Elizabeth Furnace Plantation Site: Archaeological information from the website of the Archaeology Department at Millersville University

ELIZABETH FURNACE PLANTATION SITE

GENERAL INFORMATION

The Coleman (background)and Stiegel (foreground) mansions at Elizabeth Furnace Plantation. The Stiegel mansion was built in 1757, while the Coleman mansion was constructed about 1788.

The Elizabeth Furnace Plantation is an 18th century treasure. Thirteen colonial-era buildings, constructed between 1746 and 1788, are still standing in the 10-acre core of the property. In fact, the 1788 Coleman mansion is the newest standing structure on the property today, which has seen no new buildings erected since the 18th century. The buildings are in exceptional condition, with original woodwork, windows, sashes, summer beams, and fireplaces; the windows of the "Hessian barracks" building still contain the iron bars placed there during the Revolutionary War when the building housed prisoners. Because of the large number of original buildings in remarkably unchanged condition, and in light of the total absence of newer construction, Elizabeth Furnace Plantation may be one of the best-preserved Colonial-period villages in the United States. The plantation grounds have remained in private hands from the 18th century until today, and as a result, the public and most scholars are unaware of the existence of this rare survivor. In the summer of 2005, the archaeology program of Millersville University began the first archaeological excavations ever undertaken at this site. If you are interested in the history of the property or Millersville University's archaeological excavations, it is the University's hope that you will continue reading. However, you are asked to respect the fact that the site is on private property, and is not open to public tours or visitors at this time.

THE BUILT ENVIRONMENT

The surviving colonial-era buildings at Elizabeth Furnace Plantation can be viewed as essentially the heart of a colonial-era village, which grew up around the central industry of the furnace and ironworks. The large number of workers required for the furnace necessitated workers housing, plantation-style outbuildings and farmlands to produce food: a creamery and dairy, multiple cold cellars for food storage, at least two blacksmith shops, a glasshouse, and even a general store which was still in operation as late as the 1830's. While the furnace was the central economic focus of the property, it was such a large undertaking for the time (particularly when it is considered that this was prior to the large-scale industrialization of the 19th century), the infrastructure of an entire colonial village was required to facilitate its operation. Unlike most villages, however, all of the houses, fields, and industries were in the possession of the furnace owners.

The oldest building on the property is the Huber House (ca. 1746), which was the home of the furnace founder, John Jacob Huber. Built in vernacular German style, its original central chimney is no longer present. Of the four buildings originally comprising the furnace itself, only the charcoal house (ca. 1750) remains. The Stiegel mansion, an attached summer kitchen, an office, the aforementioned Hessian barracks, the stables, and the icehouse, all date to the 1750's and early 1760's and are remarkably original in terms of the historic fabric of the buildings. At least four tenant houses, most likely dating from the 1750's to the 1780s, still stand in various locations around the property including two in the core area.

From the perspective of historical archaeology, the buildings that are not still standing are possibly even more impressive than the surviving structures. Each is an archaeological site, which given the absence of subsequent building on the property, presents the strong possibility of undisturbed archaeological deposits. These deposits represent the words, paragraphs, and chapters of the history of the people who lived at Elizabeth Plantation Furnace- a history that can be recovered through archaeological excavation and analysis. Each of the myriad of sites scattered throughout the grounds, therefore represents an opportunity for research into the colonial period in Lancaster County. Buildings which were once part of the Elizabeth Furnace Plantation village, and which appear on historic maps of the property but are no longer standing today, include at least eleven tenant houses, two blacksmith shops, a creamery / dairy, a colonial-era glassworks, and a general store. It is probable that many other buildings yet to be discovered once stood on the property, as well.

HISTORICAL BACKGROUND

In 1746, John Jacob Huber patented 400 acres of land in northern Lancaster County. As early as 1750 he had built and put in blast a furnace, where he cast five-plate stoves for the Pennsylvania market. His stoves, some of which survive today, were cast with the confident inscription (in German) "John Jacob Huber, the first German man who can manage ironwork". In 1752, Huber's daughter Elizabeth married a young German employee of her father. Heinrich Wilhelm Stiegel would later become famous for his audacious decorative glassworks in Manhiem, his name synonymous with some of the most highly collectible colonial-era decorative glass in America. Stiegel bought out his father in law's interest in Elizabeth plantation in 1757 and with backing from wealthy Philadelphia investors, constructed most of the buildings that survive in the core of the property today. He also rebuilt the furnace and renamed it Elizabeth Furnace for his wife, the daughter of its founder. Stoves cast here by Stiegel still survive today, including one in Stiegel's office on the property inscribed "Elizabeth Furnace 1769".

Stiegel was legendary for his flamboyance. He owned, at one point, more than 2000 pounds worth of musical instruments for his personal marching band, and constructed a 75 foot stone tower with a cannon mounted on top of a nearby hill, so as to grandly salute when he entered the Elizabeth Furnace village. His extravagance eventually cost him Elizabeth Furnace Plantation as well as his Manhiem glassworks, and he landed in debtors prison in Philadelphia by the early 1770's. After losing money for some years, Stiegel's creditors eventually leased the furnace to a young ironmaster named Robert Coleman.

Coleman rid the operation of the inefficiencies of the Stiegel period, undertook significant new construction to improve the efficiency and output of the furnace, and quickly turned the venture into a highly cost-effective operation. Coleman managed the furnace so ably he was able to earn enough to purchase the property, moving from renter to owner before his initial 7-year lease was up. The mansion Coleman built in 1788 remains, incredibly, the newest standing structure on the property today.

ARCHAEOLOGICAL RESEARCH

The Lancaster Colonial Settlement Project at Millersville University began initial archaeological testing at Elizabeth Furnace Plantation in the summer of 2005. Due to the sheer size and diversity of resources of the plantation, it was decided to concentrate on one area of the property for this initial look into the archaeological potential of the site. The area around the John Jacob Huber house (ca. 1746) has been chosen for this initial project.

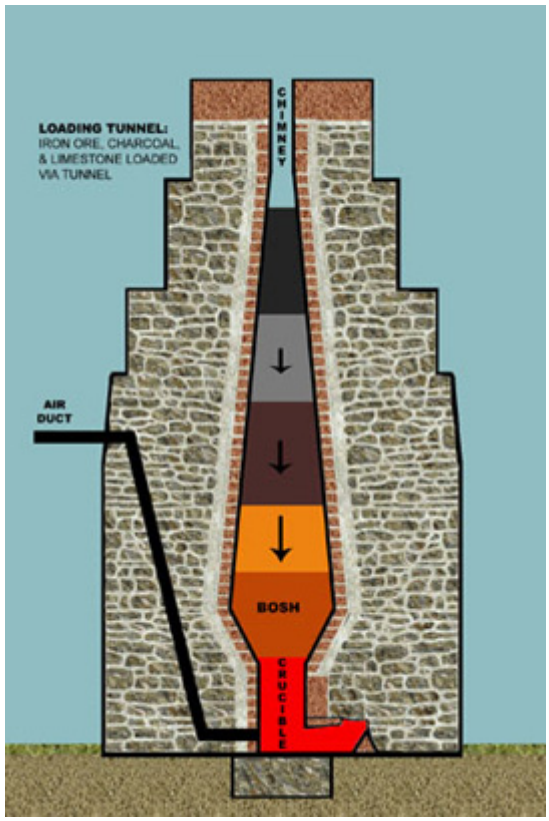
Archaeological testing, though highly preliminary, has already revealed areas of significance. We have learned that the grounds immediately west, south, and east of the Huber house were heavily disturbed sometime during the early 20th century, possibly relating to the destruction of most of the tenant houses. It appears, however, that the original furnace race (the stream-channel dug to carry water to power the wheel of the furnace) was too deep below ground level to have been destroyed by this action. Excavations revealed a rich layer of artifacts in a sealed context, in the silted-in bed of this 12-15 foot wide channel. Since the channel was located within 15 feet of the back of the Huber house, it appears that items deposited by the people living in the house wound up in the base of this channel, and should provide valuable insight into the daily lives of the people who lived there. Excavations also indicated that the area to the east, immediately down-slope from the Huber house, was not disturbed by the 20th century activity in the area.

