Influential Inventions of the Middle Ages and Renaissance

By
Brian Frantz

Mrs. ---- --------
March 7, 2002
4th Period
English

Introduction

As you read the news, go to a meeting, or even look outside, you are probably using technology that wouldn't be here if it weren't for the advances of the Middle Ages and the Renaissance. Or if the technology were here, it would not be in the advanced state that it is currently in. Though the modern age has seen more technological advancement in a small period of time than did our ancestors centuries before us, we cannot overlook the important discoveries and inventions that did take place prior to modern times. This paper will focus on two time periods in Western civilization: the Middle Ages and the Renaissance.

The Middle Ages were a relatively dark and challenging time. The period saw the black plague, the crusades, famine, weak government, and a lack of interest in learning which all gave the Middle Ages a stigma that nothing good really happened. Despite all this, there were some very important technological advancements during this time. Thanks in part to the influence of the Church; learning was not completely abandoned during the Middle Ages. Important discoveries were made that have affected the societies and lifestyles that followed. Use of the waterwheel greatly increased, making it possible for more mechanization and automation of tasks that otherwise would have been animal-driven. Early mechanical clocks and eyeglasses were introduced in Europe at this time. Finally, the discovery of gunpowder and the cannon in the West would prove to be an enormously significant advancement in the art of war.

The Renaissance was a time of rebirth, primarily in the fields of art and learning. Starting in Italy and making its way to most of Europe, the Renaissance ideal of a universal man, one capable of doing many things well, was embodied in the person of

Leonardo Da Vinci. Da Vinci was skilled in many fields, but this paper will focus on the technological breakthroughs made by him. In addition to the amazing designs of machinery by Da Vinci, the Renaissance also saw the invention of the printing press with movable type by Gutenberg, and the continued advancement of both gunpowder weapons and the clock.

This paper will focus primarily on the development of the clock, gunpowder, the printing press, and the works of Leonardo Da Vinci. Details will be given of the inventions, and an attempt to recognize the significance of each will be made.

The Inventions of the Middle Ages

Despite the common opinion that the Middle Ages were a time of little technological advancement, there are some inventions from that period that simply cannot be ignored. The early mechanical clock and the discovery of gunpowder are simply the greater among many achievements made in the Middle Ages.

The Early Mechanical Clock

Probably built earlier in China, mechanical clocks made their debut in Europe at the end of the thirteenth century. Clocks were a monumental improvement in the everyday life of Europeans. Prior to the clock, the best and easiest way for most people to calculate the time of day was by the sun. Clocks changed all this by providing a quick and easy way to learn the time. They also provided a visual way of planning one's day, since he could look at the clock's face and decide at what times he wanted to do what.

Early mechanical clocks used a weight that turned the hands, the speed of which was regulated by the escapement mechanism (see illustration #1). The escapement

mechanism began with a notched gear that tried to spin by the force of the weight. A double-toothed anchor connected to a pendulum caused one tooth to engage and stop the gear, while the other tooth became disengaged. As the pendulum swung, the teeth rocked back and forth on a pivot like a seesaw. Each time one tooth disengaged and the other engaged, the gear turned one notch. Thanks to this mechanism, the speed of the clock's hands was significantly decreased. The remaining speed was geared down by going from small gears to larger ones, so that the hands moved very slowly.

The first European clock striking equal hours was located in a church in Milan. Like it, early European clocks were such expensive constructions that they were usually only installed in public buildings. Other early European clocks were installed in the cathedrals of St. Paul's, Canterbury and Westminster Abbey.[1] In about 1360, Henry De Vick built a clock for the French king Charles V. Placed in the Royal Palace in Paris, the clock weighed 500 pounds.[2]

In addition to clocks that merely showed the time of day, some, such as the astronomical clocks, kept track of much more than just hours and minutes. Giovanni de' Dondi built a famous astronomical clock (see illustration #2) that not only showed the time in hours, but also the motion of the sun, moon, and five planets. Built between 1348-1362, the original clock is believed to have been destroyed, however an intricately detailed description by de' Dondi has survived, and the clock has been rebuilt.[3]

Though magnificent creations for the time, early European clocks had an inaccuracy of up to half an hour per day, and the very first clocks were even less accurate. A great improvement over previous methods of telling time, early European

[1] *Colliers Encyclopedia* (New York: Crowell-Collier Publishing Co. 1961), Vol. 5, Pg. 191.
[2] *Colliers Encyclopedia*, Vol. 5, Pg. 191-192.

clocks still had a long way to go. Many of these improvements would not be made until the seventeenth century.

