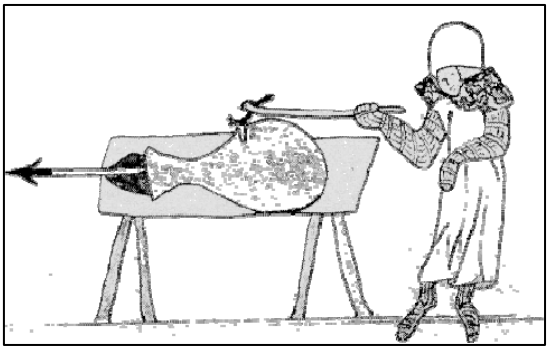
Lesson 2

Student Handout 2—Bells, Buddhas, and Bombards: Military Gunpowder Technology

Gunpowder weapons reached Europe by several pathways across Afroeurasia. This involved both the technology of producing gunpowder to create an explosion and the applied technology to deliver a destructive projectile–bullet, ball, or bomb. European political, geographic, and military conditions favored the development of gunpowder weapons into an efficient, destructive technology. This knowledge contributed to the growth of strong, centralized states and the expansion of overseas empires. Together with other developments, such as improvements in ships and navigation and the expansion of trade, the development of gunpowder weapons changed the nature of warfare in the world.

How did military and technical advances result in gunpowder weapons? A bottle-shaped device designed to shoot an arrow with explosive force was the first documented gunpowder weapon. The bore was narrow, but the metal near the touch-hole, where the explosion took place, was thickened to prevent cracking from the explosion. Examples have been found in both Chinese and European manuscript illustrations from about the late thirteenth and early fourteenth centuries.[8] Historians believe China was the source of the invention, and the Mongols probably spread the idea. Technical advances followed with devastating effects: Europeans built bigger and more powerful guns and learned to aim them against castle and city walls. In one direction of development, gunpowder technology led to large weapons called bombards; they were later known as cannons or artillery. Artisans also invented handheld weapons (handguns) for foot soldiers.



Three elements—the idea, the resources, and the technical knowhow—were the ingredients for advancement of gunpowder weapons

- First, the idea refers to knowledge of how to make weapons and of what they could do. Early gunpowder weapons could frighten mounted cavalry, or they could shoot flaming objects to set things on fire. Two new ideas were using cannons to break down walls and giving foot soldiers and cavalry a new type of weapon that was not simply a sharp object. Cannons and handguns were the result.

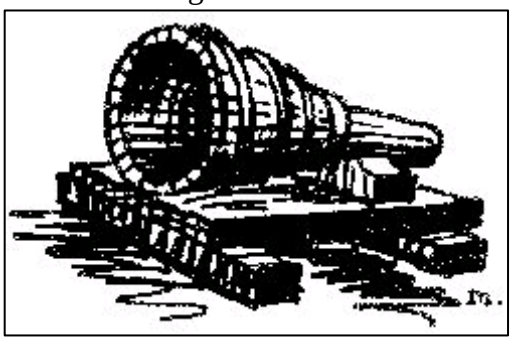
- The second element was access to metal, at first bronze or brass (made by combining copper with other metals) and later iron. Advances in mining technology and local

[8] Johan Verachtert, "Een blik op de buskruitindustrie in de Lage Landen: het buskruit-bedrijf van Maximiliaan en Jacques Blommaert (1738-1798)," http://www.ethesis.net/buskruit/buskruit_deel_I_hfst_4.htm. The image represents an example of an early fourteenth-century cannon, from Walter de Milimete's "Officiis Regum."

availability of the needed metals gave an advantage to some lands over others. Deposits of iron, copper, tin, lead, and nickel were found in Germany, England, France, and elsewhere. Mechanical devices for pumping water out of deep mines spread to Europe by way of Arabic works on mechanical engineering. Using gunpowder explosions to break through rock was another new idea. Metal ingots (cast chunks of purified metal) could be imported, but when large armies began to use large numbers of guns, local access to metals was an important advantage.