ARCHAEOLOGICAL AND HISTORICAL ANALYSIS

PENNSYLVANIA COLONIAL IRON PRODUCTION AT ELIZABETH FURNACE

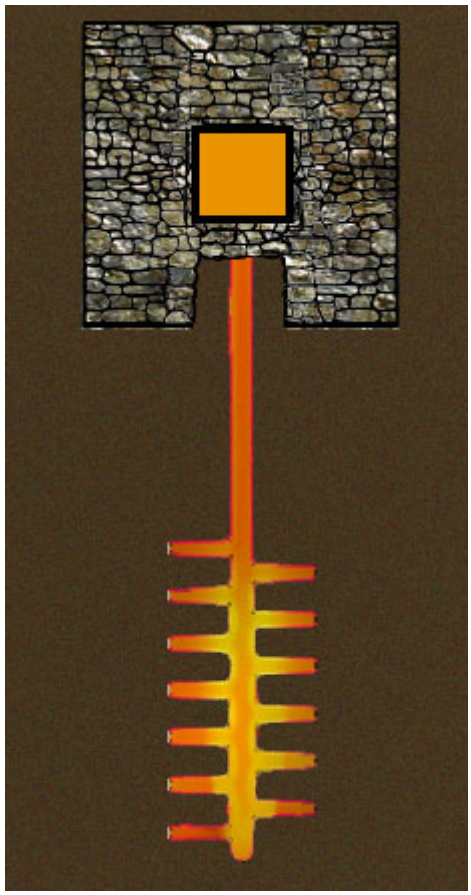
Elizabeth Furnace, in Brickerville, Pa. is a classic example of an 18th century iron plantation. Apart from its high degree of archaeological preservation, the site contains 13 original standing structures, with few modern alterations. Since 1775, the property has been owned and continually occupied by the Coleman family, who value the property's historical significance. Furthermore, an extensive documentary record for the furnace survives as do numerous examples of its product. In short, Elizabeth Furnace provides an excellent opportunity to study 18th century iron production.

IRON PRODUCTION



Iron production in the 18th century required an abundance of natural resources, skilled labor, and support teams to provide the wood, ore, food, and maintenance needed to keep an iron furnace community functioning. Elizabeth Furnace was a charcoal burning furnace, like all furnaces of the colonial period, which required vast tracks of wooded land to provide it with a steady supply of charcoal. The furnace itself was constructed out of large sandstone blocks several feet thick. The stack was approximately 30 feet tall and 25 feet wide at the base. The hollow interior of the stack was lined with fire clay and was an oblong diamond shape. The top was approximately 18 inches square which expanded outward to approximately 7 foot wide in the middle of the stack, known as the bosh. At the chimney's base was the crucible, which tapered down from the bosh to a diameter of about three feet. This unique shape focused the bulk of the heat on the iron at the base. A combination of iron ore, charcoal, and limestone flux was loaded into the furnace from the top via the chimney or a

loading tunnel cut into the top of the furnace stack. A fast flowing furnace race ran long the main chimney, providing fast moving water power to a water wheel which drove the blast furnaces twin leather bellows. These bellows forced air through a pipe called the tuyere into the crucible at the stack base, adding oxygen to the fire and raising the temperature in side the stack to the 2600° F - 3000° F necessary to melt iron. As the raw iron ore and limestone melted, the molten metal separated into layers by density. The pure iron being the densest metal sank to the bottom of the furnace, light minerals rose to the top and formed a type of metal conglomerate called iron slag. Slag was periodically drained off leaving only pure iron in the crucible. Twice a day iron in the crucible was taped to be used in casting. This process was continued non-stop for many months of the year, provided the furnace was well maintained.



Once a bulk of molten iron was prepared, casting could take place. The type of casting was largely contingent on the quality of the molten iron. If the molten iron was not of sufficient purity, the iron was tapped directly from the crucible and allowed to flow through a trench dug into casting sand. This long feeder trench in the casting sand had several branches or pigs running off of it to the sides, like a baby pigs sucking on a mother sow. Molten iron flowed down the trough the feeder trench into the pigs where it was allowed to cool. Once cooled, the iron pigs were broken off the runner and prepared for shipping to a forge where they could be beaten into a more refined iron called bar iron. Bar iron was more durable and less brittle than the cast iron used in stoves, pots, and other vessels.

Elizabeth furnace sent its pig Iron to Charming Forge several miles away where it was turned into bar iron. Making pig iron into bar iron was a way to prevent a financial loss. Poor metal quality, would cause a bad casting, and result in an inferior product that would damage an ironmaster's reputation. Thus by removing lower grade metal from the furnace, and sending it off to be further refined, a ironmaster was able to get some return for his investment, as well as insure that his castings were of high quality.

Casting using quality molten iron was done in the casting house adjacent to the furnace. Complex castings, like stove plates, kettles and pots required more preparation than simply digging a few groves in casting sand. For castings like stove plates a wooden template had to be carved out of wood. This template was then pressed into the sand creating a negative image, which served as a mold. Like making pig iron, a feeder trench connected these sand molds. Molten iron was then ladled into the trench, where it flowed down into the molds. Iron products made in such a way can

be identified by looking at the thickness of an iron object in profile. Early colonial iron products cast with feeder trenches leave a mark on the finished iron casting. Like pontil marks on hand blown bottles, iron stove plates and other objects tend to be thicker at the point where they were connected to the feeder. For instance, on a stove plate, one corner out of four will be substantially thicker in profile than the other three due to the fact that the iron had a tendency to pool where the cast plate connected to the feeder trench because there was no precise way to stop the flow of iron from the feeder trench to the mold. This can be useful in both dating, and determining how an artifact was made.

GOODS PRODUCED

While the methods of iron production that were in use during the 18th century may seem crude by modern standards, the range of goods they could produce was considerable. Ledgers from the furnace and surviving examples of its products demonstrate the capacity for producing complex, multi-stage castings. One surviving example of such a casting is the Stiegel made "Cannon" stove produced at Elizabeth furnace in the 1760's. While only two examples of this style stove survive today, they are a testament to the capabilities of these early furnaces. This stove is composed of three cylindrical, hollow, sections of varying size. Each section of the casting was cast as a semi-circular portion necessitating six separate castings were then joined together. The three legs of the stove were then cast separately as were the doors, its hinges, and interior plate. Such a casting requires greater skill, than the casting of a flat iron jam stove. It also shows the furnaces ability to cast objects that were hollow, which increased market potential dramatically.

