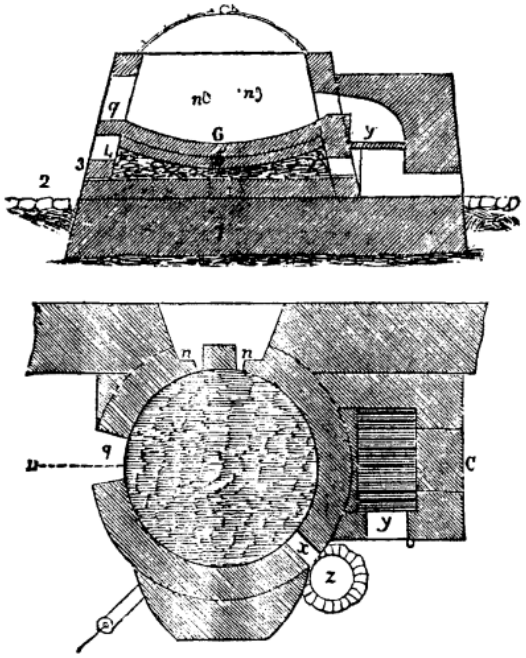
Scotch hearth furnace.
(From Collins, Metallurgy of Lead.*)*



High furnace (From Tenney, "Gold and Silver Produced in the Mines of America.")



English reverberatory refining furnace.
(From Tenney, "Gold and Silver Produced in the Mines of America.")



German refining furnace (From Tenney, "Gold and Silver Produced in the Mines of America.")

ton of silver, with small quantities of gold and copper.[19] Despite the increased complexity of its flowsheet after years of experiments with the various types of furnaces, the company continued to lose valuable lead and silver in its recovery process.

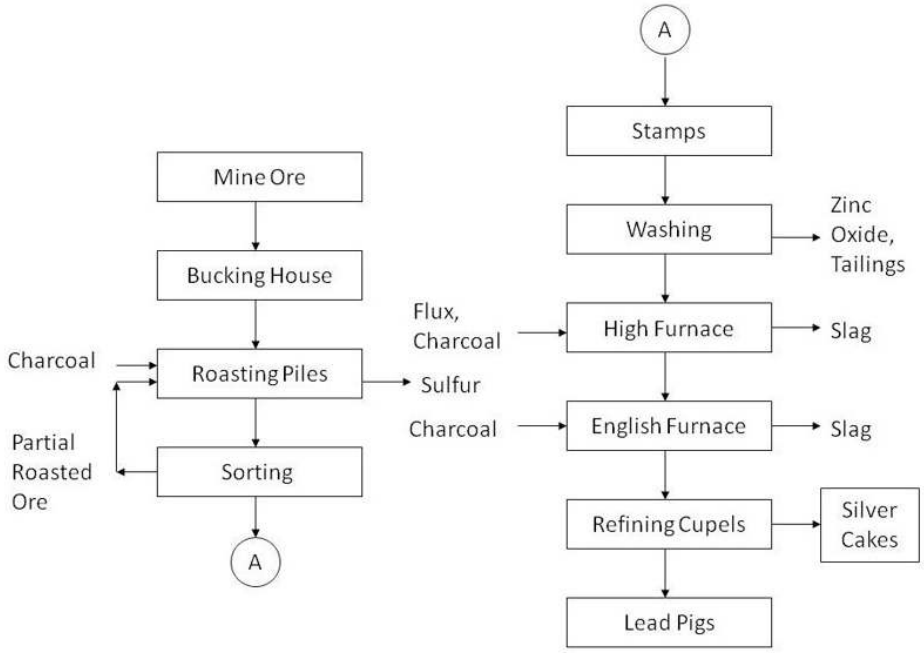
In 1852, these financially disastrous results caused the original Philadelphia owners to abandon their search for a more efficient smelting technology and to shut down the mine.[20] One source later recorded that the mine "during the thirty years of its active work [from the mid-1840s to the mid-1870s], was practiced on by all kinds of 'process' mongers, and the grounds and buildings are a museum of old and nondescript machinery and metallurgical appliances."[21]

Silver Hill's experiments with smelting furnaces apparently had little influence on processing the rich lead-silver ores discovered in the West over the following decades. Initial attempts to smelt lead in Nevada, Utah, and Colorado also employed hearths and reverberatory furnaces. As at Silver Hill, these efforts also failed. The blast furnace smelting perfected at Eureka, Nevada, around 1870, became the dominant processing technology in the West.