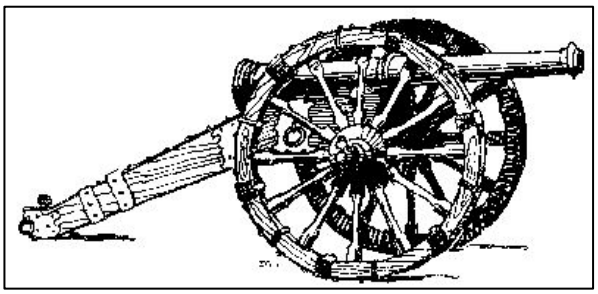
- The third element was the technical skill to cast and forge the barrels of guns and cannons and to make metal bullets and cannonballs. A thick, strong tube closed on one end was needed to contain the explosion of gunpowder in the barrel and direct the projectile out of the other end. Casting large gun barrels required the skill to heat a large amount of metal and create molds that would not break. Interestingly, the ability to cast large metal objects came through the European experience of casting bronze or brass church bells. A cannon, after all, is similar in size and shape to the great bells that rang in the cathedrals being built in many European cities at the time. In China, metalworkers had possessed casting and forging skills for centuries. Japanese metalworkers also had experience with furnaces for casting huge bronze statues of the Buddha, as well as skills in forging fine steel for swords. Steel-making arts in India, Persia, Syria, Spain, and elsewhere helped to spread European advances in the technology of gun-making to many places beyond Europe after gunpowder weapons were introduced.[9]

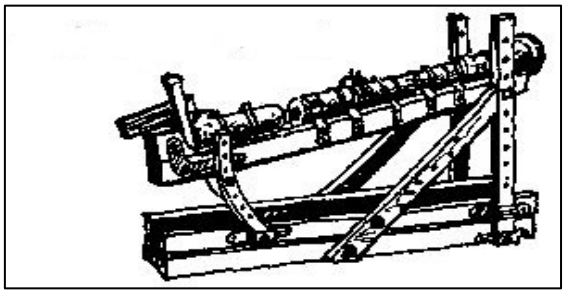
The earliest bombards were stumpy, short tubes that could shoot a stone ball. They were also hard to aim and might explode, killing the gunners who fired them. They were made of iron bars bound with wrought-iron hoops. They rested on a platform, like this illustration from 1330.[10] By 1430, bombards made in Europe were huge. They were 12 to 15 feet long and could fire a stone about 30 inches in diameter. Bombards were so heavy that in major campaigns, the metals might be brought to the battlefield and cast on the spot. The great cannon cast in 1453 by Mehmet the Conqueror, ruler of the Ottoman Turkish empire, was the biggest bombard made to date. It was cast within range of the walls of Constantinople during the siege in which Mehmet took the city from the Christian Byzantine state. Its purpose was to break through heavy walls and allow soldiers to enter the city quickly rather than camping outside the walls and waiting for the people inside to run out of food. In Europe, the king of France defeated the English by bombarding their fortifications. This tactic helped end the Hundred Years' War in 1453, when the English had to surrender most of their possessions on the European continent.



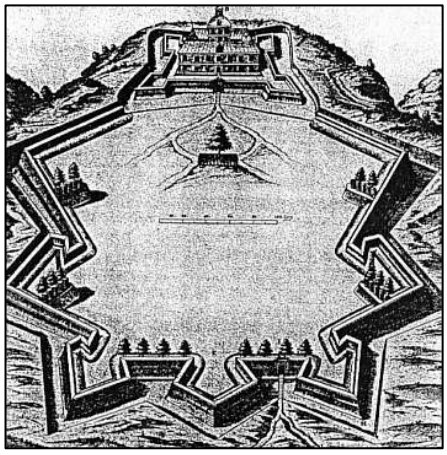
[9] William H. McNeill, *The Age of Gunpowder Empires, 1450-1800* (Washington, DC: American Historical Association, 1989), 4-5.
[10] "The Project Gutenberg EBook of Artillery through the Ages, by Albert Manucy," http://www.gutenberg.org/files/20483/20483-h/20483-h.htm

The king of France and other monarchs used gunpowder weapons to defeat **aristocratic** landowners and bring them under unified control. As gunpowder weapons were used in Europe, an arms race led to improvements and new inventions. Platforms were made adjustable for more accurate aiming, like the fifteenth-century artillery piece on the right.[11] Cannons were set on mobile platforms so they could be moved into place quickly and transported easily. Cannons were made smaller but stronger. Instead of stone balls, smaller cast iron balls proved even better at breaking through stone walls. Smaller guns were loaded onto wooden carriages with wheels like the one on the left, developed by the military expert Gustavus Adolphus in 1630 as "light artillery."[12]