Elizabeth Furnace plantation records from the later part of the 18th century give us unique insight into just how broad a range of goods the furnace was capable of producing. Apart

from bar or pig iron which was shipped to Charming Forge for use, the furnace was able to produce: 5, 6 &10 Plate Stoves, Kettles, Pots, Pans, Cannon Stoves, Irons, Flat Irons, Dutch Ovens, and Bell. Such items were produced largely for domestic consumption, sold locally and throughout the colonies. Heinrich William Stiegel owner of the furnace saw potential for profits in specialty markets as well, and began advertising in the Pennsylvania Gazette, that he could produce the types of iron goods needed by the West Indies sugar trade.

"Iron Castings Of all dimensions and sizes, such as kettles or boilers for pot-ash works, soap boilers, pans, pots, from a barrel to 300 gallons, ship cabooses, kackels, and sugar house stoves, with cast funnels of any height for refining sugars, weights of all sizes, grate bars, and other castings for sugar works in the West Indies, & are all carefully done by Henry William Stiegel, iron master, at Elizabeth Furnace in Lancaster County, on the most reasonable terms. Orders and applications made to Michael Hillegas in Second Street, Philadelphia will be carefully forwarded."

Recent excavations conducted by Millersville University at Elizabeth Furnace have yielded numerous other artifacts that support the conclusion that it was producing for more than simple or utilitarian castings. Among the artifacts recovered from the Fall 2005 excavations were, a portion of a 1765 Stiegel stove plate, a piece of grape shot cast as ordinance for the Continental Army, ornate stove legs, and other stove plates. The current property owner is also in possession of the original wooden molds used to cast a fence that still encircles his house. In short, the furnace was capable of casting a wide variety of objects, both utilitarian and decorative.

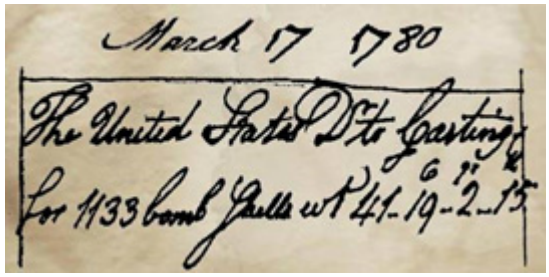
MARKETS FOR IRON GOODS

Elizabeth Furnace produced a wide variety of castings because it participated in the colonial economy on several levels; as an isolated and self-sustainable frontier community, as a part of the local economy, as part of the regional economy, as well as part of Colonial Trans-Atlantic trade. For instance, while the furnace plantation was located in a relatively isolated frontier area, which necessitated plantation-style food production comprised of several tenant farms on the property, it did rely on the surrounding community to some degree. Because furnace required vast amounts of wood to supply the furnace with charcoal, ironmasters would therefore hire local farmers to cut wood for them on furnace owned land or from their own land. They were paid for their work in either cash, barter for a furnace product, or more often through trading for goods from the furnace company store. The store served as a frontier trading post trading items like shoes, knives, utensils, clothes, or even liquor. Thus, many people in the area surrounding area came to the store to shop or trade. In exchange, Stiegel and other furnace owners got a cheap and constant supply of the cordwood they needed to keep Elizabeth Furnace in blast. Ledgers record many such transactions of furnace resources for furnace goods. While trade with the local community may have been

sufficient to keep the furnace in blast, it was not large enough to offer any market capable of making the furnace a successful financial venture. Where then were the sustaining markets that made iron production profitable?

The larger regional market had a greater demand for iron goods, especially in the more populated areas surrounding Lancaster, Reading, and Philadelphia. Iron goods like stoves, kettles, and pots were shipped to these more metropolitan areas and sold at substantial profits due to the higher demand. Henry William Stiegel employed agents like Michael Hillegas to take orders for products from customers in Philadelphia. These orders were then communicated back to Stiegel via letter, who would then produce and ship the ironwares to his customers in Philadelphia. Many of these orders were for specialty items, made to the customer's specifications. Mass produced utilitarian wares like kettles, pots, and stoves were sold to shopkeepers in these areas who in turn sold them in their stores. This regional market comprised the bulk of the trade in which Elizabeth Furnace engaged. Ledgers indicate that most of the furnace's castings were sold to customers or retailers in Lancaster, Berks, and Bucks counties as well as Philadelphia. This was the market that provided the demand for the largest variety and volume of furnace castings; however, it was not inherently the most profitable market.

Some of Elizabeth Furnace's products did not end their journeys in large colonial cities like Philadelphia. Bar iron from Charming Forge was shipped from Philadelphia over seas to London, England. An Elizabeth Furnace ledger details the shipment of 69 1/2 tons of bar iron shipped to London in 1765. Further entries suggest that Elizabeth Furnace did in fact supply iron ware for the West Indies sugar trade, producing the large iron vats used in sugar production in the West Indies as the 1769 Pennsylvania Gazette advertisement indicated. While records about Elizabeth Furnace's trade with the West Indies is less specific than those for regional trade, there is sufficient evidence to suggest that for a short time in the late 1760's and early 1770's Elizabeth Furnace engaged in a profitable trade with the West Indies in specialty ironwares like cast iron pots that could hold several hundred gallons, boilers, and specialty stoves. This trade in specialty ironware conceivably opened the region to Elizabeth Furnace's more utilitarian wares as well.


March 17 1780
The United States Dr to Casting
For 1133 bomb Shells wt 41-19-2-15

In the late 18th century during the American Revolution the available markets shifted from overseas to the national arena, where the demand for military iron goods was high. Elizabeth Furnace Plantation became one of the first government sub-contractors producing ammunition for George Washington's colonial army. For example, a ledger entry from March of 1780 records the production and sale of 1,133 bomb shells for the colonial army. While the new government could offer little in terms of monetary support to such vital war industries, there were able to supply the vital furnaces with cheap labor in the form of captured

soldiers. After the battle of Trenton, Robert Coleman the new owner of Elizabeth Furnace arranged a deal, in which he received 70 captured Hessian prisoners as laborers to work the furnace, and to dig a ditch which would increase the water flow to the furnace bellows and consequently the production of the furnace. Coleman found cheap labor for his business and the colonial government received vital ammunition for its war with Britain, monetary compensation for the use of the prisoners, plus the added benefit of not having to pay for the upkeep of the prisoners. Such arrangements were an intelligent method of sustaining the profitability of the furnace in a time when political circumstances had closed foreign markets. Thus, the national market proved to be a suitable substitute for the foreign ones until they once again became available after the war.

CONCLUSIONS

Pennsylvania iron production at Elizabeth Furnace was a technologically and economically demanding endeavor. While it would appear to the modern observer that production was limited by the technological level of their craft, it seems that if a profitable enough market arose the furnace was able to adapt to meet the new demand. The adaptive nature of Elizabeth Furnace allowed it to participate in trade in the local, regional, national and trans-Atlantic markets, making it able adapt to market changes, and shifts. The variety ironwares produced at Elizabeth Furnace made it capable of supplying many different people and places with goods, and its economic success was not contingent on one specific market. The ability of the ironmasters to transition to new markets when old ones disappeared allowed the furnace to survive and thrive, before, during, and after the American Revolution and continue to remain a competitive part of the iron industry until the mid-19th century.

