

# **Blacksmithing**

## **Background Information**

Synonyms: Ironwork, forge work , forging, smithing

Related fields: Armoring, cutlery, blademaking, metal work, ironmaking, bloomery

Related terms: Farrier, isenschmidt (German), ferronnier (French)

The craft is called blacksmithing in English because iron is known as the black metal. A black oxide coating forms on the surface due to the high heating. If the coating is removed iron has the characteristic silvery color of steel. The word “smite” meaning hit or strike gives the second part of the word. All smiths whether a tinsmith or silversmith, use various hammers to strike and shape the metal.

Blacksmithing is the craft of shaping iron and or steel, which has been heated to a plastic state around 800- 2300 degrees F. In the simplest terms it can be likened to shaping clay or Play-doh by squeezing with a hammer. Iron has been used for 4000 years. There was only one piece of iron in Tutankamen’s tomb, an Etruscan knife. Steel is made from purified iron and is an alloy with 0.5%-2.0% carbon, which allows it to be hardened for cutting tools. Iron can be only minimally hardened. All metals of the period except mercury could be worked by hammering. The major difference is that iron is heated and worked hot while all others are heated, cooled and worked while cold.

Wrought (worked) iron is a mixture of elemental iron and silica from the ore and surrounding rock. The ore is heated to around 2300 degrees F and hammered. The silica melts at 1800-2200 F and is squeezed out of the iron. Some silica remains in the iron and gives it properties unique from all other forms of iron. Wrought iron nearly went out of existence with the advent of the Bessemer converter and reverberatory furnace, which made pure iron in cast form. Casting involves melting the metal to a liquid state and pouring it into molds to cool. Without specialized modern furnaces cast iron cannot be forged. Iron was successfully cast in the late 15<sup>th</sup> century.

A unique property of iron is that it can be welded together, that is two pieces made into one. It can also be brazed which is akin to soldering. Copper or brass, which is a alloy of copper and zinc, are melted onto clean iron at about 1300 F and “glues” the pieces together. It is not as strong but has many uses.

Like many crafts the iron industry soon specialized. Those persons who mined the ore usually did not convert it to iron. Those that made useable lumps or bars of iron from ore sold it to smiths to make into useable items. If there were only one smith in a region he would perform all the fabrication and repair of iron items as well as shoeing of horses and oxen. However, in a populated area, smiths could specialize in his best skill or what was in demand. Platteners made sheets of iron for the armorers. Nailors produced nails and rivets for others. Cutlers bought steel from shops specializing in converting iron into steel.

## Trade Secrets

Most guilds protected their employment by controlling who could work. The apprenticeship tradition helped quality assurance as well as who was allowed to work. Blacksmiths were forbidden to work other metal and vice versa.

Prior to the scientific age, techniques for hardening tools or welding were closely guarded secrets. They all accomplished the same thing by *slightly* different ways. Without access to consistent materials the processes took on a magical and artistic quality which was promoted to enhance the prestige of the craftsman as well as protect the trade secrets. Because everything of the period was handmade no effort was made to enhance that effect as is done today. Hammer marks are a sign of careless workmanship. Indeed, a smooth, often decorated, surface was often the norm. Due to the high cost of metals, most tools were made of wood with only the blade or crucial parts of metal.

## Tools

- The forge- An iron or brick pot to contain the fire.
- Bellows or blower- Devices to blow a steady stream of air into the tuyer (twee yair) which conducts the air into the bottom of the fire. This increases the heat substantially. The blower is a modern mechanical device common after 1860. It is more compact and more easily maintained as well as transported.
- Anvil - any heavy block of iron or stone upon which the iron is laid as it is struck. There are various shapes in use. The shape we know best is the “London pattern” anvil, about 400 years old. Various holes in the top either hold tools or allow a tool to pas though the work without hitting the top. The square hole is the hardie hole , the small round hole is the pritchel hole.
- Tongs - Long handled pliers to hold the hot metal while working and for placing it in and retrieving it from the fire. A multitude of shapes and sizes depending on the piece being worked.
- Hammers- also myriad shapes and sizes depending on the work done
- Hardy or hardie – any tool made to fit the hardie hole, often chisel-like but also specialized to the work.
- Pritchels - punches to pierce the work rather than drill through. They can be any shape, square ,round and oval are most common.
- Fuel or coals - Today bituminous coal is the fuel of choice due to its high heat value and lower cost. Hardwood charcoal is available but expensive. It was the only fuel for centuries.
- Clinker- a mineral inclusion in coal which melts out and can clog the tuyer.
- Saws and drills are period but in cruder form.
- Swedge block - a heavy iron block with many shapes in the surfaces. These are used to shape the iron. Bars can be made round, oval or triangular. Plates can be

dished. Some small swedges are actually hardies and can come as pairs one top and one bottom.

