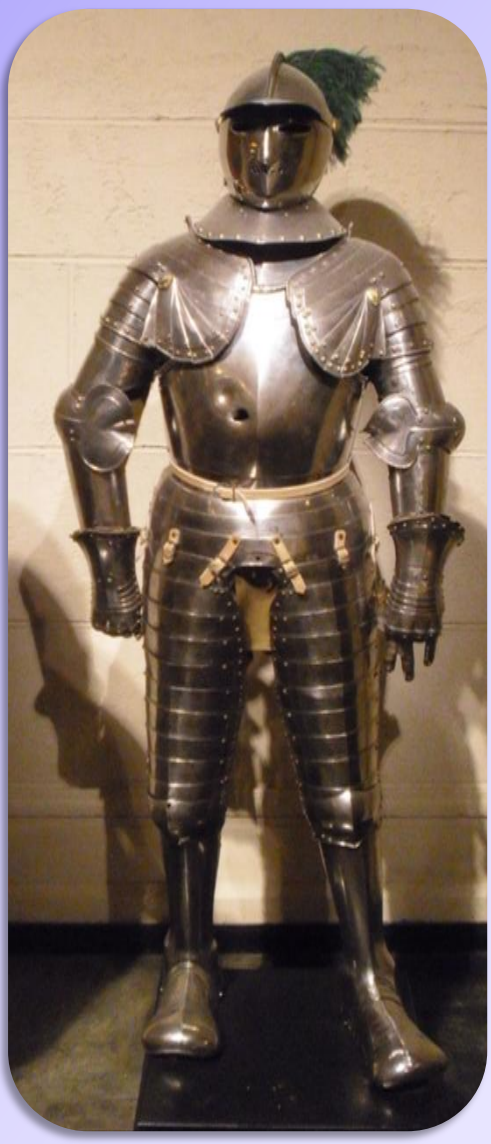
Medieval Metallurgy



Benjamin Davidson

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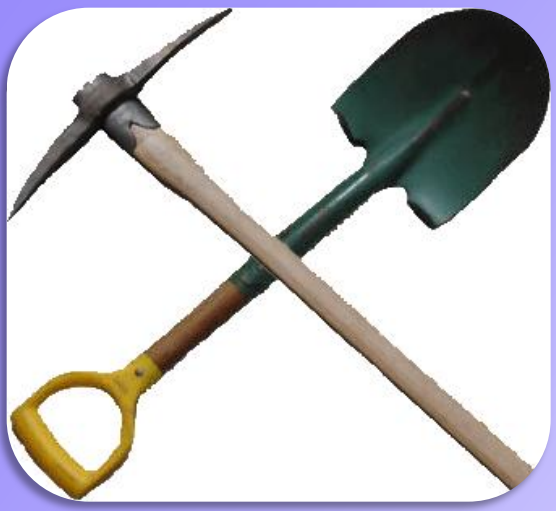


Shovel and mining pick

Medieval miners were workers who used tools to dig ore from the ground. First, they dug into the ground using shovels until they found ore. It was very difficult to find an ore mine. Once a mine was identified, miners used shovels to move the dirt and get to the ore. Then, workers used **mining picks** to break up the rocks around the ore. During this time period, miners focused on mines that were the most accessible. They would often move to another mine instead of digging deeper. Then, the ore was mined out of the rock, transported to be smelted. Although ore forms naturally, it takes millions of years, so when miners extracted all of the ore from a mine, they needed to find a new mine. Because miners worked underground, it is very dangerous. They make wooden support beams to prevent cave-ins. Dangerous gases from deep underground could also be released into the mining shaft. It could also be very dangerous to transport the ore because it was very heavy.

Did You Know?

Cities were often built very close to mines. It is very difficult to transport ore because of its weight and irregular shape, and by building a city close to a mine, ore would not have to be transported as far.