1 - Sieling, J. H. "Baron Henry William Stiegel", Journal of the Lancaster County Historical Society 1 (1869): 46. Beck, Herbert. "Elizabeth Furnace Plantation," Journal of the Lancaster County Historical Society 69 (1965): 35.

2 - Beck, Herbert. "Elizabeth Furnace Plantation," Journal of the Lancaster County Historical Society 69 (1965): 33.

3 - Beck, Herbert. "Elizabeth Furnace Plantation," Journal of the Lancaster County Historical Society 69 (1965): 33.

4 - Beck, Herbert. "Elizabeth Furnace Plantation," Journal of the Lancaster County Historical Society 69 (1965): 34.

5 - Beck, Herbert. "Elizabeth Furnace Plantation," Journal of the Lancaster County Historical Society 69 (1965): 34.

6 - Beck, Herbert. "Elizabeth Furnace Plantation," Journal of the Lancaster County Historical Society 69 (1965): 34.

7 - Tyler, John. Letter to Jeff Driesbach, 4 March 2003. Concerns the authenticity of a Stiegel "Hero" stove plate.

8 - Heiges, George L. Henry William Stiegel: The Life Story of a Famous American Glass-Maker. Manheim (Pa): George L. Heiges, 1937. (pg: 19)

9 - Stiegel, Henry William, Cannon Stove, 1760's, Jeff Dreisbach Collection, Lancaster (Pa).

10 - List compiled from Stiegel and Coleman Ledgers of Elizabeth Furnace, 1765-1780 (Not a complete list)

11 - Heiges, George L. Henry William Stiegel: The Life Story of a Famous American Glass-Maker. Manheim (Pa): George L. Heiges, 1937. (pg: 16-17)

12 - Statement based on Elizabeth Furnace Ledgers 1762-1765 and 1769-1771, Currently in the Historical Society of Pennsylvania: Call #212

13 - Statement based on Ledgers 1762-1769, archived in the Historical Society of Pennsylvania: Call #212

14 - Statement based on Ledgers 1762-1769, archived in the Historical Society of Pennsylvania: Call #212

15 - Heiges, George L. Henry William Stiegel: The Life Story of a Famous American Glass-Maker. Manheim (Pa): George L. Heiges, 1937. (pg: 20)

16 - Heiges, George L. Henry William Stiegel: The Life Story of a Famous American Glass-Maker. Manheim (Pa): George L. Heiges, 1937. (pg: 16)

17 -The Coleman Papers, Lancaster County Historical Society, Coleman Elizabeth Furnace Ledger 1780, March 17, 1780, pg. 187 Beck, Herbert. "Elizabeth Furnace Plantation," Journal of the Lancaster County Historical Society 69 (1965): 40.

18 - Sieling, J. H. "Baron Henry William Stiegel", Journal of the Lancaster County Historical Society 1 (1869): 60. Beck, Herbert. "Elizabeth Furnace Plantation," Journal of the Lancaster County Historical Society 69 (1965): 38.

19 - Beck, Herbert. "Elizabeth Furnace Plantation," Journal of the Lancaster County Historical Society 69 (1965): 38.

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THE BLACKSMITH FORGE FOUNDATION

THE BLACKSMITH FORGE FOUNDATION 2007

Photograph of stables showing foundation in foreground.

During the initial survey of the Elizabeth Furnace property, one of the few archaeological features clearly visible during the walk-over were the remains of a stone foundation, located in the core area between the Huber House and the Stables. The function of the structure was unknown, and it was not specifically referenced in any period documents or subsequent historical research. The crew began to refer to the site as the "ghost foundation", and the name stuck throughout the project. There were many buildings mentioned in period documents that once stood at Elizabeth Furnace but are no longer extant, and it seemed probable that this foundation may have been one of them-hence, determining the construction date, original function, and uses of this building became one of the important research goals for the project. During the Fall of 2007 excavations at this site were conducted during the Millersville University archaeological field school.

The crew breaking ground at the at the start of excavation.

One of the most intriguing aspects of the ghost foundation was the fact that the northern wall appeared to have been built upon a much larger wall that served as the uphill boundary of the furnace race. This wall was between 2 and 3.4 feet above the current ground level, and aligns with both the visible linear depression in the soil showing the location of the furnace race (now mostly filled-in), and also aligns with the northern wall of the stables building. The furnace race, therefore, appears to have run in a roughly straight line from the corner of this building, along the current stone wall, and up past the stables. At this point, the trace of the furnace race becomes intermittent and difficult to follow into the woods, but portions of it are still visible, particularly during Winter and early Spring when ground cover is most sparse.

Previous excavations at the Huber House revealed that the furnace race, directly downhill from the building, provided a natural basin that trapped items that had been broken or thrown out of windows and doors. The artifact assemblage in this section of the furnace race very clearly reflected the domestic use of the Huber House, and the furnace race naturally trapped these items and provided a deeply-buried (and hence undisturbed) context that preserved artifacts related directly to the function of the house.

It was therefore hypothesized that the artifacts found in the furnace race immediately downhill from the foundation would likely represent the trash produced there, and would therefore likely to reveal the original function of the building. A large block excavation was therefore surveyed-in and excavated during the 2007 field season. The stratigraphy of units showed two distinct episodes of deposition within the boundaries of the excavation units. It became evident early in the excavation that the area immediately adjacent to the stone wall had been used as a burn pile for trash during the 20th-century. An extremely artifact-rich layer, characterized by heavy amounts of charcoal and burned materials, predominated in these units in the upper layers. Further away from the stone wall, the upper layer also dated to the 20th century, but was comprised of a heavy red clay mixture (similar to subsoil), indicating heavy plowing or churning had taken place. This was not surprising

given that this area was used as a garden area for the Coleman family during the 20th-century. The topsoil layer in these units showed a mixing of artifacts from multiple eras, and included some 18th-century materials, mixed with 19th and 20th century artifacts.

Excavations in progress. Photograph on the left shows block after removal of topsoil, with heavy charcoal layering in the foreground from the burn pile. Photograph on right shows excavation in progress, with garden layer in background and charcoal-rich burn area in foreground.

Below the topsoil and burn-pile layers, the stratigraphy revealed several interesting features. The outlines of the original furnace race were discernable, but archaeologically the race feature was somewhat different that the race area excavated near the Huber House. For example, it became evident that the ground-disturbing activities, likely associated with gardening or plowing as mentioned earlier, had torn away the downslope rock wall that served, near the Huber House, as the lower boundary of the furnace race. Several large examples of these stones were found, knocked out of place from their original alignment, during excavation and most were removed to facilitate exploration of the soil beneath their locations.

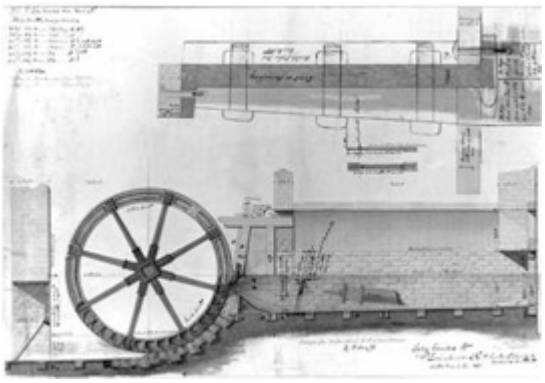
Final excavation photograph showing metal spikes in-situ within the remains of the wooden gate, now decomposed but visible as darker, richer organic soils. The subsoil on either side of the feature was left in place to prevent the feature from falling apart when it was pedestalled.

