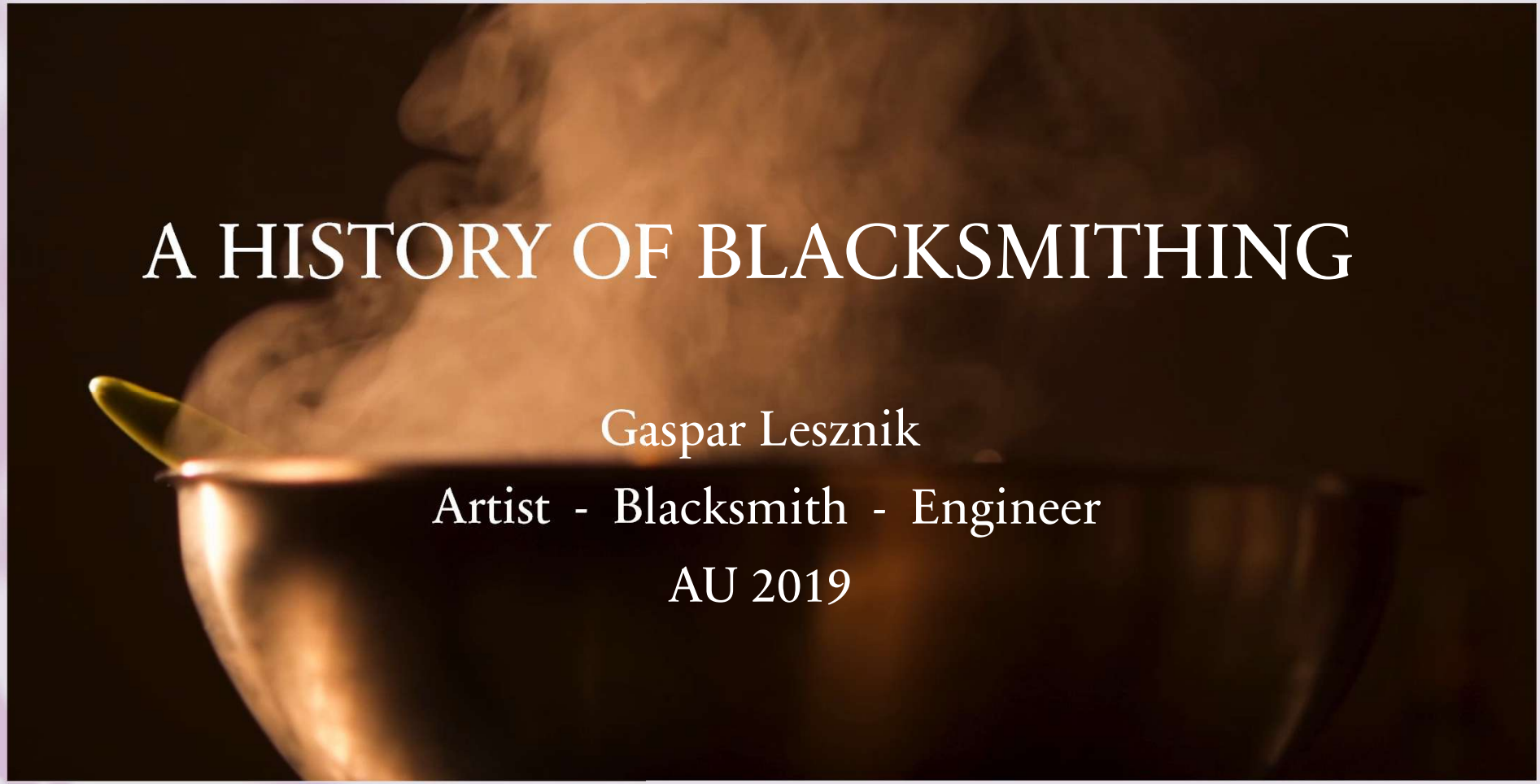


A HISTORY OF BLACKSMITHING

Gaspar Lesznik

Artist - Blacksmith - Engineer

AU 2019

Disclaimer

- I don’t shoe horses.
- Farriers shoe horses.
- All Farriers are Blacksmiths.
- Not all Blacksmiths are Farriers.

Blacksmith = black + smith

Steel, or iron, creates a **black** layer of scale (iron oxide) when heated and exposed to oxygen. Also, hot steel is often coated with oil to help protect it from corrosion. This further blackens the metal.

smith

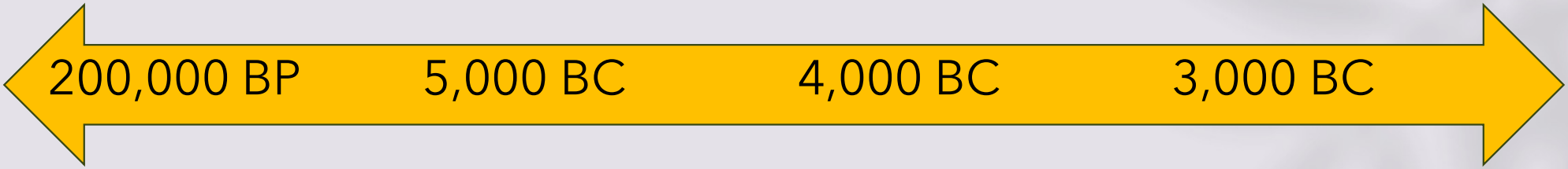
- From the Old English word “smythe” which means “to strike”.
- From the proto-Germanic word “smithaz” which means “skilled worker”

A blacksmith makes tools and other objects out of metal by heating it and using force to bend, twist and otherwise shape the material.