By 1885, the large smelters in Leadville, Colorado, had further improved blast-furnace techniques. Like Silver Hill, the original ores discovered at Leadville in 1876 and 1877 were lead carbonates. As these ores were depleted and production of sulfide ores increased, mining companies constructed roasting furnaces. By 1885, all of Leadville's smelters had roasting furnaces in their processes preceding their blast furnaces.[22]

Reopening as the Silver Hill Mine and the Civil War Era

The mine remained closed from 1852 until 1854, when new owners, the Zinc and Silver Mining Company of New York, renamed it the Silver Hill Mine and announced plans for a new recovery process. Bradford separators would be used to extract the sphalerite from the galena before the lead concentrate was smelted.[23] Without the zinc interfering with the smelting process, the company predicted that metal recovery would in-



Silver Hill Mine flowsheet, 1852.

crease dramatically, but the success of this scheme cannot be confirmed.

An 1860 report indicated that the mine's ore process included stamps, a roll crusher, and ten buddles to provide gravity separation into a galena concentrate, a sphalerite concentrate, and tailings. A second, smaller steam engine had been added to operate the buddles, but the report made no mention of the use of Bradford separators or smelting furnaces. This document also included a copy of a new North Carolina charter for the Silver Hill Mining Company, indicating that the company was again attempting to raise funds for the mine.[24]

Another report stated that the Whim Shaft (East Shaft) had been driven on an incline following the footwall of the East Lode to the 300-foot level. Favorable showings of ore were reported on the 250- and 300-foot levels of both the East and West lodes. This report noted that the capacity of the processing equipment was thirty tons per month of lead concentrate with an estimated value of $130 per ton at a New York smelting works. A four-year accumulation of eight thousand to twelve thousand tons of sphalerite concentrate at the mine was said to contain 44 percent zinc that could be upgraded to 55 percent at low cost and sold at a large profit.[25]

It appears likely that the mine was once again idle on the eve of the Civil War, but the Confederacy had few options for obtaining lead. In his 12 August 1861 response to an interrogatory concerning supplies of raw material, General Josiah Gorgas, head of the Ordinance Bureau of the Confederate War Department, reported the intention to reopen the Silver Hill Mine.

> Besides the Wytheville mine, in [Virginia], the Confederate Government has directed the working of a mine in North Carolina. In reference to this Governor Warren Winslow writes, August 8: "I have written to Pasco, an experienced miner, to come down and get ready to open the Silver Hill Mine, in Davidson County. . . . It will not require much means. The furnace will cost only $500, I think, and labor is now so cheap that a small addition will be all that is required." These two mines will, it is believed, supply all our wants [for lead].[26]

The 1860 Census for Davidson County lists Richard W. Pascoe, age 39, as the agent (i.e. superintendent) of the Silver Hill Mining Company.[27] The census also shows that English and Irish miners lived close to the mine. By this time, skilled Cornish miners, like Pascoe, had been immigrating to America for several years. Slave schedules for the census also show that fourteen slaves, hired from their owners, were under Pascoe's charge at the mine.[28]

Curiously, Pascoe also appears, with his family, in the 1860 census tabulations for South Bethlehem, Pennsylvania, in the Friedensville zinc mining area.[29] He is listed as superintendent of the Lehigh Zinc Company's Uberroth Mine. Like many Cornish mine captains of the period, Pascoe may have served concurrently as manger of more than one mining operation. What is unique is that one mine was in the North and one was in the South. It is unknown whether or how often Pascoe traveled back and forth between North Carolina and Pennsylvania. Mine records are incomplete for the war years, but Pascoe was clearly involved with the Silver Hill Mine from 14 June 14 1860 until at least 15 March 1862.[30]

The same mine records show that shipments of lead, probably concentrates, went via the North Carolina Railroad to the Confederate lead works in Petersburg, Virginia (Table 1).[31] The North Carolina Railroad connected to the Weldon Railroad, which served Petersburg. This railroad stayed in operation until 18 August 1864, when Union troops severed the line south of Petersburg during the Battle of Globe Tavern.[32] Lead shipments by rail from Silver Hill could have continued, but would have had to travel the last thirty

miles to Petersburg by wagon.