Gunpowder and The Cannon

Invented first by the Chinese in the eleventh century, gunpowder was discovered by mixing saltpetre, sulfur, and charcoal to form an explosive powder. The Chinese used this mixture in battle many times, utilizing it in iron fragmentation bombs that would explode over an area of more than 6000 square feet, killing whoever was there. Bamboo guns similar to muskets were also used, but must not have been efficient since bamboo is not a very strong material. It is probable that the Arabs brought saltpetre West from China. Once the Europeans had learned how to make gunpowder, warfare was never to be the same again.

Although the Europeans began using gunpowder in the thirteenth century, cannons did not become a major part of warfare until the fourteenth century. One of the first references to cannon in the fourteenth century was in the account of the siege of Gibraltar, with the cannon being used by Ferdinand of Castile, Spain.[4] In the years that followed, two primary types of cannon were developed in the fourteenth century. The bombards were the for-runner to the later mortars. They were usually short cannons that shot arrows or round stone balls. Another weapon they used was the ribaudequin, which was a portable type of weapon with several small guns mounted on a single cart. They were primarily used against cavalry.

In the fifteenth century cannons improved even more. Mortars became used to lob the projectile up into the air and onto their enemies. Bombards, which were more

---

[3] Trevor I. Williams, *The History of Invention* (New York: Facts on File, Inc. 1987), Pg. 116.
[4] *Colliers Encyclopedia*, Vol. 2, Pg. 242.

horizontal and longer than the mortars, were greatly increased in size over the bombards of the fourteenth century. The Turkish Sultan, Mohammed II had a 30-inch bore bombard built that required 60 oxen and 200 men to move. Taking two hours to load, it fired a 1,600lb stone ball, and had a range of about a mile.[5] The ribaudequin continued to be used frequently as a small anti-infantry and anti-cavalry weapon as well.

The Inventions of the Renaissance

"Renaissance" literally means "rebirth". In the period following the Middle Ages, Europe went through what historians call the Renaissance Age. This was a time of increased interest in art and classical knowledge, among other things. In addition to a period that produced great artwork, the Renaissance was also a time of technological advancement and improvement. New inventions were made, as were improvements over previous discoveries. Leonardo Da Vinci was a famous Renaissance artist, but he was also responsible for the invention of many concepts that were centuries ahead of his time. In addition to the works of Da Vinci, the invention of the printing press and the improvements of the use of gunpowder were of immense significance.

The Printing Press

Printing, like gunpowder and clocks, was something that the Chinese had done before the Europeans. The Europeans most likely learned of block printing by the bringing of Chinese technology to the West. Block printing was the best method known to Europeans prior to Gutenberg. It was very simple, for it was merely a die-cast stamp that would be inked and then pressed onto paper, most likely by hand.

[5] *Colliers Encyclopedia*, Vol. 2, Pg. 243-244.

Unlike block printing, Johannes Gutenberg's movable type printing method was completely the invention of Gutenberg and owed nothing to the Chinese. This method utilized individual letters that could be fitted together to form words. Although presses had existed before Gutenberg, Gutenberg was the first to use it for printing.[6] His press utilized a screw that pushed the paper onto the type. The type was set on a flat bed of the press, and above it was a large screw. After all was ready, the screw was rotated, which lowered the paper onto the type. This made it possible for many copies of one page to be made easily and quickly. In addition, the press method also held the paper and type still so that the text on the page would be straight and not smeared by accidental movement during the process. Gutenberg not only made the press, but came up with an improved method of casting type by using an alloy that had a low melting point and that solidified without distortion. He also used a type of ink that wouldn't smudge.