Blacksmiths and the Gods

- Vulcan, son of Jupiter (Roman)
- Hephaestus, son Zeus (Greek)
- Sethlans, fire god of smithing and crafts (Etruscan)
- Ptah, patron god of craftsmen and smiths (ancient Egypt)
- Ikenga, spirit of success and blacksmiths (Igbo - ancient Nigerian)
- Ogun, patron of blacksmiths (Yoruba – African religion)
- Qaynan, patron god of smiths (Sabaean people of pre-Islamic Arabia)
- Ribhus (Hindu)
- Brigid, goddess of blacksmithing (Celtic)
- Gofannon, god of blacksmithing and ale (Welsh)
- Kothar-wa-Khasis, patron got of metalworking (Ugaritic)
- Tlepsh, god of smithing (Circassian)
- Ilmarinen, god of blacksmithing (Finnish)
- Hadur, god of metalworking and war (Hungarian)
- Brokkr, one who works with metal fragments (Nordic)
- Kudalaegon, god of blacksmiths (Ossetian)
- Svarog, god of the forge (Slavic)
- Kagu-tsuchi, patron god of blacksmiths (Japanese)
- Ba Kim, goddess of metal and blacksmithing (Viet Nam)
- Goibniu god of blacksmithing (Irish)

Stone Age



- **Pre-history**
- **Early man tames fire**
- **Wheel**
- **Simple machines**

- **Prehistoric art**
- **Stone Tools**
- **Agriculture**
- **Early writing**
- **Copper usage**
- **Domestication of animals**

- **Earliest iron artifacts**
  - **Ornamental Beads**
  - **Meteor iron-nickel**
  - **Copper smelting**

- **Metalsmithing emerges**
- **Cold working with stone and bone tools**
- **Soft elements**
  - **Gold**
  - **Silver**
  - **Copper**
  - **Lead**

Fun Facts !!

Fun Facts !!

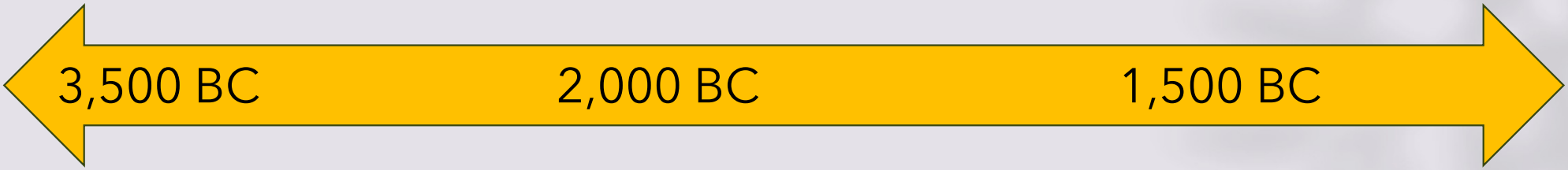
Fun Facts !!

- **Melting points of common metals:**
  - **Tin** 449.5 F
  - **Lead** 621.4 F
  - **Silver** 1,763.2 F
  - **Gold** 1,947.5 F
  - **Copper** 1,984.3 F
  - **Iron** 2,800.0 F

4,000 BC

500 BC

Bronze Age



- **Smelting of copper and tin to produce bronze developed in separate global regions at different times.**

- **Bronze tools, weapons, armor, ornaments, bowls, containers, urns, other.**

Mesopotamia,
Ancient Greece,
Babylonia

British Isles,
Asia
China

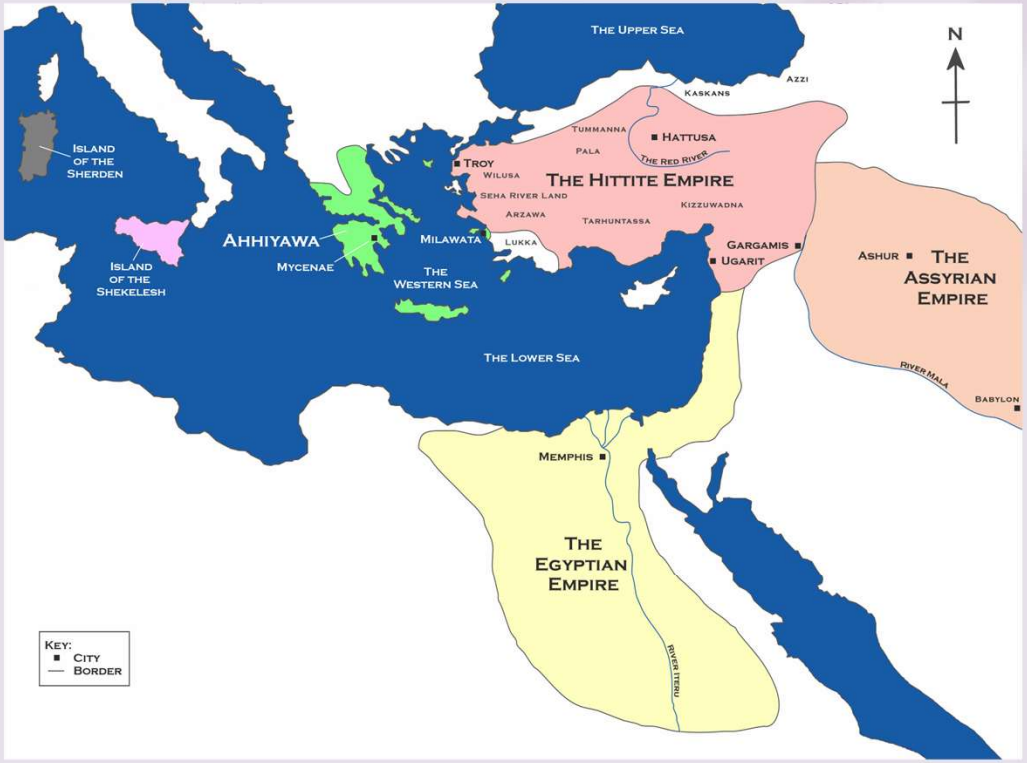
- **Iron making technology starts to emerge.**
- **Hittite Empire**