The Petersburg Lead Works was constructed by the Confederate Government to produce lead for bullets. It remained safely behind Confederate lines until the fall of Petersburg on 2 April 1865, only a week before Lee's surrender at Appomattox. During the war, the silver was not recovered from Silver Hill's ores. It remained in the lead used to manufacture bullets, and a popular legend soon evolved that the Confederates were shooting Yankees with silver bullets.[33]

The total quantity of lead that Silver Hill Mine produced for the Confederacy is not known. It is certain that Silver Hill was never more than a secondary lead supplier during the War. The Union Lead Mine Company in Austinville, Virginia, provided most of the Confederacy's lead. These Virginia mines remained in production until 17 December 1864, when they were destroyed by Union forces.[34]

Post-Civil War Production

In 1867, the first report on the mine after the Civil War noted that it had reached a depth of five hundred feet. This indicates that substantial activity had taken place during the war. Many thousands of tons of zinc concentrate were still present on the surface. The prospectus for the Silver Lead Mining Company of New York, included with this report, sought to raise capital to expand the scale of the operation and to repay an indebtedness of thirteen thousand dollars "incurred in keeping the mine clear of water, and preventing depreciation during the unsettled period since the war."[35]

By 1872, the mine had reached a depth of 650 feet and was producing at a rate of four hundred to five hundred tons per month. Buddles were still being used to separate the ore and waste minerals. The galena concentrate was roasted at the mine and shipped to New York for the manufacture of Bartlett's White Lead paint. Apparently no market had yet been found for the zinc.[36]

In 1878, J. Howard Jones extended the inclined portion of the East Shaft from the 200-foot level to the surface. The result was a completely inclined shaft. In the process of driving the new portion of the incline, a rich body of carbonate ore was encountered near the surface and a large quantity of it extracted.

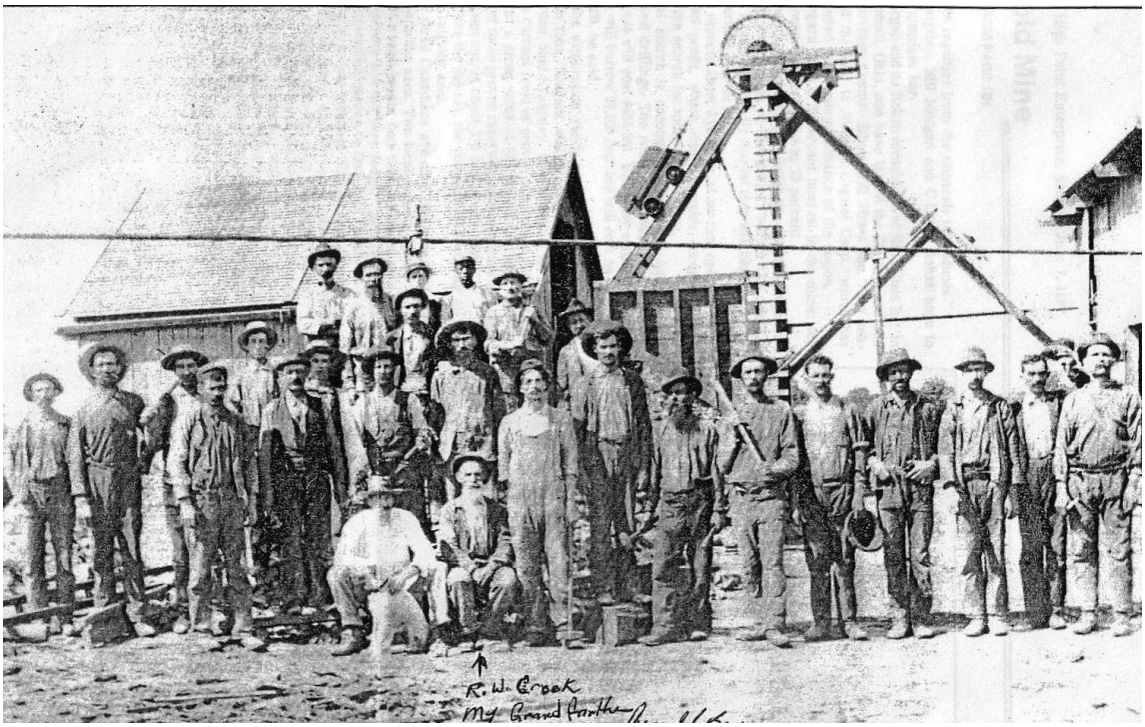
At some point prior to this the Symonds East and West shafts in the north ore body had been deepened to 110 and 210 feet respectively. A drift was driven from the 210-foot level of the Symonds West Shaft to connect with the 250-foot level of the main East Shaft.[37]

