HISTORIC BLACKSMITH
BLACKSMITH SHOP INTERPRETIVE INFORMATION

The blacksmith shop at Carriage Hill represents a farm shop that would be used to repair implements and make ordinary repair tools around the farm. Henry Arnold, the head of the household a century ago, characterized himself as being a "natural mechanic and farmer" and undoubtedly had more than the usual abilities as a mechanic and probably as a blacksmith. The very fact that separate buildings were used for woodworking and for blacksmithing indicates that there was more than ordinary interest in the two activities.

Henry Arnold, according to his grandchildren, was always more interested in his mechanical pursuits than he was the farming, although most of his income came from farming. He was interested in and purchased the more innovative farm implements.

Although our purpose is not to recreate the lives of the Arnolds, we do use them as a guide to how at least one conservative farm family lived. It is our job as interpreters to relate each farm, household and craft activity to the overall lifestyle of a late 19th century conservative farm family.

The size, appearance and location of the shop were dictated by family recollections. It would appear that a wagon or piece of machinery could have been stored there awaiting repairs. Diary entries indicate that both wagon and steam engine repairs were done there, however, most entries just say, "I worked some in the smith shop."

The following article was provided by Charlie Wiltrout, volunteer with Five Rivers MetroParks.

Spend a few hours in the blacksmith shop and you will hear several standard comments from visitors:

"This is where they made all the metal things they needed because they couldn't just go to the
store."

"This is the blacksmith; he makes horseshoes."

The truth is that the Arnolds did not make all the metal things they needed, and Henry's diary indicates that they had their horses shod by blacksmiths in the area within a few miles of the farm.

The shop at the farm was a farm shop not a production shop. The shop did not utilize a full-time smith making items for sale. It was used by the Arnolds as needed primarily for repairing tools, implements, etc. It would not have been used every day, and due to the relatively simple lifestyle of the German Baptists, they would not have made fancy decorative items. They also would not have spent time making labor intensive iron items that they could easily buy at a hardware store. For example, why would they go through the tedious time-consuming job of making nails by hand when they could buy a pound of machine nails for a few pennies? (There were nail making machines patented as early as 1790.)

Probably most reasonably sized farms of the time had some kind of "blacksmith shop" somewhere on the farm even if it was just a corner of a wagon shed. The farmer needed a place to repair a broken mower blade, sharpen a pickaxe or make an occasional simple gate hook, bracket or brace. (The iron wall braces on the wall of the family cemetery at Carriage Hill were probably made at the shop on the farm.

An ad in a 1902 Sears catalog for blacksmith tools says:

"Buy your own tools, do your own work and save money. Sharpen the plows, shoe the horses, set the loose tires, and mend the machinery. With an outfit selected from this list every farmer, ranchman and mechanic can be his own blacksmith. No delay for repairs in the busy season while the team and a man have gone to the blacksmith shop. Again, if you have an outfit, you will improve rainy days to fix up things that are showing wear and avoid costly vexations and dangerous breakages in a busy time."

An "outfit" consisting of a metal forge, an anvil, a vice, a post drill, a couple of hammers and a couple of pairs of tongs could be purchased from Sears in the 1902 catalog for $25.00. Since the Arnolds had a sawmill, and Henry had a fondness for machinery and equipment, they probably had lots of things to repair.

> Visit any working farm today and you will find the equivalent of the Arnold's blacksmith shop. The farmer will have some place where he has an oxy acetylene torch, a welder, a vice, some tools and maybe even an old anvil or a piece of railroad rail to use as an anvil. He uses his modern-day blacksmith shop to save time and money to make needed repairs just as the Arnolds did 100 years ago. (C.W)

Not all 19th century farms had blacksmithing capability as evidenced in 31 property appraisals where only 2 listed blacksmith tools. While many farmers exhibited fine mechanical skills, many had to rely on the local blacksmith for support.

The following information pertains to early 19th century ironwork however, most remains applicable to the 1880s. This information was provided from a lecture entitled "Early 19th Century Ironwork" by Thomas Sanders, Fort Snelling, Minnesota.