The Hittites ~ 1,500 BC



- **A warlike people occupying Anatolia in modern day Turkey developed technology to smelt iron ores.**
- **Their weapons, tools, and chariots were far superior to anything available at the time.**
- **Their iron works are believed to be the first in the region and they had a monopoly on these products, which can be found in archaeological digs.**
- **Their knowledge was closely held for the next 300 years allowing them to dominate the region (~1,500 – 1,200 BC).**

Hittite Empire





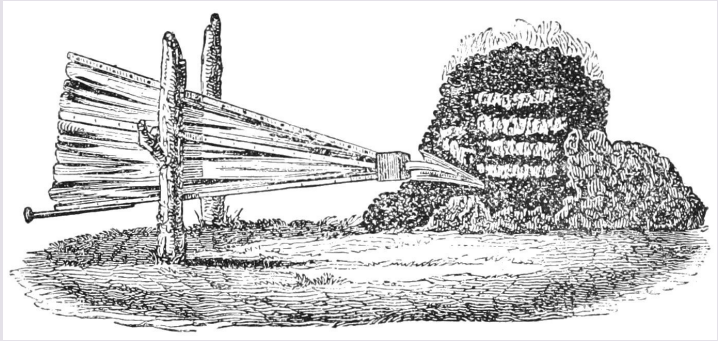
A Hittite Blacksmith



How did they do it?

The **Bloomery** furnace**:**

- Metallurgical furnace used to smelt iron ore.
- Produced a mass of iron and slag called a **bloom**, or sponge iron.
- Long, arduous process. The bloom was reheated multiple times to separate impurities.
- Blacksmiths hammered the mass creating a block of wrought iron.







An Iron Bloom





An Iron Bloom





Iron Age Emerges



- Hittites control iron technology and the market for iron.
- Production could not meet demand.

- Hittite empire starts to decline.
  - Drought
  - Earthquakes
  - Famine
- Invasion from neighboring peoples.
- Hittite people migrate into the Mediterranean, Asia Minor.
- **Iron producing technology spreads**.
- Daily life, farming, pottery, metalworking continued but on a smaller scale.

- Iron production (wrought iron) well established throughout Europe, Asia and sub-Sahara Africa.
- Also, China and India but evolved separately.
- **Roman and Greek** empires start to emerge.
- Blacksmiths thrive.

Iron Age fully established.

Fun Fact !!

Fun Fact !!

Fun Fact !!

- Iron (Fe) – *Latin: ferrum*
  - by mass is the most abundant element on earth, just ahead of oxygen, 32.1% and 30.1% respectively
  - Extracted from ores found on earths crust and surface
  - Melts at ~2,750°F where it is separated from other minerals present
  - Relatively soft and malleable, dense

Forging and Temperature

- Forging is the act of shaping metal with kinetic energy (tools and muscle)
- Heating steel to above it's critical temperature (~1,350°F) changes the crystalline structure of steel making it malleable. A plastic state called austenite. Non-magnetic.
- Forging is typically done between 1,650°F to 1,975°F

- Blacksmiths produce objects such as **weapons**, gates, grilles, railings, light fixtures, furniture, chain, sculpture, tools, agricultural implements, decorative and religious items, cooking utensils, and **more weapons**, and much more.

Blacksmith Equipment - the Forge

- Hearth or forge to heat metal.
  - Target high temperature from 1,700° to 2,300°F.
  - Originally constructed of brick and mortar. Today cast iron, steel, brick and mortar.
  - Must have forced air (oxygen). Bellows, blower, fan, ...
- Fuel
  - Originally wood, charcoal.
  - Today coal. Widely available. Efficient and inexpensive.
  - Propane
- Delivery of air (oxygen) is essential for a hot fire