Silver Hill closed in 1882, reportedly because of continued difficulty with processing the sulfide ores and litigation over title to the mine. It once again filled with water, ending Silver Hill's last important period of production.[38]

Attempts to Reopen the Mine

A number of attempts were made to revive the mine. From 1898 to 1900 the West Prussian Mining Company operated the mine. E. Hopkins, the engineer in charge of the project, did a thorough survey of the mine. His maps provide the most complete picture of its underground workings. The company dewatered the mine, enlarged and retimbered the Incline Shaft above the 250-foot level, and repaired the rest of the shaft. The mine shipped some argentiferous galena and sphalerite concentrates, but production did not continue for long.[39] A photograph of the mine (next page) was probably taken during this period.[40]

It was reported that by 1908 the mine had practically no equipment, all machinery having been either discarded or sold, and that its few remaining buildings were dilapidated.[41] Between 1909 and 1911, T. A. M. Stevenson dewatered the mine down to the 350-foot level. The operation worked remaining ore on the upper levels and some dump material, and shipped approximately 700 tons of zinc concentrate and 225 tons of lead-silver-gold concentrate.[42]



Miners at the Silver Hill Mine, circa 1900. (From Austin "Search Slated For Main Vein." Courtesy of the Davidson County Historical Society.)

During World War II, the U.S. Bureau of Mines evaluated mines and prospects across the nation in search of minerals critical to the war effort, with Silver Hill included in that program (Figure 8). In 1940, R. L. Stevenson re-timbered the North Shaft (the old Symonds West Shaft) and dewatered the mine to the 250-foot level. At that time the Bertha Mineral Company of Austinville, Virginia, owned by New Jersey Zinc, drilled nineteen diamond-drill holes totaling 5,578 feet in an attempt to intersect the veins at depth.[43] This effort was unsuccessful in locating additional ore bodies of commercial size, and the bureau recommended that no further exploration be done.

In the late 1950s, the Tennessee Copper Company explored the Incline Shaft to a depth of 772 feet and carried out an extensive exploration drilling program. Lead and zinc mineralization was found down to fifteen hundred feet. In 1960 the company announced that it had contracted for work to reopen the mine.[44]

The Incline Shaft was deepened to a length of seventeen hundred feet, approximately twelve hundred feet deep vertically. A four hundred foot drift was driven from the shaft bottom into the hanging wall for deep diamond drilling. Three thousand tons of ore were excavated and placed on a surface stockpile. The company certainly envisioned using flotation to at last unlock the full potential of Silver Hill's complex ores. But though the newly discovered ore was rich, reserves were deemed insufficient to be economically produced.[45]

However some mines never die, especially famous ones. Silver Hill is no exception. In 1987, the Niagara Capital Corporation of Vancouver, British Columbia, Canada, announced its intention to undertake a $1 million evaluation, to be followed, if successful, with an additional $5 million investment to bring the mine back into production. Niagara's partner was Silver Hill Mines, Inc., of Cincinnati, Ohio, which had leased the mine from the Stevenson family.