Unfortunately for Gutenberg, he did not receive in life the credit he deserved for his magnificent invention. Not only did he not put his signature on the books he printed, but he eventually lost his press to his partner, Johann Fust. Fust provided Gutenberg with the necessary funding, but he wanted Gutenberg to work faster in order to crank out more books and thus sell more. Gutenberg wanted to go at a slower pace and produce books of a higher quality. After winning a lawsuit against Gutenberg, Fust was able to take the press and everything away from Gutenberg. He then printed books in his name, receiving the credit for the products of Gutenberg's machine. There is no question, however, that the famous 42-line Bible printed in 1455 was the work of Gutenberg.

[6] Andi Damewood. December 13, 1998. < http://user.icx.net/~vanblu/DeadGerman/ >

Printing was the first mass-production industry, and allowed one person to do the work of many. In fact, a printer could crank out in one day what took a scribe a year to produce.[7] The printing press greatly improved the efficiency of printing, and thus increased the number of books that could be made in a certain amount of time.

Gunpowder and Handheld Firearms

Inventions and weapons with gunpowder continued to advance in the Renaissance. In addition to overall improvements to the previous types of artillery, artillery had begun to be used in naval warfare on ships. Handheld firearms also came on the scene during this time.

The artillery of the time period improved greatly with various smaller inventions. One of these, the gunners' quadrant invented by the Italian Niccolo Tartaglia, was an aid in helping gunners aim. It worked on the principle that guns shot farthest when trained at a 45-degree angle.[8] Explosive shells were also invented during this time, first in the Netherlands. These shells were hollow iron balls that were filled with gunpowder. The first explosive shells had a fuse that was lit from the end of the cannon, before the propulsion gunpowder behind the shell was lit. However, this inefficient and potentially dangerous method was replaced in about 1580 by the single-ignition shell. This shell had the wick go into a highly inflammable material on the side of the propulsion gunpowder. When the gunpowder in the cannon was lit, it would light the inflammable material, which would light the wick. The shell would be shot and the wick lit with one strike of the match.

---

[7] Feldman, Anthony and Ford, Peter, *Scientists and Inventors*, (New York: Facts on File), Pg. 17.
[8] *Colliers Encyclopedia*, Vol. 2, Pg. 244.

Handheld firearms appeared in the late 1400s, and were simple muzzle-loading muskets. They were not very accurate and originally took quite a while to fire. Although the accuracy did not improve greatly over the course of the next century, the firing mechanism did. The first method of firing was to light a match and apply it to the gunpowder. This was improved upon by the matchlock mechanism which had a serpentine (S-shaped hammer on top of gun) that held a match. It would hit the gunpowder when the trigger was pulled. After this, the wheel lock had a serrated wheel that would rotate against a piece of iron pyrite and send a shower of sparks into the gunpowder pan. An improvement on this, the flintlock (which was to be used for many years after) held a piece of flint in the serpentine, which struck against a rough piece of steel, sending sparks into the gunpowder. Though early firearms were used in war at close range, they were too slow and inaccurate to be as influential as artillery was. Upon the invention of rifling (the spiral grooves made in gun barrels to make the bullet spin) in the early sixteenth century, the accuracy of firearms increased. Rifling, however, did not come into military use until the seventeenth century.

Works and Innovations of Leonardo Da Vinci

"In the normal course of events many men and women are born with various remarkable qualities and talents; but occasionally, in a way that transcends nature, a single person is marvelously endowed by heaven with beauty, grace, and talent in such abundance that he leaves other men far behind, all his actions seem inspired, and indeed everything he does clearly comes from God rather than from human art. Everyone acknowledged that this was true of Leonardo Da Vinci…"[9]

[9] Giorgio Vasari, *Lives of the Artists* (from *Western Civilization* by Jackson J Spielvogel, California: Wadsworth/Thomson Learning, 2000.), Pg. 350.

Leonardo Da Vinci, an Italian man who was good at just about anything, possessed one of the most inventive and innovative minds in history. However, unlike the inventors mentioned in the previous paragraphs, most of Da Vinci's inventions never saw the light of day, at least not while he was alive. Many recreations of his works have been made in recent years based on his sketches. Da Vinci considered the possibilities of human flight, the use of steam power, and even the modern concept of a war tank. Da Vinci was certainly ahead of his time, but many of Da Vinci's inventions and innovations were merely concepts. Some had serious flaws that would keep them from working, such as his helicopter, which lacked a power supply capable of providing enough power and speed to keep it airborne.