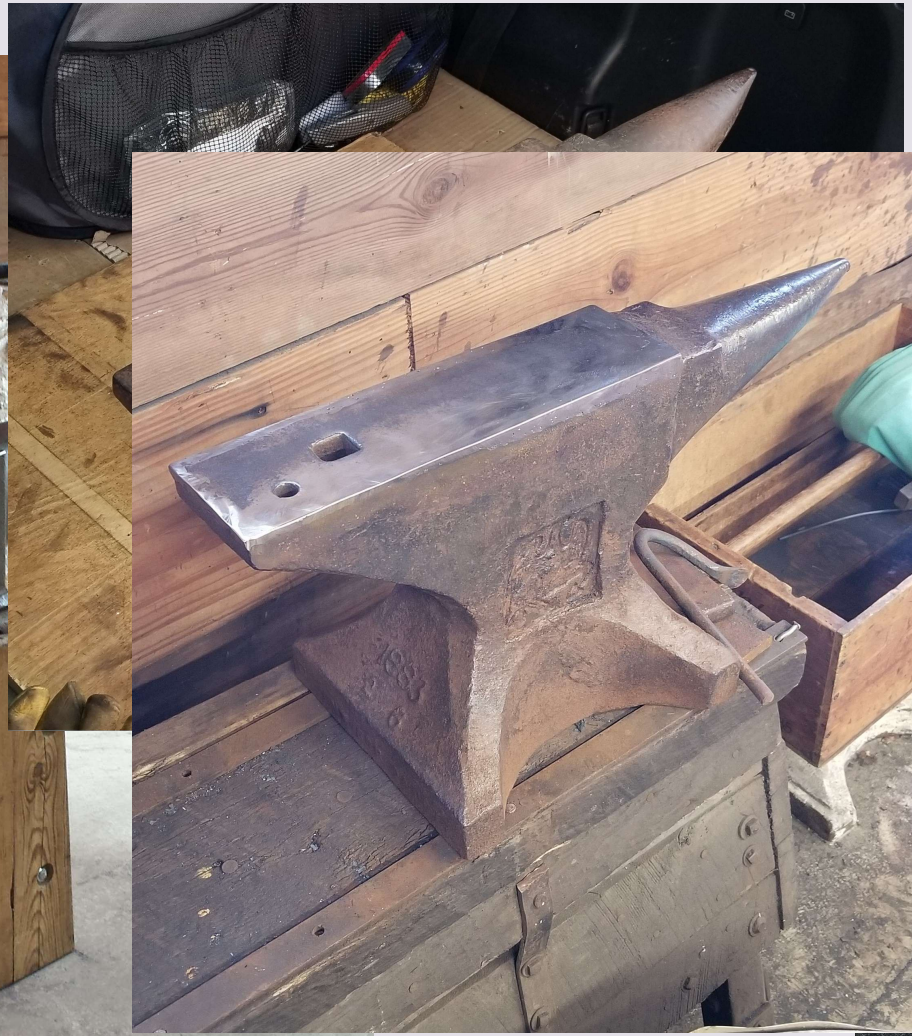




Blacksmith Equipment – the Anvil

- Anvil (the soul of the smithy)
  - Acts as a mold, platform and third hand to shape the metal.
  - Accepts various tooling for cutting, twisting, holding, etc.
  - Must have mass.
  - Any heavy metal block can work to degree.
- Accessories
  - Vice, quench bucket(s), hammers, tongs, punches, chisels, hand tools