Rising metal prices were cited as the reason

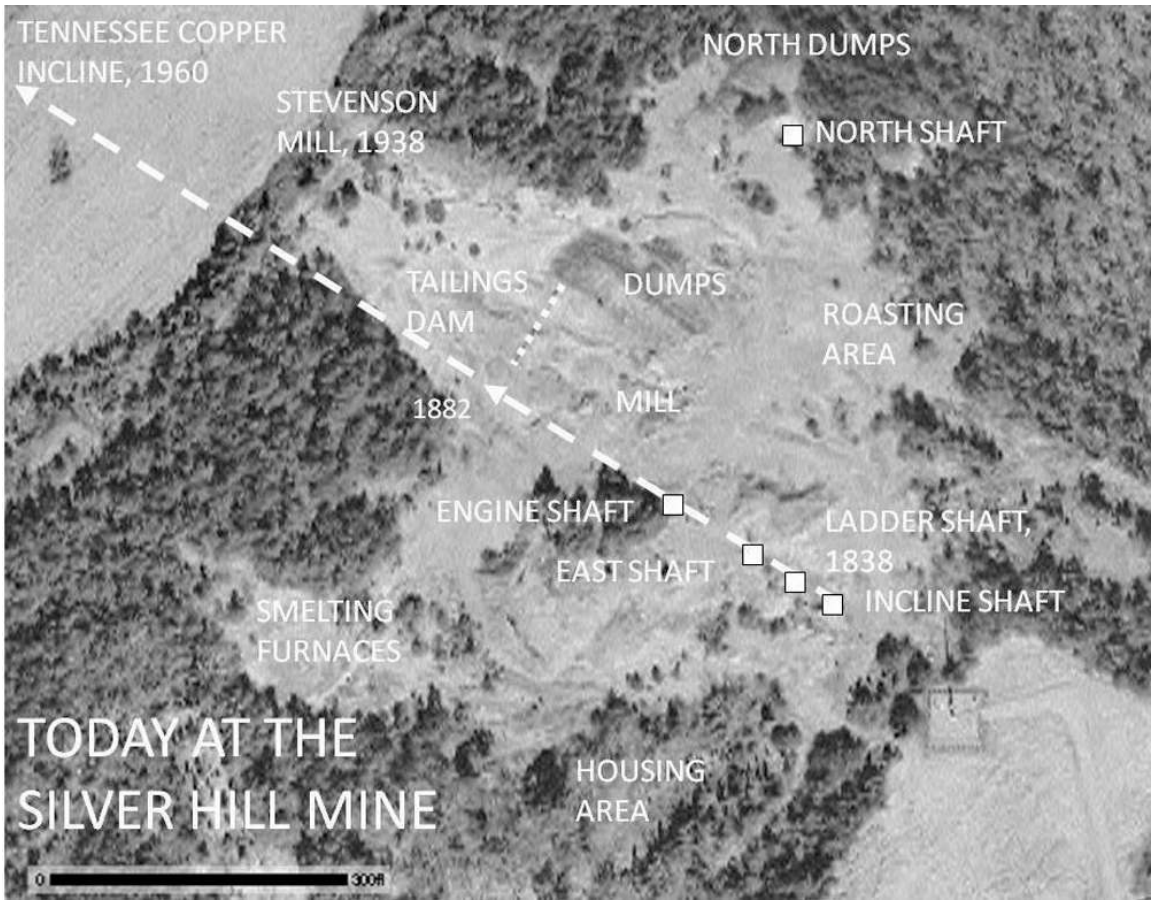
USBM photo of the Silver Hill Mine in the early 1940s showing the North Shaft headframe (right rear) and the Stevenson Mill (left center). (From Cohen, "Silver Hill Mine." Courtesy of U. S. National Archives.)

for renewed interest in the mine. Niagara stated that the mine had proven reserves worth $30 million, and the company planned to offset the cost of the initial evaluation by concentrating the stockpile left by Tennessee Copper and sending it to England for smelting. The stockpile was indeed removed and processed at a nearby mill, but the mine never reopened and no record has been found of any additional exploration being done on the property.[46]

Conclusion

Today, the site of the Silver Hill Mine is a small, rather desolate spot, surrounded by lush North Carolina farmland. The ruins of only a few of its more than sixty original buildings remain. Probably few of Davidson County's residents know of its existence and far fewer understand its historical significance. As the first U.S. silver mine, its early production of native silver was truly unique. The mine's high ore grades make it easy to understand why its owners were continually willing to invest heavily in mine development and metallurgical experimentation.

Silver Hill illustrates the dependence of early U.S. mines on European expertise and technology. Cornish mine captains were instrumental in the mine's initial underground development and its reopening at the time of the Civil War. The mine's workforce was heavily populated with English and Irish miners. The array of smelting furnaces tested at Silver Hill was based on English or German designs. The failure of these tests foreshadowed the challenges faced three decades later when western miners encountered poly-metallic sulfide ores. Finally, as a supplier of lead to the Confederacy, the mine was an important part of General Josiah Gorgas' effort to ensure that southern forces had the critical minerals they needed during the Civil War.



The Silver Hill Mine site in 2005. (Courtesy of Davidson County, NC, annotated by the author.)