BASIC BLACKSMITHING
TECHNOLOGICAL TYPES

Additive	**Manipulative**	**Subtractive**
Welding	Drawing	Filing
Brazing	Upsetting	Cutting
Soldering	Spreading	Drilling
Riveting	Bending	Threading
Case hardening	Piercing	
	Hardening	
	Tempering	
	Splitting	
	Welding	
	Swaging	

"Smithing is the art of uniting several lumps of iron into one mass, and of forming any lump or mass of iron into any intended shape." (Nicholson, 1811:260). Blacksmiths unite and form lumps of iron by heat and pressure. In order to form (or forge) and unite (rivet, weld, braze or solder) iron, a blacksmith needs to heat iron to temperatures between 1550- and 2400-degrees Fahrenheit. This is done in a forge fueled by charcoal or coal. For the pressure needed to forge and weld iron, a hammer is struck against an anvil with the heated iron between.

The temperature of iron is controlled and used by the smiths according to the process he is planning to use. He controls the temperature by the length of time he leaves the iron in the fire, the amount of air supplied to the fire, and the size and depth of the fire. Since the subject of our study is the early nineteenth century blacksmith, the different temperatures of heat used here will refer to those used on wrought iron, blister steel, shear and cast steel. The mild steel and tool steel of the late nineteenth and twentieth century smith required the use of different temperatures when working them. The basic heats used by the early nineteenth century smith were a blood red heat, white flame heat and the sparkling or welding heat (Nicholson 1811:265). The blood red heat (1550 degrees Fahrenheit) is used to smooth the surface with a hammer after its shape has been achieved. The white flame heat (2000 degrees Fahrenheit) is used to draw, upset, spread, bend, pierce, cut and split iron. The sparkling heat (2200 2400 degrees Fahrenheit) is used to weld iron.

Blacksmithing includes **additive, subtractive and manipulative technology**. For a list of the basic blacksmithing processes by their type of technology, see Table I.

Listed under **manipulative technology** is drawing, upsetting, spreading, slitting, bending, piercing and hardening and tempering. All manipulative processes alter the form of iron without a significant loss or gain of volume.

Drawing is the reduction of iron or steel by cross sectional area and at the same time increasing its length. This is done by hammer and anvil, either using the face or the peen of the hammer or by using a fuller, hammer and anvil. (For a more detailed description of tools and their use, see the tool section.)

Upsetting or jumping up is the thickening and shortening of iron and steel by driving it into itself with a hammer.

Swaging is a molding process similar to casting except the iron is not melted but softened by heating to a yellow or white heat and formed between two blocks of iron: each having one half of the desired shape. The bottom half is fixed to the anvil in its square hole. The top half is handled. The heated iron is placed between the swages and struck with a hammer.

Spreading is the reduction of iron or steel in thickness while achieving optimum lateral spread at a right angle to the central axis of the bar. This process is done by using the peen of a hammer and anvil. This can also be done using a fuller.

Bending is the changing of the direction of a bar of iron in any of various angles or arc of any degree using a vice, the horn of the anvil, or the corner of the anvil, and a hammer. If the stock is thin enough, pliers or tongs may be used to bend it.

Piercing is driving a punch through iron at a yellow heat. This is done with iron thicker than one eighth of an inch. It can be done cold with iron less than one eighth of an inch. A punch can be of almost any shape. For example, it can be round, square or rectangular. A hole is pierced in iron by driving a punch with a hammer, with the iron placed on the anvil, until it is almost all the way through. Then the iron is turned over and placed on a bolster and the hole is finished by driving the punch through the reverse side. A bolster is a thick plate of iron with various sized holes that is placed on the anvil to finish punching holes.

In order for iron to be **hardened and tempered** it first must have carbon added to make steel. In the early nineteenth century this was done by cementation, either by steel manufacturers or by the smith himself. The cementation process done by the smith was called case hardening and formed a very thin layer of steel on the piece of iron. In the process of case hardening, carbon is added to wrought iron to form a hard skin of steel on its surface. The cementation process done by the steel manufacturers could produce steel with the carbon distributed throughout the piece. Steel has the unique ability to be hardened and tempered. The process is done by heating the piece to a blood red heat (1550 degrees Fahrenheit) and by rapid cooling in water it becomes harder than iron. However, at this point it is so hard it is brittle and must be tempered. It is tempered by slowly reheating the piece until oxidation colors begin to show. These colors begin with yellow at 400 degrees Fahrenheit, brown at 500 degrees Fahrenheit, purple at 550 degrees Fahrenheit, and end with blue at 600 degrees Fahrenheit. Tempering controls the harness of steel. Yellow is the hardest temper but is still too brittle to be used for anything but straight razors. Brown is good for pocketknife edges. Purple is used for blacksmith tools that are to be used on hot metal. Blue is good for cold chisels. A blue temper is the least hard and brittle.