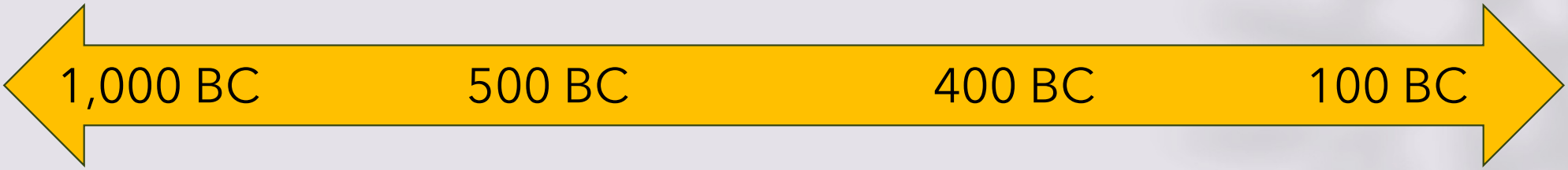





Adobe Stock | #267756410



Notable Ancient Blacksmithing Events



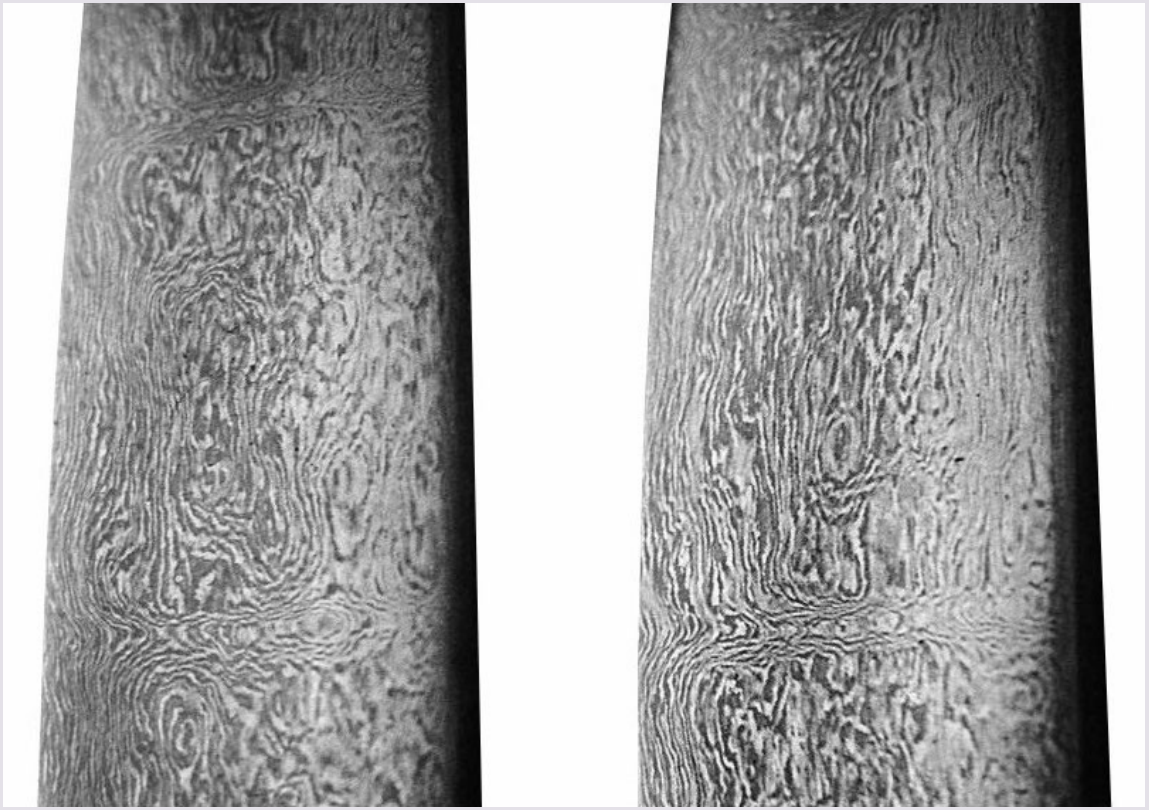
- **Wrought iron** production well known and spreading.
- *Ancient Roman and Greek empires start to emerge.*

- Smiths in Europe start making wrought iron from **pig iron** using finery forges fed with charcoal.
- Evidence of cast iron in China.

- India exporting **wootz** steel to China, Africa, Europe, **Middle East**.

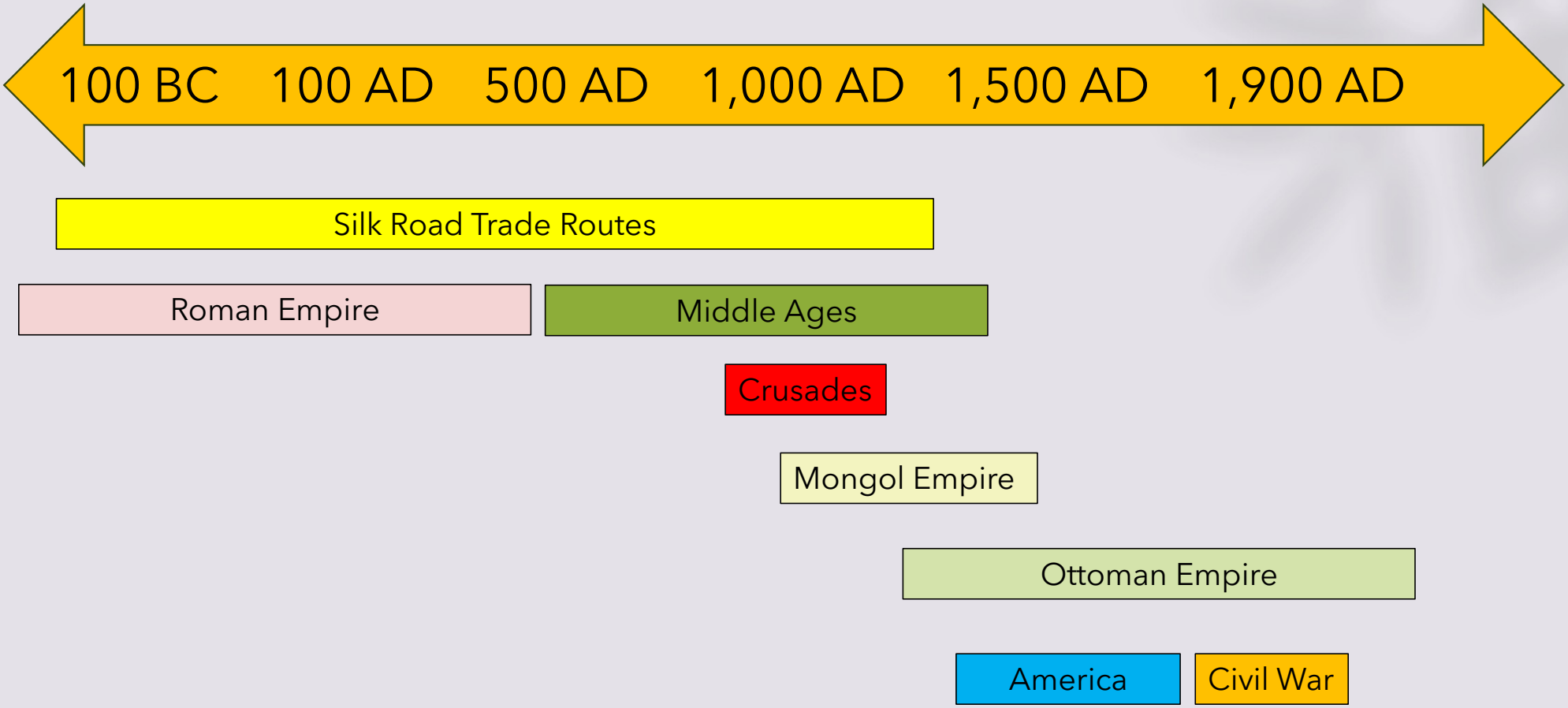
Roman empire subjugates the Greeks ~146 BC.