Acknowledgements

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L. Michael Kaas is a retired mining engineer with a career in government and the private sector. He received a BS degree from Pennsylvania State University and an MS degree from the University of Minnesota. His research interests include the historic mining areas in the eastern states.

Notes:

1. Josiah D. Whitney, *The Mineral Wealth of the United States: Described and Compared with that of Other Countries* (Philadelphia: Lippincott, Grambo & Co., 1854), 181, 356, 399-400. The Silver chapter mentions the Washington Mine as the most important silver mine in the country. The Lead chapter provides more details about the mine, including a small cross-section.
2. Richard F. Knapp and Brent D. Glass, *Gold Mining in North Carolina: A Bicentennial History* (Raleigh: Division of Archives and History, North Carolina Department of Cultural Resources, 1999), 5-46.
3. Elisha Mitchell, *Elements of Geology with an Outline of the Geology of North Carolina for the Use of the Students of the University* (?: ?, 1842), 136-7.
4. Ebenezer Emmons, "Geological Report of the Midland Counties of North Carolina," in *Repositories of Metals* (New York: George P. Putnam and Co., and Raleigh: Henry D. Turner, 1856), 184-94. This report contains a description of the Washington Mine's workings, ore, mineralogy, and geology. Also included is a discussion of the metallurgical problems that led to the closing of the mine in the early 1850s and a new approach to separating sphalerite before smelting.
5. Richard Cowling Taylor, *Reports on the Washington Silver Mine, Davidson County, North Carolina* (Philadelphia: E. G. Dorsey, 1845), 1-40. This is a set of two reports on the mine with a series of informative appendices including ore analyses, financial results, and shareholder reports. The volume includes a copy of the 1839 North Carolina company charter, "An Act to Incorporate the Washington Mining Company."
6. Taylor, *Reports on the Washington Mine*, 3-24. The report contains a comprehensive set of early mine maps.
7. Mineral specimens from the Silver Hill Mine are in the collections of the following museums: Smithsonian Institution, National Museum of Natural History, Washington, DC; American Museum of Natural History, New York, NY; Yale University, Peabody Museum of Natural History, New Haven, CT; and North Carolina Museum of Natural Sciences, Raleigh, NC. W. C. Kerr and F. A. Genth, "Geology of North Carolina," in *Minerals and Mineral Localities in North Carolina*, v. 2 (Raleigh: P. M. Hale and Edwards, State Printers and Binders, 1881), 101. This publication includes a list of minerals from the Silver Hill Mine.
8. James C. Booth, "Analysis of Various Ores of Lead, Silver, Copper, Zinc, Iron, Etc. from Kings Mine, Davidson County, North Carolina," *American Journal of Science and Arts I* XLI (1841): 348-52.
9. Taylor, *Reports on the Washington Mine*, 25.
10. E. J. Pinkerton to Wm. Blackstone, 2 Aug. 1841, "Washington Mine Letter Book for June 6, 1841 to August 2, 1841," photocopy in the Davidson County Historical Museum, Lexington, NC. This book provides great insight into the operation of the mine, development of underground workings, repair and construction of furnaces, and shipments of lead. The letters were written by Mr. E. J. Pinkerton, company secretary, who temporarily managed the mine during the late spring and early summer of 1841.
11. Taylor, *Reports on the Washington Mine*, 25, 30, 33-34.
12. Taylor, *Reports on the Washington Mine*, 30, 33-4. "Washington Mine Letter Book," 1841. The letter book includes shipping confirmation letters.
13. Taylor, *Reports on the Washington Mine*, 4-29. Taylor repeatedly advised exploration to the north and south of the existing mine workings to determine if the veins continued in those directions beyond the points where they appeared to end in the underground workings. He described the changes in mineralization as the mine deepened but advocated gaining additional experience with furnace operations before judging the value of the mine.
14. H. Schoonmaker, *A Statement of the Condition and Prospects of the Zinc and Silver Hill Mine, in Davidson County, N. C., with Returns of the Gold and Silver from the United States Mint, Illustrative Diagrams, and Assays of the Ores* (New York: Baker, Goodwin, and Company, 1854), 7-19. This report by the mine's new owners in New York contains excellent diagrams and maps of the operations, updated versions of those in the 1845 report by Taylor.
15. Unknown author, "The Silver Mine in North Carolina," *The Friend* XVI, no. 5 (1842): 35-6. The author describes a visit to King's Mine (the Washington Mine) including a detailed description of its workings, ore processing, smelting in the early Scotch hearth furnaces, and minerals observed.
16. Henry F. Collins, *The Metallurgy of Lead*, 2nd. Ed. (London: Charles Griffin & Company, Limited, 1910), 49-53.
17. "Washington Mine Letter Book," 1841. Reports to the company president describe the progress of construction of the new high furnaces. William J. Tenney, "Gold and Silver Produced in the Mines of America from 1492 to 1848," *Mining Magazine II* 1 (1853): 365-73. The author describes the metallurgical techniques and types of furnaces used by the Washington Mining Company.