Splitting is the cutting of iron while either hot or cold (best done at a yellow heat) but not completely removing any iron. For example, splitting the end of a bar of iron to form a fork. This can be done with either a hot or cold chisel. A hot chisel has its cutting edge shaped to a 30-degree angle and a cold chisel has a cutting edge shaped to a 60-degree angle.

Welding is the union of two or more pieces by heating them to a white sparkling heat (2200 2400 degrees Fahrenheit) and sprinkling the intended surfaces with flux (borax or sand) to clean the surfaces. Then the pieces are reheated to the sparkling heat and hammered together on the anvil. When a bar of iron is folded back upon itself and welded to increase its size, welding is a manipulative technology.

Additive Technology includes the processes of welding, brazing, soldering, riveting, and case hardening. Additive processes alter the forms of iron by the union of separate pieces of iron into one piece or, as in the process of case hardening, carbon is added to wrought iron to form a hard skin of steel on its surface.

Welding is an additive technology, when two or more separate pieces are combined.

Brazing is joining two or more pieces of iron by the use of brass or copper heated to a fluid state (brass 1900 degrees Fahrenheit, copper 1900 degrees Fahrenheit) in conjunction with its edges to be joined and then allowed to cool slowly. This process is used to repair cast iron (which cannot be forged or welded) and to join iron that is too thin to weld.

Soldering is joining two or more pieces of iron, brass or tin. Solder and the pieces to be joined are heated to approximately 200 degrees Fahrenheit where the solder is reduced to a fluid state. Solder is an alloy of lead and tin.

Riveting is the union of two or more pieces of iron by battering the ends of a pin that has been placed through a hole that passes through both pieces.

Case Hardening is the process by which wrought iron has its surface converted into steel. This is done by packing an iron piece that has been forged into its intended

shape in an iron box filled with vegetable or animal charcoal and kept at an orange heat (1900 degrees Fahrenheit) for an extended time. The longer the time the deeper the steel surface.

Subtractive Technology includes the processes of filing, cutting, drilling, and threading. Subtractive technologies alter the shape of iron by the removal of part of the iron to form the intended shape.

"**Filing** is the operation of cutting or tearing iron into particles or very small parts, called filings, by means of an instrument toothed all over its surface: the instrument itself is called a file" (Nicholson 1811:267).

Cutting is the removal of iron by the use of chisels (either used hot or cold), metal saws or shears.

Drilling is the boring of holes with a spinning bit, which cuts an exact round hole in iron. This is done when an exact round hole is desired in a piece that has acquired its shape and punching would deform it, or the piece is too thick to punch.

Threading is the cutting of spiraling grooves on screws and bolts with a screw plate and the cutting of spiral grooves in a hole in a plate of iron or a nut. Some early l9th century threading devices split thin slivers of metal and bent them to form threads. This type of threading is a manipulative technology.

Historic Blacksmith Safety Instructions

If you are apprehensive about using any equipment, please notify a staff member and ask for assistance.

- The forge is essentially a hearth for heating and working on metal. It usually consists of a firepot, flue and bellows for introducing air.
- The bellows are designed to introduce air gradually into the fire. There are different types of bellows. The type that we use is a hand crank blower that is correct for the time-period.
- Coal will not burn quickly. To start a fire, use kindling or paper to initially get it going. After the fire is started, introduced cooked coal, or coke, will help build the fire up to temperature.
- Flammable materials should not be used in the forge for safety reasons. Paper or kindling is sufficient and anything else flammable should never be used.
- Not all projects will require the same temperature. It all depends on the level of work that will be done and the type of project it is.
- Coke is what is created when bituminous coal is heated and cooked. It has a high carbon content and few impurities. To create coke, coal should be arranged around the fire and dampened with water. It will help start the process the converting the coal itself into coke.
- The fire pot should always be cleaned out before using. Impurities, known as clinkers, can impede air flow in the forge.
- The best way to dampen a fire at the end of the day is to smother it or remove oxygen from it. Pouring water on a hot forge can crack the fire pot. This is due to the high temperatures that the forge burns at.
- There is a fire extinguisher in the blacksmith shop for emergency purposes. It is checked regularly and is behind the forge and clearly marked. In the case of a bigger emergency, call 911 and contact a Five Rivers MetroParks staff member immediately.