Wootz Steel and Damascus Blades

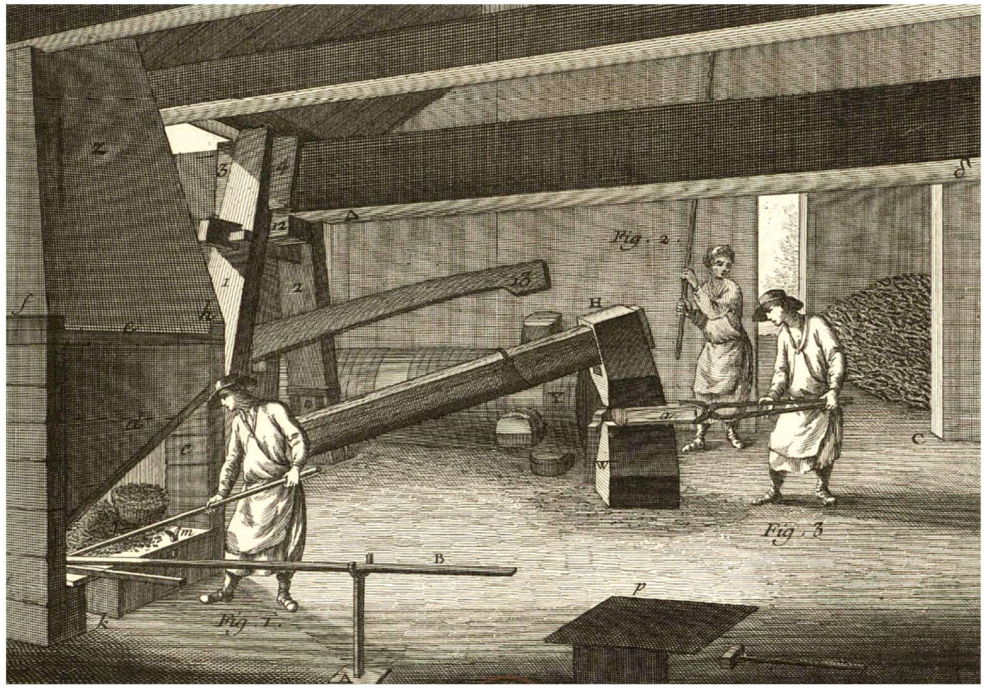




Blacksmithing Thrives During Historic Eras



Middle Ages





Water Wheel Trip Hammer

Viking Age

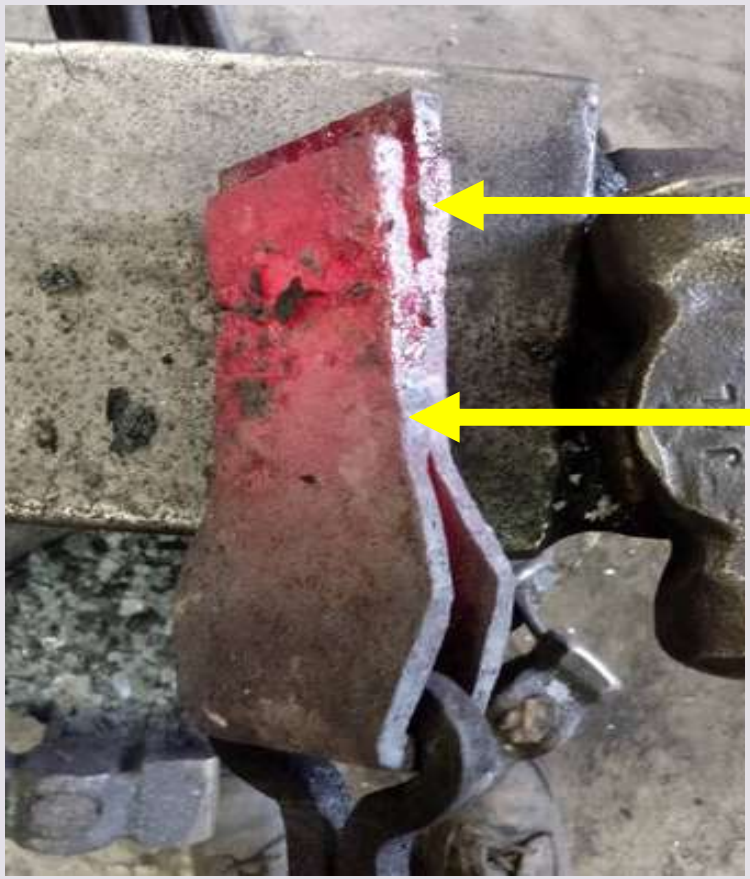
- ~793 to ~1066 AD
- Mastermyr chest, circa 1000 AD found in Sweden
- Over 200 blacksmith tools and works in progress
- Largest find of tools in Europe from that period
- Chain, hammers, small anvils, snips, lock parts
- Many of the tools resemble those from early Roman age

Viking Age





Forge Welded Axe Head



- Tool steel blank
- Mild steel body



Fun Fact !!