One of the many things that Da Vinci studied was air and the possibility of flight. He made many sketches of flying machines. One was a type of glider (see illustration #3), with bird-like wings and a harness for the flyer. The wings were to be flapped like a bird's. Another example of his interest in flight was his helicopter (see illustration #4). Similar in many respects to the modern helicopter, Da Vinci's used a vertical axle on which a kind of screw would spin. It would push the air down like a screw does.

Da Vinci also studied the characteristics and flow of water. This is visible in his sketches as well. For example, he designed a hydraulic screw (see illustration #5) which would have been able to easily lift water to a higher elevation without the use of waterwheels, as had been used earlier. Da Vinci designed various types of boat hulls as well.

In addition to all this, Da Vinci sketched many designs of war machines. He designed a triple-tier machine gun artillery (see illustration #6), which would be able to

fire a row of barrels at once, while one was reloaded and the other cooled. He designed a war tank (see illustration #7), which would drive on wheels and had a protective shell on the outside. Guns poked out of the tank's body all around, making it a movable, armed, and armored war machine.

Finally, Da Vinci designed many practical and plausible mechanisms. A few examples are his spring-powered vehicle, ball bearings, gear mechanisms, a jack, file-cutters, bridges, and various mechanisms for measuring distance traveled, time, wind speed, humidity, and inclination.

The Influence of Middle Ages and Renaissance Inventions on Modern Life

Although the technology of the Middle Ages and Renaissance was, by today's standards, quite primitive, it is important to recognize how significant a role they have played in history, leading up to the present. What modern technology did they influence? What if they hadn't been invented when they were, but instead were only being discovered now? These are all questions worth pondering, for it will give us a better appreciation for these seemingly primitive time periods.

How have clocks affected us? Obviously, had it not been for the earliest mechanical clocks, modern mechanical clocks would not be here in their advanced state. What else might have happened if mechanical clocks hadn't been built in the Middle Ages? For one thing, the modern fast-paced lifestyle would likely be quite different. If we didn't have expedient ways to tell time, we wouldn't be able to accurately fit so many things into our schedule. We'd have to arrive quite early for an appointment or meeting if the best way we could tell time was as much as a half-hour off. Modern lifestyle is in

many ways dependent on knowing the time of day. Finally, if clocks hadn't begun to advance when they did, games that require the comparison of best times would not have accurate ways of timing the events. Clocks have affected modern life in many ways that we don't usually think about.

Where should I start in explaining the influence of gunpowder? The modern machine gun wouldn't exist if gunpowder were a new discovery today. We'd be using primitive muskets or cannons. And war tactics would be much different, too. Long range, accurate sniping would not be possible. Stone fortifications might still be capable of resisting attack. Swords and bows and arrows might still be in use. In addition to how war would be fought, what about how roads would be built through mountains? What about how mines would be cleared? Modern explosives might not have been invented until we had discovered all of the uses of gunpowder. Even hunting would be affected. Gunpowder has clearly been an important and highly influential discovery.

Another influential invention was the printing press. It allowed for a faster spread of books in the middle ages, and has influenced the modern method of printing. However, what if the printing press hadn't been made when it was? The books that were printed contained knowledge, and because of the mass-production of books made possible by the press, it was then possible for that knowledge to be given to more people, including the lower classes. Had the printing press not been made for hundreds of years after the Renaissance, fewer people would have had access to the knowledge contained in books. As such, less advancement in intellect and knowledge would have been made. The great minds that came from lower-class families might not have received the books necessary to give them the knowledge needed for success in their field. Even more

startling, it is quite possible that the Protestant Reformation would not have taken place if the press hadn't been invented. Luther might not have had his own Bible to read, and he would have had a much harder time distributing his writings and his German translation of the New Testament. Thus, the printing press influenced more than just how modern books are made.