18. Tenney, "Gold and Silver Produced in the Mines of America," 367-70. Furnace diagrams and operational details are provided.
19. Frederick A. Genth, "On the Mineral Resources of North Carolina," *Journal of the Franklin Institute* (Series III) LXIII, no. 1 (1872): 58-9. The author advised the previous owners to separate the sphalerite from the galena before attempting to recover lead and silver. The company failed to heed his advice and the mine failed and changed ownership.
20. Joseph. E. Pogue, Jr., *Cid Mining District of Davidson County, North Carolina* (North Carolina Geological and Economic Survey, Bulletin 22), (Raleigh: Edwards and Broughton Printing Co., State Printers, 1910), 98-103.
21. Henry B. C. Nitze and George B. Hanna, *Gold Deposits of North Carolina* (North Carolina Geological Survey, Bulletin 3), (Winston: M. I. & J. C. Stewart, Public Printers, 1896), 62.
22. Walter Renton Ingalls, *Lead and Zinc in the United States* (New York: Hill Publishing Company, 1908), 38-40, 148, 154-7, 180-5.
23. Schoonmaker, S*tatement of the Conditions and Propects*, 22-4. Information is included on the unsuccessful metallurgical processes used by the former owners and plans for a new flowsheet. Emmons, *Geological Report of the Midland Counties*, 193.
24. Thomas Petherick, "Report of Thomas Petherick, Esq., of Pottsville, PA, Upon the Silver Hill Mine, Davidson County, N.C.," *Mining Magazine and Journal of Geology II* (William P. Blake, ed.) 1 (1860): 428-31. Two steam engines are described, one for the needs of the mine and stamp mill, the other to operate ten buddles for ore concentration. No mention is made of any furnaces being used.
25. William P. Blake, "The Silver Hill Mine," *Mining Magazine and Journal of Geology II* 1 (1860): 368-71. This article describes the buildings, engine equipment, mine workings, and concentrating process.
26. John Tyler, Jr. for Major Josiah Gorgas, 12 Aug. 1861, a response to interrogatory on raw material supplies. "The War of the Rebellion: A Compilation of the Official Records of the Union and the Confederate Armies," Series 4, V. 1, Part 1 (Washington, D.C., USGPO, 1900), 555-7. Winslow served briefly as North Carolina's governor and in the U.S. House of Representatives until secession. No copy of Governor Winslow's letter to Richard Pascoe has been found and its exact date is uncertain. The 8 Aug. 1861 date in Gorgas' response appears to be the date of a communication between Winslow and the Confederate War Department. By that date, Pascoe had already been at Silver Hill for some time.
27. "United States 1860 Census, Schedule 1" (1860), 90. The Free Census Schedules for the South Division, Davidson County, North Carolina, include Richard W. Pascoe, agent for the Silver Hill Mining Company, in house 666. This is probably a company-owned staff house because a cook, two mine bosses, and the mine clerk were also residents. Many English and Irish mine workers lived in the settlements of Silver Hill and Healing Springs.
28. "United States 1860 Census Schedule 2" (1860), 9. The Slave Census Schedules for the South Division, Davidson County, North Carolina, show two groups of slaves employed by Richard W. Pascoe at the Silver Hill Mine.
29. "United States 1860 Census Schedule 1" (1860), 21. The Free Census Schedules for Bethlehem Borough in Northhampton County, Pennsylvania, show R. W. Pasco[e], superintendent, his wife, and five children living in house 136. His employer, Lehigh Zinc Company, owned the Uberroth Mine, the largest zinc mine in the area.
30. "Silver Hill Mining Company Ledger, 1859-1862," Southern Historical Collection, Manuscripts Department, University of North Carolina Library, Chapel Hill, 237, 319, 341. This original ledger shows payments to Richard Pascoe from 14 June 1860 to 15 Mar. 1862.
31. "Silver Hill Ledger," 336, 344, 345, 347. Accounting credits are shown for the Confederate States and George C. Irwin, who may have been an agent for sales to the Confederate States of America.
32. "Weldon Railroad," National Park Service, http://www.nps.gov/pete/historyculture/weldon-railroad.htm (Accessed 15 May 2008).
33. "Silver Bullets," http://www.craterroad.com/silver-bullets.html (Accessed 5 May 2008).
34. Robert C. Whisonant, "Geology and the Civil War in Southwestern Virginia: The Wythe County Lead Mines," *Virginia Minerals* 42, no. 2 (1996): 16. Production from the Union Lead Mines Company from 1 May 1861 to 17 Dec. 1864 was 3,283,316 lbs. of lead. The lead mines were destroyed by Union forces on 17 Dec. 1864. The mines resumed operation on 22 Mar. 1865 and were raided again on 7 Apr. 1865. "W. L. Albers Papers," University of North Carolina, Southern Historical Collection, Chapel Hill, Part I, 46-7. The average price received during the war years was 11.84 cents per lb., ranging from 2.58 cents in the first year to 34.09 in the last.
35. A. Snowden Piggot and Chas. P. Williams, *Report of Prof. A. Snowden Piggot. and Prof. Chas. P. Williams*