As excavation continued the outlines and base of the furnace race were uncovered. Unlike the area near the Huber House, the fill of the race channel in this area was far less deep, and was much less silted-in. Additionally, a deeply-cut feature was uncovered that cross-cut the furnace race channel. This feature, measuring just 4-6 tenths of a foot across, was deliberately dug into the natural subsoil, and was filled with a clearly darker and more organically rich soil. Further excavation of this feature revealed that a series of hand-wrought metal spikes were found in-situ, situated horizontally across the feature. This was the final clue to the origin of the feature- it was clearly the remains of a wooden wall that had been built, and seated strongly into the underlying subsoil, that would have acted as a dam to the furnace race. The wooden planks with which the original structure had been built had decomposed over the years, leaving only the rich dark soil we found in the feature, as well as the spikes that originally held the structure together, still in place where the wood rotted away around them.

Final excavation photo showing foundation and gate.

The discovery of the wooden gate or dam feature provided the first clue to the buildings historic use. The second clue came from the nature of the artifact assemblage found in the sediments that accumulated at the base of the furnace race itself. The artifact assemblage recovered in this location was quite unlike that recovered from similar sediments from the furnace race at the Huber House. The Huber house channel sediments were extremely artifact rich and produced an obviously domestic scatter consisting of large amounts of fine earthenwares and glass, as would be expected in an area directly adjacent to a domicile. However, the sediments from the furnace race adjacent to the ghost foundation were very artifact poor, producing comparatively few domestic artifacts or glass items. The datable artifacts that did appear, however, confirmed the active date range for the use of the furnace race, suggesting that it was an active depositional environment from roughly 1770-1850. The furnace clearly opened earlier than this, and presumably utilized the same channel, but it is possible that with the 1779-1781 construction of the Hessian ditch by the captured soldiers supervised by Robert Coleman, the entire furnace race channel was rebuilt and possibly re-excavated around this time, cleaning out earlier artifacts and producing the date range of artifacts recovered. By far the most common artifacts found were iron, including hand-wrought

spikes and nails in huge quantities, as well as miscellaneous iron pieces. In short, the assemblage recovered strongly indicated and industrial use for the building, centering on the production of small iron items, from nails to tools and plows.



Period drawing of a small waterwheel, indicating the general design that was likely utilized for the blacksmith shop / forge building.

The third piece of information about the use of the building came from a 5 x 5 foot test unit places within the walls of the foundation itself. This excavation unit revealed a stone cobbled work floor roughly 1.5 foot beneath the modern surface soil. Additionally, the soil matrix was extremely charcoal and slag-rich, containing in places more charcoal that soil. There were very few artifacts recovered within this soil/charcoal layer, but the intensely black nature of the soil was indicative of blacksmithing and forging activities within a small industrial outbuilding.

These three lines of evidence allowed for the historical function of the building to be inferred. The ghost foundation was evidently a blacksmith / forge, as the large amounts of charcoal waste and iron artifacts found in the furnace race suggest. Additionally, it appears that this building was deliberately sited on the furnace race, and a wooden gate for raising the water level was built, in order to operate a small waterwheel in order to power the bellows needed to produce higher-quality ironwork. This interpretation is strengthened by comparing photographs of the final excavation to period drawings of small waterwheels. These wheels were only able to generate sufficient power, particularly with small or irregular water flow, by the use of a gate / dam. In fact, excavations revealed a cornerstone base that would have functioned as a foundation for a frame to hold the waterwheel, further strengthening this interpretation.

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ARCHAEOLOGICAL EXCAVATIONS 2005

ARCHAEOLOGICAL EXCAVATIONS 2005

The Millersville University excavations conducted during 2005 at Elizabeth Furnace represent the first archaeological research undertaken at this site. Because the core area of the property contains roughly six acres of densely-packed colonial and later period settlement and associated archaeological sites, a thorough archaeological investigation and survey of the property will necessarily be a long-term process.

Our initial research focused on testing and excavation around the John Huber house (ca. 1746). Testing during the summer of 2005 indicated that much of the area north, west, and south of the Huber house had been disturbed, most likely by grading activity conducted sometime during the early to mid- 20th century. Intact stratigraphy dating back to the 18th-century was found to exist on the east side of the house. Additionally, a large stone-lined furnace race (a man-made stream constructed to carry water to power the bellows of the furnace) was found directly off the north-west corner of the house. Large-scale block excavations were conducted in these areas during the Fall of 2005, revealing all of the underlying stratigraphy and features in these areas.

The excavations around the Huber house revealed the furnace race channel. The furnace race's base is approximately 4ft. below current ground surface, and much of its dry-laid stone walls remain intact.

The Huber house is a classic central-Pennsylvania German vernacular house. Measuring 18 by 38 feet, the asymmetrical windows and doors mirror the interior room layout, which is the standard 3-room "Kitchen - Stove room - Chamber bedroom" Germanic small-house plan. Significant discoveries resulted from these initial excavations. The furnace race was found to extend nearly 4 feet below the present ground surface, and produced large numbers of relatively intact artifacts including a wide range of colonial-period materials. This context represents the silt which accumulated slowly at the base of the channel from roughly 1750 to 1850, as the associated artifact dates have subsequently indicated.

The excavations clearly revealed the channel of the furnace race, bounded on the downslope side by a large dry-laid stone wall, and on the uphill side by a more ephemeral stone lining. The stones lining both sides were there presumably to prevent erosion during times of high-volume water flow in the channel. Surprisingly, at its nearest point, the upper wall of the furnace race was built less than two feet from the foundation of the Huber House.

The initial excavations have produced more than 23,500 individual artifacts all of which have been cleaned, stabilized if necessary, and catalogued into an artifact database enumerating up to 12 separate diagnostic attributes for each artifact. The sealed contexts around the Huber house produced multiple 18th and early 19th-century contexts containing a wide range of artifacts. Several porcelain doll legs, 18th and 19th-century coins, buckles and harness tack, and a three-tine fork with portions of the wooden handle still attached were typical of the artifacts recovered.

The excavations around the Huber house revealed the furnace race channel. The base of the channel is approximately 4ft. below current ground surface, and much of its dry-laid stone walls remain intact.

Numerous metal artifacts including many pieces cast at the furnace, such as these fragments of stove plates, were found. Faunal remains consisted almost exclusively of cow and pig bones and teeth. One particularly interesting artifact was a loaf of lead found in the furnace race. Small pieces

were removed from the loaf in order to cast lead shot individually for muzzle-loading weapons, usually around a campfire or hearth, and this example shows clear evidence of the hack-marks and cuts of previously removed pieces.

Other artifacts included numerous pieces of creamware and pearlware, including several specimens that could be cross-mended into nearly complete vessels. Hand-blown bottle glass with pontil marks, a black basalt teapot, and pipe-stems and bowls were typical. For more on artifacts from this excavation (Click Here)...

The artifacts indicate that the primarily German immigrants, who were working and managing the furnace during the first 25 years of its operation, utilized English and American manufactured material culture in their daily lives. Every piece of ceramic recovered thus far was of English or American manufacture. Not a single piece of German stoneware, for example, was present in this artifact assemblage, an interesting fact given the ethnicity of the occupants. Additionally, transport or local availability does not appear to be an issue, as Germanic-manufactured materials, particularly Westerwald Stonewares, were found during excavation at nearby Ephrata Cloister as well as other contemporary sites in Colonial Pennsylvania at this time.