Ore

Ore is made of metal and **mineral** that is found in its natural state under-ground. It comes in numerous shapes and sizes. Craftsmen needed ore to make weapons and armor. The primary material for these craftsmen was iron. In the Middle Ages, ore was always in demand because people needed metal for everyday tools, implements of war, bells, and indicators of social status and wealth. Metal items were very expensive because it took a lot of work to craft them from metal. The metal in ore is not perfectly pure. Based on its mix with rock and other chemicals, ore is classified as oxides, sulfides, or

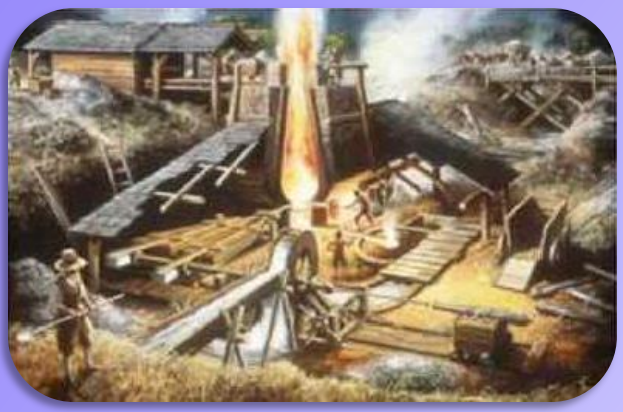
Iron ore

Did You Know?

Ore is also found in different colors! For example, there is dark grey, bright yellow, deep purple, and rusty red iron ore.




Blast Furnaces



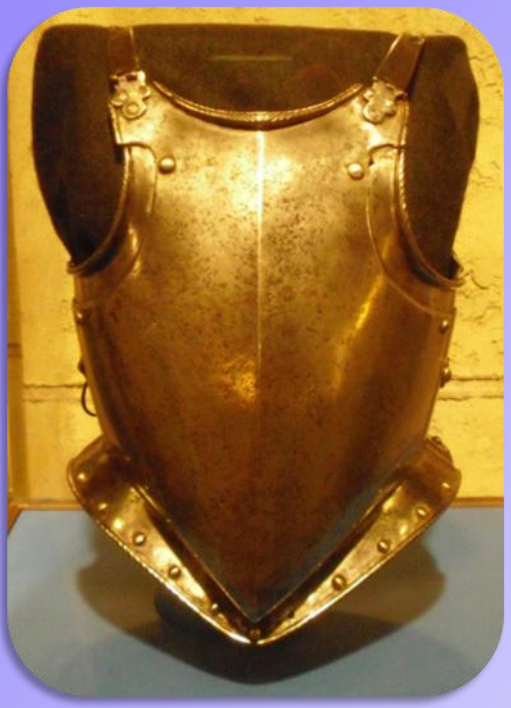
Medieval blast furnace

To obtain metal from ore, medieval people smelted the ore. That is, they heated the ore until it became a liquid and flowed out of the rock. Some ores didn't require that much heat to melt, so large fires were sufficient. Iron, the main ingredient for most medieval metal products, melted at much higher temperatures. To make a fire that could reach such high temperatures, the blast furnace was invented. Early furnaces could only produce small balls of wrought iron. These balls, called **osmonds**, could later be forged together. It is called wrought iron because metallurgists could not remove all of the impurities of the ore. Still, the blast furnace removed more impurities than other smelting methods.

Did You Know?

Water wheels were often used to produce the energy needed for blowing heated air into the furnace. Blast furnaces that were located near the water were much more productive than other blast furnaces.