- Steel = Fe (~99%) + C (~<1%)
  - Mild (Low Carbon) Steel: C = < 0.25%
    - Inexpensive, the most abundant steel used globally (~90%). It is used in everything that does not require superior strength or durability.
    - Can not be hardened. Can not hold a sharp edge.
    - Piping, fencing, ornamental, wide range of structural applications (bridges)….
  - Medium Carbon Steel: C = 0.25 – 0.55%
    - Can be hardened.
    - Railroad tracks, machinery parts, pressure vessels, cranks…..
  - High Carbon Steel: C = 0.55 – 0.99%
    - Maximum strength and hardness, low ductility.
    - Knives, chisels, punches, spring steel, cutters, ……

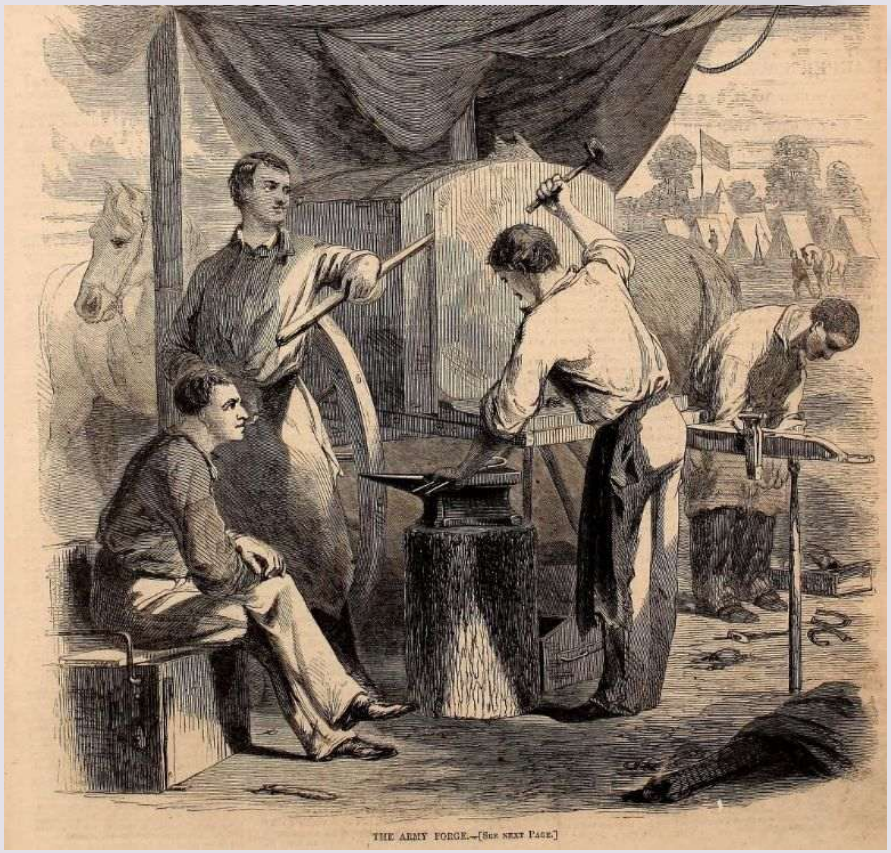
- *Wrought Iron*
  - *An iron alloy with <0.02% carbon and ~2% other impurities (slag)*
  - *Used throughout history but replaced by advanced steelmaking methods*
  - *No longer commercially available, last foundries shut down in the 1970's*

Colonial Period Blacksmith Shop



Civil War Traveling Smithy




THE ARMY FORGE.—[See next Page.]