This is one of the many chamber pots discovered in the furnace race. The fact that many of the chamber pots are nearly complete or broken in large pieces, suggests that they broke as they were dropped or thrown in the furnace race. This suggests that the furnace race was being used for human waste disposal.

Additionally, there appears to be strong evidence of human waste being disposed in the furnace race, as opposed to the more English style of privy construction. Visual searches for differential plant growth, conventional test pits, and a soil resistivity survey all failed to reveal the presence of a conventional privy in the area around the Huber House. Alternately, the remains of a minimum of 14 individual chamber pots were found broken around and in the furnace race, including several nearly complete specimens, suggesting regular waste disposal in the race. This practice may have its origins in cultural practices of German immigrants from urbanized industrial areas, where

disposal of waste in channeled waterways like furnace or mill races was a more common practice. Soil chemical analysis of samples from the fill of the race may ultimately provide further evidence for this hypothesis.

In terms of refuse disposal, trash produced by the occupants of the Huber house was disposed of on the grounds surrounding the building, appearing to cluster outside windows and doors in the common pattern. Several small trash pits showing deliberate disposal of items were found within five to ten feet of the exterior walls of the building.

The above is a illustration of how a building, whose ghost foundation was discovered adjacent to the furnace race, may have looked.

Excavations also revealed the unexpected discovery of the foundation trenches of a building and an associated fireplace hearth directly adjacent to the furnace race. The location produced a strong domestic artifact scatter including window glass and numerous ceramic fragments, as well as charcoal flecking in the soil. It appears this was a wood-framed building with a large stone fireplace, and the southerly wall of the building built directly on top of the furnace race wall. The artifacts indicated an occupation date from roughly 1780-1840.

The layout of the landscape, including the discovery of the location of the furnace race and an associated building foundation adjacent to it, display clear evidence of a work life and built environment ordered around Germanic, as opposed to English, practice. Unlike settlers of English descent, who tend to locate buildings and activity areas away from water, a significant number of buildings at Elizabeth Furnace were deliberately sited directly on or adjacent to the furnace race.

A total of five buildings, including the charcoal house, stables, a domestic or craft house, and two dwelling houses, were all deliberately sited on the furnace race. It is possible there are more, as yet undiscovered, buildings sited on the race, as well. The overall layout and organization of the built environment is similar to small proto-industrial continental towns, where a more urbanized population concentrated around water sources like furnace or mill races. However, unlike

continental towns and urban areas where land was at a premium, the choice to concentrate these building around the furnace race at Elizabeth was made in the absence of land or population pressures- the furnace was centered on a 2,000 acre tract and land, even in the core area of the property, was hardly scarce.

One of the research issues we immediately encountered at this site was how to identify, explain, and understand differences and similarities between the primarily German immigrants who owned and operated this furnace and the predominantly English broader culture. Questions of assimilation and creolization immediately became significant. The historical and archaeological evidence appears to indicate an interesting mixture of both the retention of Germanic cultural models or practices in certain areas of life, juxtaposed with the adoption of English practices and accommodations to the broader culture in others.

For instance, our initial research indicates that Germanic cultural models informed the organization of work space, the architecture and style of buildings, and the cultural landscape of this village, which was founded and run primarily by German immigrants for the first thirty years of the operation of the furnace. It is likely no accident that the only true Georgian-style building on the property, the Coleman House, is the only building constructed by an English descendant. Alternatively, English material culture appears to have been predominant in the daily lives of the Germanic workers and owners of Elizabeth Furnace during the 18th century, a fact which cannot be explained through issues of transport or local availability alone.

This a Stiegel-period stove plate known as the "Hero" plate. Some historians believe the face to be the likeness of Stiegel himself. Interestingly the text on this plate is in English, not his native German. bone midden is nearly 10ft wide and more than 20ft long.

Hienrich Wilhelm Stiegel gives us an interesting sense of the fluidity of ethnicity and the ways in which at least some German immigrants would emphasize adoption of English practice or manners in some contexts, and yet emphasize their Germanic heritage in others. In the local, primarily German communities of Elizabeth Furnace and Manhiem, Stiegel went to some lengths

to model himself after the nobility of the continental provinces. Locally he encouraged the sobriquet "Baron von Stiegel", emphasizing both his Germanic heritage and his high status in the local community. His personal marching band and the 2,000 English Pounds worth of instruments he owned, even his personal carriage which was reputed to be the largest and most expensive in the county and pulled by a 6-horse team of matching white chargers, all echo the extravagant behaviors of the Germanic nobility of the 18th-century. Yet Stiegel apparently worked quite hard to learn to correspond in grammatically correct English, written in a very clear hand, and he Anglicized his name from Hienrich Wilhelm to Henry William when corresponding with English descendant merchants or his business partners in Philadelphia. The stoves Stiegel produced contained Germanic decorative motifs, yet the inscriptions on them were written in English.

ELIZABETH FURNACE ARTIFACT COLLECTION

The artifacts pictured below were recovered during excavations during the Fall 2005 archaeological field school at Elizabeth Furnace. When excavations at the Huber House (ca. 1746) were initiated, it was discovered that the furnace race, a stone walled channel which provided the high velocity flow of water necessary to power the water-wheel driven furnace bellows, had been originally located within 3 feet of the northeast corner of the Huber House. This waterway was a convenient place for people to dump trash and other waste, resulting in a particularly high density of artifacts. In just three months of excavation the field crew recovered more than 23,000 individual artifacts in this area. Researchers interested in conducting analysis or accessing the artifact database for comparative purposes are encouraged to download the artifact database from this site.

Analysis of this extensive collection is ongoing at Millersville University. Some initial indications of activity and function are already apparent. For example, we have been able to infer an unusual secondary use of the furnace race by the residents of the Elizabeth Furnace village. It appears that people living in and around the village utilized the furnace race for waste disposal. Artifacts recovered from the silt deposited in the channel indicate that chamber pots were emptied into the race regularly, presumably so that their contents could be flushed down-steam. In all, more than ten nearly complete chamber pots were found in the excavated section of the furnace race, as well as the rims and bases of several less complete examples. The density of chamber pots in this small area, and fact that the vessels were still largely intact, support the conclusion that this channel was a dumping ground for human waste as well as trash. This is just a simple example of how artifact analysis can contribute to our understanding of daily life at the site and the behaviors and practices of the people who lived and worked there.