Finally, what about Leonardo Da Vinci? He never really made any inventions that revolutionized the world. Although he was certainly influential in the world of art, how different would modern technology be if he hadn't lived? The influence of Da Vinci is more in relation to the way modern man views the Renaissance, rather than the way the Renaissance influenced modern technology. Because of an understanding of the conceptual drawings of Da Vinci, modern man can have a better understanding of just how amazing he was, and how the Renaissance really was a time of intellectual rebirth. For many of the designs of Da Vinci exhibit an understanding of concepts only proven to be possible in recent days. He designed ways of flight, a horse-less carriage, a tank, rapid-firing weapons, and much more. Finally, the sketches of Da Vinci have changed the lives of many modern men. For example, in 2001, a bridge designed by Da Vinci that had previously never been built was completed in Norway.[10] This bridge has brought Renaissance design into the modern world, and many modern people thought the design wasn't even possible! So, even though Leonardo Da Vinci's works may not have significantly affected modern designs, they certainly are a testimony to the intellect of the Renaissance and show that the intellect of Leonardo Da Vinci lives on.

[10] Doug Mellgren, *The Guardian* (November 1, 2001), "Da Vinci Comes to Life 500 Years On".

Conclusion

In conclusion, the Middle Ages and the Renaissance were in no way a time when technological discovery was dead. Recent years have showcased unequaled advances in technology, but that does not mean the periods with less were unimportant. The amazing technology that we use and take for granted every day would not be here had it not been for the discoveries made during slower times. And the clock, printing press, and gunpowder were just a few of the many inventions and discoveries that have helped shape modern society.

After all, how would you read the news if it weren't for the modern state of printing? And how would you know precisely when to leave the house for a meeting if clocks were a new discovery and you had to rely on a timepiece up to half an hour off? Finally, can you imagine pictures of Saddam Hussein with a musket or a bow and arrow adorning his wall instead of an AK-47? (Ok, so maybe that'd be a *good* result of not having gunpowder earlier!)

We can never know just what the state of society would be today had it not been for the advancements of those before us, but it is certain that life would be different, to some degree. Would we have inaccurate clocks and primitive guns? Or would we have found other ways to tell time accurately and to increase military strength? These are things to ponder, and reasons to appreciate the discoveries and inventions of the Middle Ages and the Renaissance, as well as the people who made them.

Bibliography:

D'Estaign, Valerie-Anne. The World Almanac Book of Inventions. New York: World Almanac Publication, 1985.

Damewood, Andi. "Johannes Gutenberg and Movable Type". December 14, 1998. <http://user.icx.net/~vanblu/DeadGerman/>.

Encyclopedia Britannica Online – Premium Service. 2002. <www.britannica.com>.

Feldman, Anthony and Ford, Peter. Scientists & Inventors. New York: Facts on File Inc., 1979.

Kramer, Ann (editor). The Random House Children's Encyclopedia. London: Dorling Kindersley, 1991.

Mellgren, Doug. "Da Vinci Comes to Life 500 Year On". Guardian Unlimited. November 1, 2001. <http://www.guardian.co.uk/international/story/0,3604,584448,00.html>.

Shores, Louis and Crawford, David (editors). Colliers Encyclopedia. New York: The Crowell-Collier Publishing Company, 1961.

Spielvogel, Jackson J. Western Civilization – 4th Edition. California: Wadsworth / Thomas Learning, 1999.

Williams, Samuel C. Library Online. "Leonardo Da Vinci Collection". Stevens Institute of Technology. 2002. <http://www.lib.stevens-tech.edu/collections/davinci/inventions/index.html>.

Williams, Trevor I. The History of Invention: From Stone Axes to Silicon Chips. New York: Facts of File, Inc., 1987.

Illustration Credits:

"Ernie's Clock Parts Craftsman" <http://www.ernie.cummings.net/escape.htm>.

"Phys2622: Science and Society" <http://www.physics.hku.hk/~tboyce/ss/assignments/ascent/dondi.html>.

Williams, Samuel C. Library Online. "Leonardo Da Vinci Collection". Stevens Institute of Technology. 2002. <http://www.lib.stevens-tech.edu/collections/davinci/inventions/index.html>.