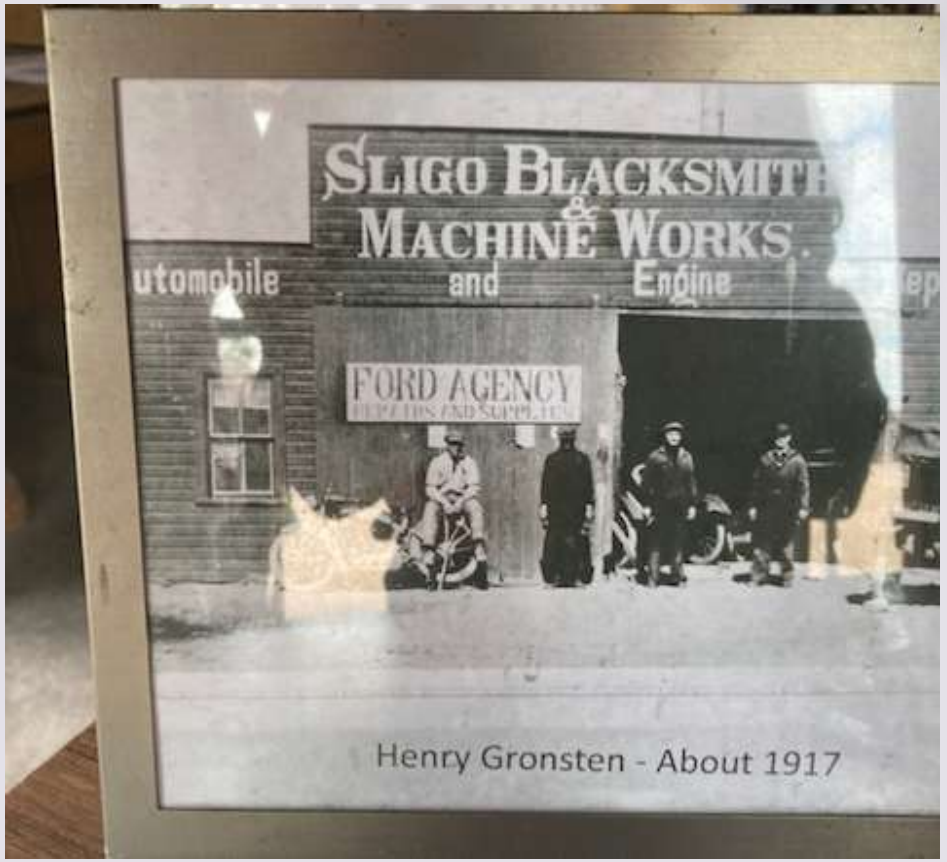
Navy - Civil War

Blacksmiths on deck of USS Leigh, a Passaic class monitor ship.



Evolution – post Industrial Revolution

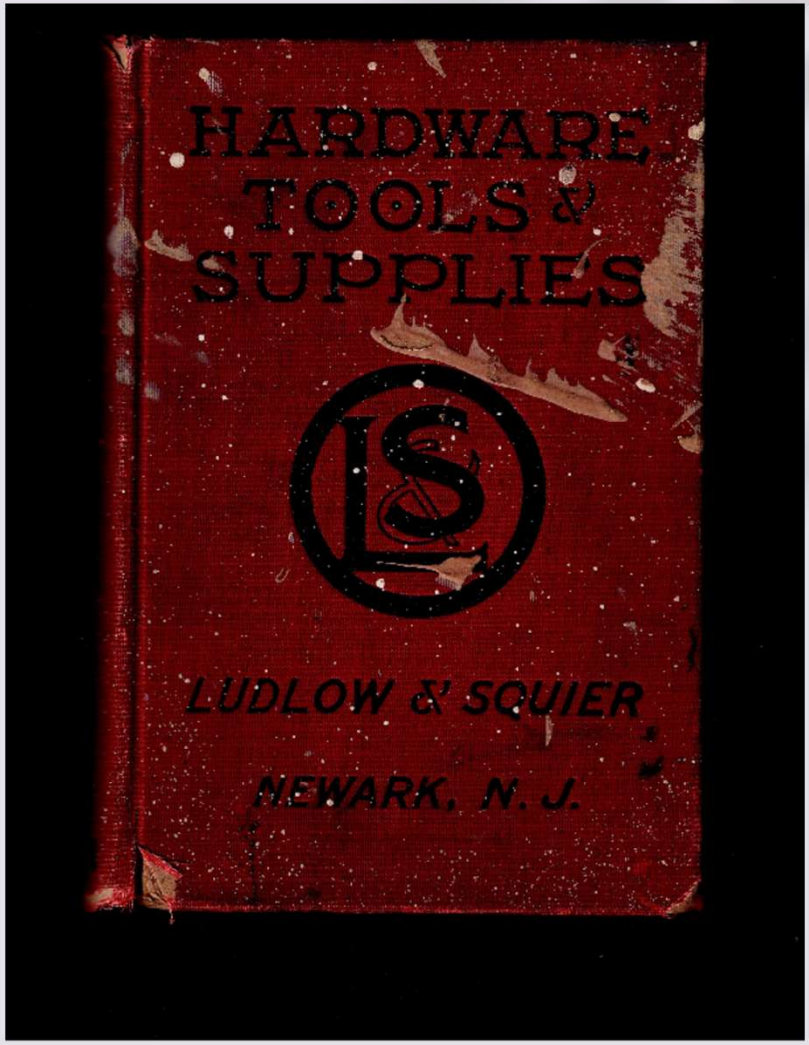
- Ironworkers
- Mechanics
- Pipe-fitting
- Other



Ludlow & Squire
Newark, NJ

Industrial Supply Catalogue
©1919

15 pages dedicated to blacksmith tools



Navy


Photo # NH 102969 Blacksmith shop aboard USS Camden, 1921
BLACKSMITH SHOP, U.S.S. CAMDEN

Navy - WWII

USS Alabama

Full blacksmith shop



Blacksmithing Today

- Alive and well
  - Artistic and ornamental, repair and restoration, farriers
- ABANA - 5,000+ members (US)
  - Most states have a club or association
- U-tube - hundreds of channels
- Anvil and other accessory manufacturing is growing

Fun Fact !!

  - Anvils average $7.50 to $9.00 / lb.

Sculpture











Future ?

- Metamorphic manufacturing aka robotic blacksmithing

Questions?

THANK YOU!