Bronze Smelting



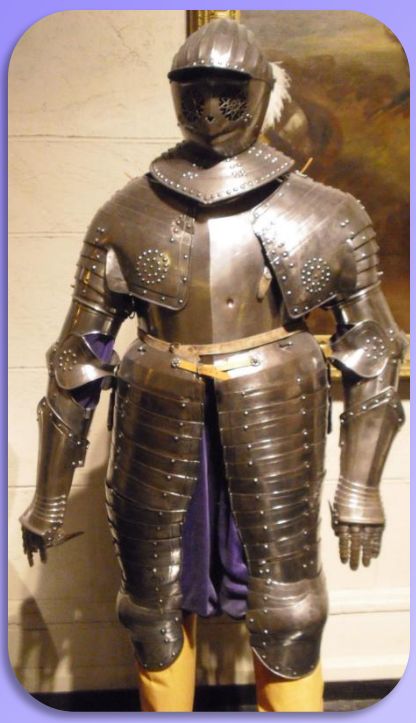
Bronze breastplate

In the medieval period, copper smelting had been around for more than 7000 years. Copper is a very soft metal, so medieval weapon crafters could only make **blunt** weapons such as maces – making copper swords was not an option. Armor crafters found reasonable success with copper armor, but it did not hold up to most weapons. Before steel smelting was discovered, it was better to use stone weapons, which cracked on impact. In order to make copper stronger, smelters added tin to produce bronze. For the first time, soldiers could wield metal weapons that were effective on the battlefield. Also, metal armor became very viable because it protected with ease against other weapons of the time.

Did You Know?

- Because copper was so soft, it was very easy to shape.
- The discovery of the mixture that forms bronze was a mistake.
- Bronze and brass are so similar that they are often called the same thing.

Iron Smelting



Steel armor

Like pure copper, pure iron was relatively soft. Without smelting two metals together to make an **alloy**, it was too soft to use for combat. Metallurgists added various amounts of carbon to iron to make it stronger. Pure carbon came in many forms including diamond and graphite (like the lead in a pencil). Carbon was used because it was cheap and available. Steel is an alloy with iron and approximately 0.2% to 2.14% carbon. Wrought iron, the alloy that was most often used in the medieval times, contained very low percentages of carbon and contained 1% to 3% slag. Wrought iron was easier to forge than steel and was only a little bit weaker.

Did You Know?

Iron and most of its alloys rust. Rust forms when iron is exposed to water and air. A red compound forms and deteriorates the metal. Wrought iron rusts considerably less than steel.

Slag

A 6.5 inch long piece of slag

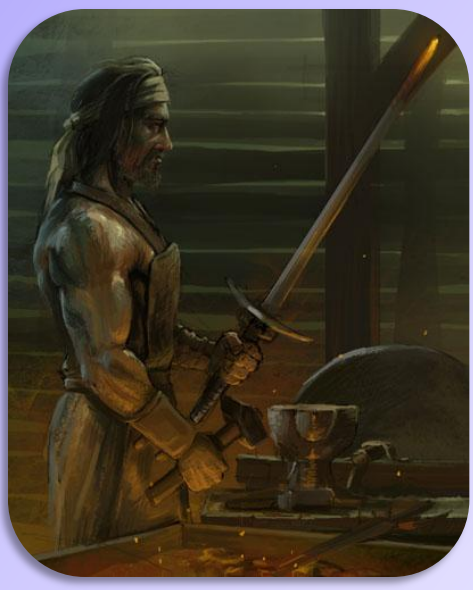
Slag is a by-product of smelting. When ore is smelted, metal and slag are produced. Slag is the impurities, or non-metal parts, of the ore. In the early medieval times, smelters did not have the tools necessary to remove slag and produce pure metal. On the other hand, slag often had beneficial effects. In general, it has a lower melting point than the metal. It will start to melt at a lower temperature, and if slag is mixed with the metal, the entire mixture melts at a lower temperature. This makes the metal easier to forge because forging becomes faster and more efficient. In a mixture of iron and slag, the iron is much less likely to rust.

Did You Know?

After it was separated from impure metals, slag could be used as a fertilizer on nearby farms. This fertilizer made the crops grow better because it added various minerals and nutrients to the soil.

Blacksmithing

A blacksmith is a person who can shape metal by bending, cutting, hammering, and forging. In the medieval period, metal became an indicator of status. If someone had a lot of metal things, he or she was respected much more than someone with fewer. The making of weapons and armor was really important for medieval nations. Without blacksmiths, nations would have less military power. Blacksmiths also made metal fences, horse shoes, and tools. Because they made so many products that many people wanted, the economy of a nation was often controlled by blacksmithing **guilds**.



A blacksmith forging a sword

Did You Know?

Forge welding is the process of heating two pieces of iron so hot that they glow white and then hammering them together to join the two pieces permanently.