- Fullers- an example of these matched tools. They squeeze the metal from both sides at once. The grooves in a sword or knife blade are made using fullering tools. This is the predecessor of modern drop forging.

## Processes

- Drawing – hammering a bar to make it longer and thinner.
- Upsetting – Thickening a section by striking the end of the bar. Not as easily done. A nail or bolt head is made this way.
- Fullering- making creases in a bar to widen it. The grooves of a blade makes it wider, lighter and stronger.
- Shouldering – abrupt change in the dimension of a bar such as where the tang and blade meet.
- Swedging or drifting ( a hole)- enlarging a hole by displacing the metal rather than removing it. The hole in a hammer head is made this way.
- Punching – piercing metal with a punch. Very little metal is removed this way.
- Riveting – joining pieces with a rivet, which acts like our modern bolt and nut.
- Collaring – joining bars by wrapping with a small strap. Gates and grills are often made this way. The collars can be made decorative.
- Twisting – a decorative treatment of a bar

## Costs of Tools and Materials

**Tools:** All of the tools can be purchased new and are quite expensive. Expect \$28 for simple tongs and around \$2-\$5 per pound for quality anvils and swedges. Many tools can be found at farm auctions. Common substitutes are acceptable, eg. pliers instead of expensive tongs. Any heavy iron or steel block can function as an anvil

**Coal:** smithing grade- \$25-\$35 per 75# bag Any grade can work to start.

## Resources

*Books:*

Andrew Weygers, The Complete Modern Blacksmith ISBN: 0898158966

Alex Beeler, New Edge of the Anvil 1879535092

*Webpages:*

**<http://www.abana.org/>** The Artist Blacksmith's Association of North America

*Trade journals:*

The Artist Blacksmith's Association of North America (ABANA), "The Anvils Ring"  
<http://www.abana.org/membership/publications/index.shtml>

*Other resources:*

**The Upper Midwest Blacksmiths Association (UMBA)** often hosts workshops in all levels of smithing at Centaur Forge in Cedarburg, WI. Their website is currently down, contact ABANA (below).

**The Artist Blacksmith's Association of North America (ABANA)** Central Office, P.O. Box 816, Farmington, GA 30638-0816, (706) 310-1030, (706) 769-7147 fax, Office Hours: 8:30 a.m.- 4:30 p.m. Monday-Friday, EST, [abana@abana.org](mailto:abana@abana.org)

## **Glossary:**

**Burned** - All metals can be burned. Burning is oxidation. Get it hot enough and it will chemically combine with oxygen and burn like a 4<sup>th</sup> of July sparkler.

**Cold** - A relative term depending on the metal and the process. Iron begins to glow dull red at 1000 F. This is too cold. Welding is done at near the burning temperature. 800 is then too cold. Example- cold shut- an incomplete weld.

**Colors** - Without a modern pyrometer the temperature of a metal can be determined by its color or color of the glow. Most of the spectrum is used ranging from 600-2400 F.

**Cutting or Splitting** - Done with chisels when hot or cold or a saw when cold. Hot chisels usually have handles and resemble odd hatchets.

**Damascus steel** - a term which causes confusion. Knives first encountered by Europeans in Syria during the Crusades provide the name. Also- damascened. In modern terms this refers to *pattern welded* steel.

**Flux** - a material used to coat and protect the hot iron from oxidizing at welding heat.

**Forge, to forge or forging** - Shaping metal by striking it.

**Hardening** - Relatively quick cooling of steel from an optimal temperature. The cooling medium, usually water or oil, determines the speed of cooling.

**Pattern welded** - welded layers of higher and lesser quality steel to create a more homogenous piece with properties of hardenability and flexibility. Often quite decorative. Japanese and Norse blades are known for this.

**Splitting or Cutting** - Done with chisels when hot or cold or a saw when cold. Hot chisels usually have handles and resemble odd hatchets.

**Tempering** - Annealing or softening of a metal to prevent it from fracturing.

**Wootz steel** - A cast steel with similar patterning. Javanese kris are made this way. This is possibly what the Crusaders actually encountered.

**Working heat** - Most metals have an optimum temperature for shaping. Widely varying from that range can damage or destroy the metal.

**Wrought or worked** 1. iron worked from its ore by hammering out the impurities at high heat. 2. worked as in "made". Forged as opposed to cast.