upon the Silver Hill Mine, in North Carolina, with Assays and Prospects (Baltimore: John F. Wiley, 1867), 3-4, 7. Buddles were used to separate galena from sphalerite.

36. Genth, *Mineral Resources of North Carolina*, 59.
37. Nitze and Hanna, "Gold Deposits of North Carolina," 62-6.
38. Pogue, *Cid Mining District*, 100.
39. Pogue, *Cid Mining District*, 101.
40. Pete Austin, "Search Slated for Main Vein in Gold Mine," *High Point Enterprise* (Davidson County Historical Society, Lexington, NC), 7 June 1987. The article includes a photograph supposedly taken at the Silver Hill Mine around 1905. Because the mine was not producing at that time, the photograph was probably taken some time from 1898 to 1900.
41. Pogue, *Cid Mining District*, 103.
42. Charles J. Cohen, "Silver Hill Mine, Davidson County, North Carolina," U. S. Bureau of Mines War Mineral Memorandum, U.S. National Archives, Denver, CO (unpublished, June 1944), 3-9. Describes visits to the mine by bureau representatives in 1943. The report concluded that recent drilling by the Bertha Mineral Company offered "little encouragement for finding ore bodies of economic importance."
43. Drill Hole Location Map from Bertha Mineral Company exploration at the Silver Hill Mine, March 1943, North Carolina Geologic Survey, Raleigh, NC. The map shows the mine dumps and a few structures.
44. News Items, *Engineering and Mining Journal* 161, no. 5 (May 1960), and *World Mining* 22 (Aug. 1960), USBM files, magazine clippings, n. p., National Archives, Denver, CO. Tennessee Copper Company explored down to 772 feet and found enough ore to justify reopening the mine. Cowan and Company of Birmingham, Alabama, had contracted to clear the shaft and prepare for mining operations.
45. Jasper L. Stuckey, *North Carolina: Its Geology and Mineral Resources* (Raleigh: Department of Conservation and Development, 1965), 319-24. Christopher P. Indorf, "The Silver Hill Zinc Deposit and Associated Deposits, Central North Carolina," *Economic Geology* 76, no. 5 (1981): 1170-85.
46. Austen, "Search Slated for Main Vein." Mike Vogel, "Canadian Firm May Reopen Davidson's Historic Silver Hill Mine," *Greensboro News and Record*, 10 June 1987. "Historic N. C. Mine to Reopen," *Raleigh News and Observer*, 10 June 1987. These articles describe Niagara Capital's plan to reopen the mine. The company would offset exploration costs by processing three thousand tons of ore originally mined by Tennessee Copper Corp. in 1957.
47. Aerial Photograph of the Silver Hill Mine Area, Davidson County, North Carolina, on-line GIS System, http://arcims.webgis.net/nc/davidson/default.asp (Accessed 25 May 2008). Mining features have been added to the photograph by the author.