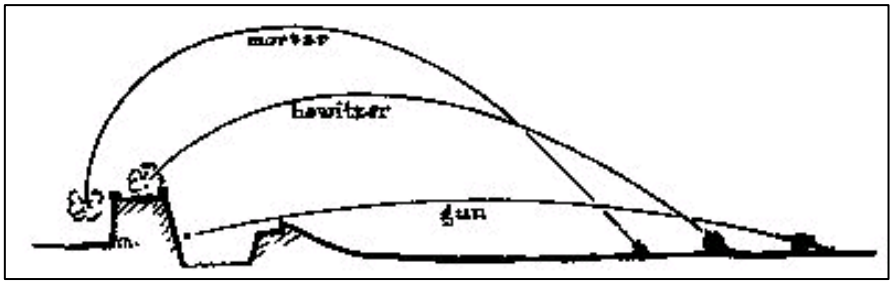
Light guns on wheels tipped the balance of power for a while. A ruler with enough money to own some of these new weapons, together with troops and supplies, was able to defeat lords who challenged the king, or even foreign enemies. The gunners could place mobile cannons on a hill and fire them into the walls of a town or castle. Soldiers then poured into the breach. On the battlefield, artillery explosions could scatter charging cavalry.



As powerful monarchs tried to increase their territory, like Charles VII of France did in 1494 by invading Italy, defenders invented new ways to counter the effects of artillery. For example, in 1500, the commanders of the city of Pisa discovered that if the city's walls were reinforced with earthen banks inside and a big ditch outside, they could absorb the force of cannonballs without harm. Attacking armies were at a disadvantage when they had to navigate a ditch. Defensive cannons placed along star-shaped walls could be aimed in any direction to defend the fortress.[13] This new style of fortifications was called the *trace italienne* (left), and for a while it checked the power of cannons. Nevertheless, the stream of new ideas continued: shells that

[11] The Project Gutenberg EBook of Artillery through the Ages by Albert Manucy, http://www.gutenberg.org/files/20483/20483-h/20483-h.htm
[12] Ibid.
[13] Johan Verachtert, "Een blik op de buskruitindustrie in de Lage Landen: het buskruit-bedrijf van Maximiliaan en Jacques Blommaert (1738-1798)," http://www.ethesis.net/buskruit/buskruit_deel_I_hfst_4.htm

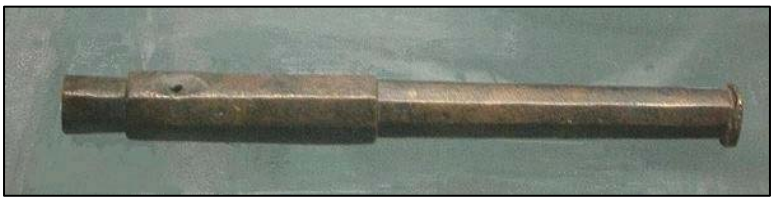
would explode when hurled over walls, new kinds of projectiles, and guns that were easier to aim and less likely to blow up in the face of the gunners.



Offensive artillery and its use in attacking fortifications.

Source: The Project Gutenberg eBook of Artillery through the Ages by Albert Manucy
http://www.gutenberg.org/files/20483/20483-h/20483-h.htm

How did handguns develop?