Forging

Blacksmiths used various methods to join two pieces of metal together. Forging was successful at cold, warm, and hot temperatures. Metal that was constructed via forging was much stronger than other metal. On a very tiny level, the molecules of the metal are able to form better bonds with other molecules. Because of the exceptional strength of steel and wrought iron, it was always forged hot. The hotter a metal is, the softer is becomes, so it is easier to shape and manipulate. The ease of crafting was a very important thing to consider because custom armor was often made for each knight. If a blacksmith wasn't able to shape the metal efficiently, the armor may not fit properly, so the knight would have a disadvantage in battle.

A blacksmith shaping metal

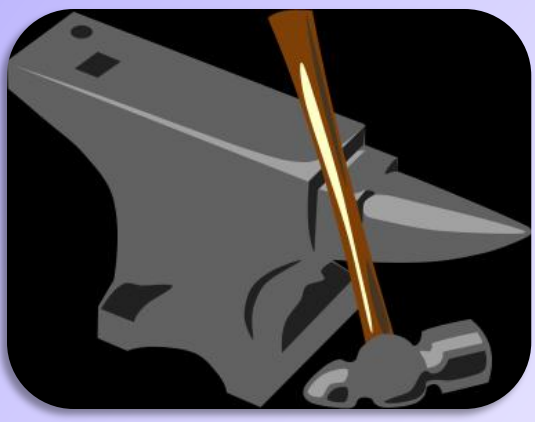
Did You Know?

Blacksmithing was a really tough profession in the medieval era. Blacksmiths needed to be relatively strong in order to use the necessary tools. It was also dangerous because of the extreme heat involved in forging.

Hammer and Anvil

Both the hammer and the anvil are tools necessary for blacksmiths because they were the primary tools that were used. Anvils varied in size and shape. Due to transportation limitations, many blacksmiths crafted their own anvils, especially in the early medieval period. By doing so, the blacksmith could customize his anvil to the specific type of armament or armor that he made.

The hammer, an integral blacksmithing tool, was able to amplify the amount of force that could be applied. Blacksmiths used different sized hammers for different applications. For example, when a blacksmith forged, welded, or shaped a large piece of metal, they would use a heavier, thicker hammer.



Did You Know?

The square hole that you see at the back of the anvil is called a hardy hole. Special tools can be inserted into the hole. Most often, these inserts are used to aid in bending metal.

Word Glossary

Mining pick: Mining picks were used to break up hard rocks. A large, heavy, pointed piece of metal was attached to a long piece of wood. By using it like a hammer, it was easy to break up tough materials.

Mineral: A mineral is a naturally occurring solid that has characteristic physical and chemical properties. In comparison, rocks are not minerals because they do not have a specific chemical composition.

Osmond: An Osmond is a small ball of metal. Before there were large blast furnaces, smelters could only melt small amounts of ore at a time.

Blunt: Blunt is the opposite of sharp. Blunt weapons do not have any pointed edges and harm their opponent with crushing force (rather than piercing force). Examples of blunt weapons are the club and the mace.

Alloy: An alloy is a mixture of one or more metals. An example is bronze– a mixture of copper and tin.

Guild: A guild is a group craftsman of a specific profession. Guilds were created to regulate trade. For example, a blacksmithing guild may choose to sell swords for more money.

Armament: An armament is a weapon.

About the Author

Benjamin Davidson is currently a 17-year-old student in his senior year at the Massachusetts Academy for Mathematics and Science. His education, especially in scientific and technical writing, has qualified him to write a children's book on medieval metallurgy and metal manufacturing. In addition, he is very accustomed to the format and vocabulary of children in the fourth to fifth grade range. Recently, he has written a technical manual for an Automatic Flute Tuning Device, an observation of nature, an experiment involving torque for young children, a chapter about the printing press to be compiled in a book of inventions and their impacts on history, a report involving the fringe science of crop circles, an essay on the volcano, and several other professional works of writing. In addition, he has been very successful with his work for the Massachusetts State Science and Engineering Fair.

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