ELIZABETH FURNACE CONSERVED METALS

Metal artifacts can be among the most interesting and unique items you recover from a site, however they also tend to be fragile and extremely delicate. Now most people would not think that a 1/2 inch thick piece of stove plate could be delicate, but they would be wrong. Apart from bone, shell, textile, and paper artifacts, which pose conservation challenges in their own right, metal artifacts are among the most difficult to conserve. Metals unlike other artifacts tend to corrode. Corrosion is the process of the metal's surface oxidizing. When metal is exposed to oxygen for any length of time, it begins to corrode. Thankfully, buried metal experiences this corrosion at a much slower rate due to the lack of exposure to oxygen. The true challenge begins once the metal is removed from the ground and exposed to air, which begins the corrosion process. For example in the case of iron, it begins to rust more rapidly when exposed to air. This is a big problem for us as conservators, for the more an artifact corrodes, the more of the original material of the artifact is loss. Therefore, we do everything in our power to reverse and prevent corrosion. Another difficultly in dealing with metals removing the dissolved salts in the artifact. Mineral salts that dissolve in water find their way into metal artifacts as rainwater and snow sink into the ground. These salts are not a problem so long as the artifact remains buried in a stable environment. Again, the difficulty arises once we remove the artifact from the soil. As the water that has worked its way inside the metal slowly evaporates, the minerals that were dissolved in it are left or deposited inside the metal. As the water evaporates the salt begin to crystallize expanding little cracks in the metal as they grow, weakening the artifact. Thus to ensure that a metal artifact is completely stable we must deal with the corrosion and salts.

The removal of the salts is a slow but simple process that works on the principle of diffusion. The metal artifact that is full of salt crystals is placed in a bath of distilled water. Since the distilled water has no salt, the water inside the artifact that contains salt will allow some of the salt to flow out of the metal and into the distilled water where the density of dissolved salt is less. The idea is that water will see to establish equilibrium, that is to say a constant level of salinity that is the same for both the metal and the water. The salinity of the water is measured periodically and when it gets above 100ppm, the water is dumped and replaced with fresh distilled water and the process is repeated. This is a lengthy process that often takes weeks to complete, but gradually the salt is leeched out of the metal.

The next challenge is to reverse the corrosion on the metal. To do this you essentially need to de-oxify the metal or reverse oxidize the metal. To do this you must break rust (FeO2) into (Fe and O2) so that only the base metal Fe is left. To do this we use a process call electrolytic reduction in which the oxidation or rust on one artifact is transferred to another piece of metal. The metal is put in a tank of 5% solution of sodium bicarbonate and electricity is passed through the artifact. The artifact is attached to the positive side and the piece of metal that is to receive the artifacts rust is placed on the negative side. The electricity breaks the bonds between the oxygen and the iron

allowing the oxygen to bond with other oxygen molecules or the carbon atoms in the sodium bicarbonate solution, producing little bubbles. These newly formed molecules are attracted to the negative plate, where they oxidize the metal. This process also can take several weeks, but is often quite successful in restoring surface detail to metal artifacts.

Once the metal has been stabilized, we take measures to ensure that they will not deteriorate again. We paint each artifact with a 20% solution of tannic acid which inhibits corrosion from forming. Then, just to be safe, we dip the artifact in a microcrystalline wax, which prevents the artifact from ever coming in contact with oxygen again. Below are some examples of artifacts we have treated in the manner described in the preceding paragraphs.

MYLIN GUN SHOP

ARCHAEOLOGICAL EXCAVATIONS 2006

ARCHAEOLOGICAL EXCAVATIONS 2006

The 2006 field season centered on three tasks: testing previously unexplored sections of the core area of the property, excavating the well located in front of the Stiegel mansion, and excavating the large midden feature discovered behind the Stiegel mansion adjacent to the Hessian barracks. Testing was begun during the summer of 2006, while the well project and the midden excavation were completed during the Fall of 2006 during the Millersville Archaeological Field School.

Field school students screening soil from test units in the core area of Elizabeth Furnace.

One of the overarching project goals at Elizabeth is a thorough testing of potentially archaeologically significant areas in the core of Elizabeth Furnace village. During 2006, several areas were tested, the preferred methodology being excavation of 3' x 3' excavation units, aligned to our site grid, and dispersed geographically so that maximum coverage of the site was achieved. The irregularity of the locations of buildings and numerous trees growing on the property precluded any standardized testing interval being used, and units were sited based primarily on the availability of open ground. Testing was conducted in five areas of the property, and revealed widespread subsurface disturbance since the 18th century. The yard area to behind the Coleman and Stiegel mansions (to the west) was tested using 3' x 3' and 5' x 5' units. This testing identified the presence of the bone midden, discussed later. Additional testing to the South of the Coleman mansion and to the east of the Huber house revealed no intact deposits dating to the 18th century,

and a widespread near-surface disturbance of soils layers, as 18th-century ceramics were commonly found in context with mid-20th century items. Test units in the location of the original store, approximately 250' east of the Coleman mansion, revealed that 20th-century grading activity had stripped the deposits in this area down to subsoil, and a five foot deep layer of cullet (a glassy waste product from the furnace) had been graded over the top of the area. Finally, the ground in front of the Hessian barracks (to the north of the building) was found also to have been disturbed.

The depth of the well was near 45ft, which meant that the only way down was by rope. This well head was constructed to safely raise and lower people and equipment in and out of the well.

The well excavation was initiated by the discovery that a concrete cap sealed what appeared to be an old, dry-lain rock well just 20 feet beyond the front door of the Stiegel mansion. The possibility that this well dated to the 18th-century led project investigators to undertake excavation, despite the fact that the well was very deep, with archaeological sediments starting at a depth of 40 feet below ground level. Additionally, it was still an active well at the time of excavation, with a water column more than 23 feet high, containing an estimated 3,300 gallons of water within the well-shaft. The seepage rate of the well was estimated at around 50 gallons per hour, so after a two-day hiatus from the site, the well would have filled with roughly 15 feet of water. The technical problems that had to be overcome to conduct this excavation led to the development of several innovative approaches to excavation, which will be the subject of a forthcoming journal article. It will suffice to say that our approach was highly successful in overcoming these technical difficulties, but the well wound up dating to the late 19th-century, much to our disappointment.

This bone midden is nearly 10ft wide and more than 20ft long. This bone midden is located behind the Hessian Barracks and the Summer Kitchen. The fact that the bones were cracked and not butched indicates that the cuts of meat were boiled in stews, common practice in communal food production.

The final area investigated during 2006 was a midden feature discovered adjacent to the Hessian barracks and to the rear of the Stiegel mansion. This feature proved to be an exceptionally rich bone midden, filled with the discard from food production in the summer kitchen. An estimated 500 individual bones were uncovered in-situ, providing archaeologists with an invaluable view of foodways and diet at this furnace during the late 18th and early 19th centuries. Many of the bones showed fractures indicating that they were deliberately shattered to open the marrow, and we believe that this is an indication they were being used as soup bones. It appears that a favored way of feeding furnace workers was with industrial-sized meat stews, and that many of these bones represent the remnants of such stews. The assemblage contained almost exclusively cow and pig bones, and further analysis will be conducted to determine the quality and cuts of meat used. Initial study suggests that many low-quality pieces were used, as jawbones and pelvises were ubiquitous throughout the assemblage. Artifact dates at the base of the layer, including English white salt-glazed creamware ceramics, suggest an initial date for the pit of around 1760-1770, while the top of the layer contained a few scattered fragments of Whiteware, indicating that the pit lay open until at least 1830.