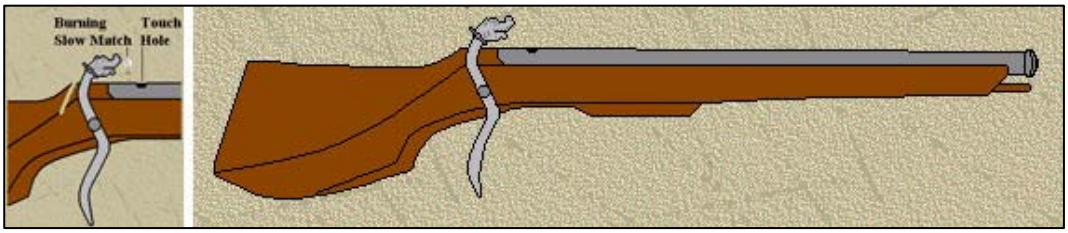
Personal weapons, or handguns, developed from the "fire-stick," a handheld rod of bamboo or wood with a small metal head in the shape of a bulb, open at the narrow end, where the explosive charge exited. The word *gonne* was used in Europe to name a device that was a lot like a miniature cannon on a stick. There are numerous illustrations of Chinese versions of this gun, like the Dunhuang example shown earlier. Some were made to fire multiple charges. The *gonne* example from Germany shown above (about 1399), give an idea of how simple the device was.[14] It was a tube that could be mounted on a stick. Gunpowder was put into the bore, followed by a lead ball. The gunpowder was ignited by a hot wire or slow-burning "match" made of chemical-soaked string. This match was poked into the touch hole on the top to ignite the explosion. Modern testing of such handguns shows that they could pierce armor and definitely kill people. They were very difficult to aim and could only be fired a second time after the soldier repeated the steps of cleaning, loading, and igniting. These weapons did not yet replace bows or swords, as the painting of a castle siege from 1468 shows.[15]

[14] The original Tannenberg *gonne*, displayed in the Germanic Museum in Nuremberg. http://www.musketeer.ch/blackpowder/handgonne.html

[15] Painting of a siege by Qinte Curce, 1468, British Museum, London. Source: "Handgonnes," http://www.musketeer.ch/blackpowder/handgonne.html

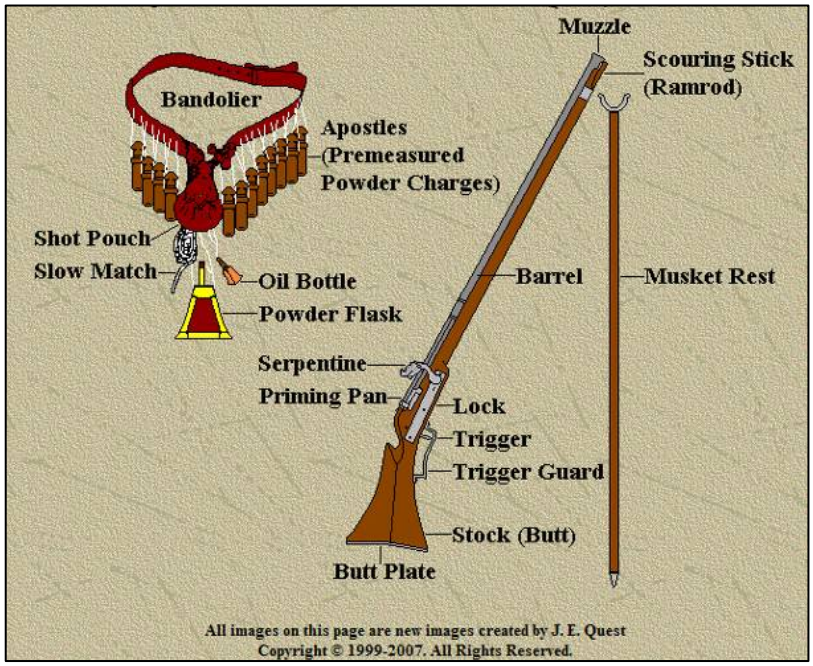
Hand-held firearms went through a series of innovations that made them more practical, effective, and deadly. By the time of the English Civil War in the mid-seventeenth century, guns had become easier to load. But they were still heavy and needed to be steadied on a forked rod held separately.

The matchlock musket, or arquebus, was an invention that had a lever, or trigger, which moved the slow-burning match to the touchhole while the soldier aimed at the target. Matchlocks were



Musket.

Source: The Arquebus & Matchlock Musket Page, http://www.geocities.com/Yosemite/Campground/8551/arquebus.html (no longer available)



Musketeer's equipment.

Source: "The Arquebus & Matchlock Musket Page," http://us.geocities.com/jequest1/equipment.html (no longer available)

the first guns to be widely manufactured. They could be fired once to twice a minute with practice. The flintlock musket, the next major improvement, was invented in the late seventeenth century and was used for a long time. It replaced the match with a trigger, which made a spark between metal and flint to ignite the powder. Flintlocks were then fitted with bayonets, that is, long, stiff blades attached by a ring alongside the bore of the gun. They enabled foot soldiers armed with guns to replace both swordsmen and pikemen, equipping modern armies for the next 150 years.