ARCHAEOLOGICAL EXCAVATIONS 2007

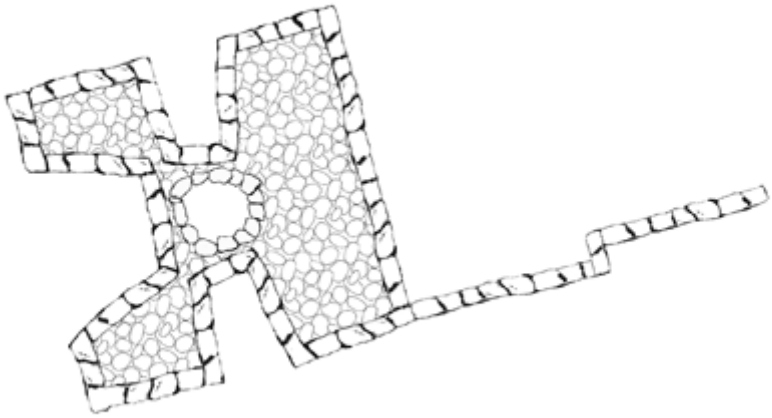
ARCHAEOLOGICAL EXCAVATIONS 2007

This arch, original though to be the main casting arch, was determined to be a tuyere arch. This is where the pipe carrying air from the bellows would have entered the furnace. The main casting arch is located in the trench on the left.

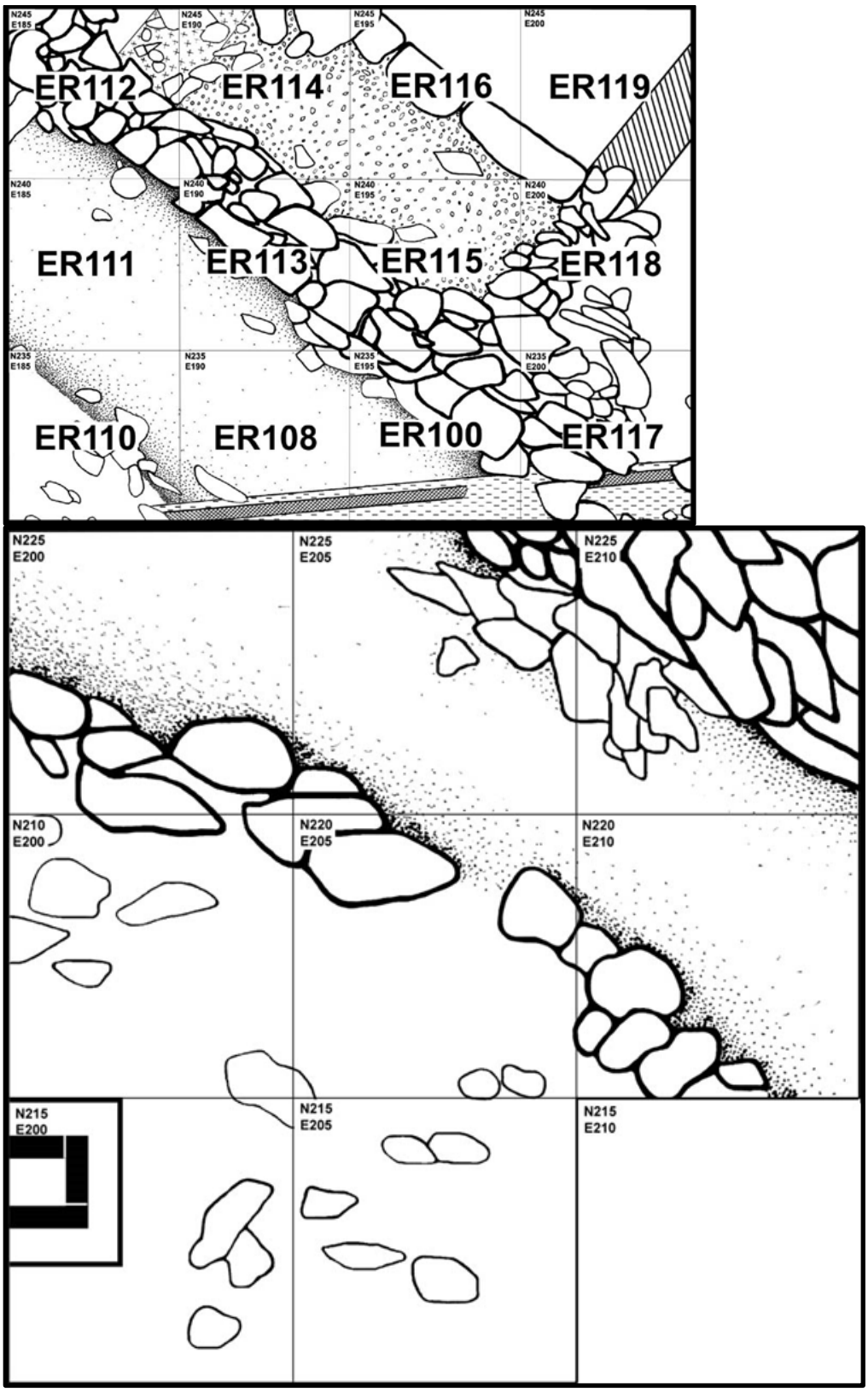
Initial excavation at Elizabeth Furnace revealed an archway that was originally thought to have been the main casting arch of the furnace. This past years excavations around the furnace have revealed that much that was previously thought about the structure of Elizabeth Furnace was incorrect. Traditionally the furnace has been drawn with the main casting arch at the base of the hill down slope from the charcoal barn. In fact the main casting arch was on the southern side of the furnace near the road, and the arch discovered during the first year of testing was a tuyere arch. The main casting arch of was discovered at the very end of the Fall 2007 field school, nearly five feet below ground. The main casting arch is more than twice as wide as the tuyere arch, comprising nearly the whole south side of the furnace.

The tail race tunnel discovered during fall excavations. It had a vaulted or arched ceiling and was large enough for a person to crawl inside.

Another exciting discovery made late in the fall of 2007 was the discovery of a nearly 100ft long stone arch vaulted tail race, the part of the furnace race that carried water away from the waterwheel after it was used to power the bellows. Testing in the area was conducted to determine the nature of an anomaly visible on the 2006 GPR survey conducted within the furnace core area. This sub surface anomaly was thought to be the continuation of the furnace race, but we never expected to discover a vaulted stone tunnel nearly 100ft long and perfectly preserved. It is so well preserved that it still carries water, although it has silted up substantially since it was initially constructed. It was likely abandoned in the 1850's when the water wheel used to power the bellows was replaced with a steam engine. In short, the excavations in the fall of 2007 answered many questions about the layout of the furnace and have indicated areas, such as the casting house floor, that are worthy and in need of further attention in the coming years.



This is a plan view drawing of the structure of Elizabeth Furnace, based on all available data. Revisions and additions will follow as excavations progress.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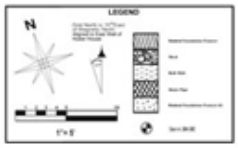
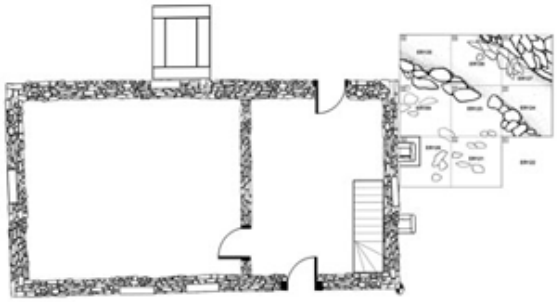
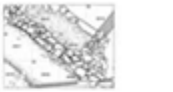
Elizabeth Furnace Plantation:
Huber House Excavations
Fall 2005

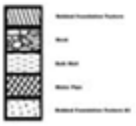






N Grid North

N True North



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