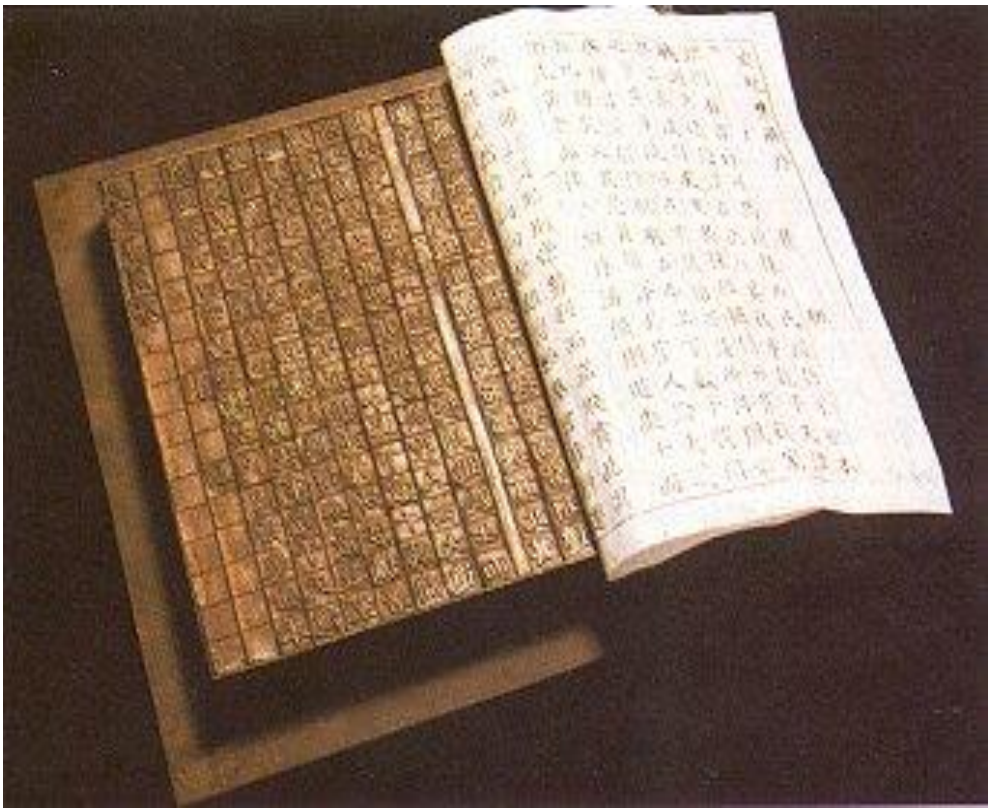
Silk Road: Spreading Ideas and Innovation

Good ideas and innovation travel easily--and far. Historically, these ideas spread along trade routes. This essay looks at the great AfroEurasian Silk Roads as a transmitter of people, goods, ideas, beliefs and inventions.

Paper, Printing and Buddhism

Good ideas travel easily and far along trade routes, and the Silk Road was no exception to that rule. A famous example of a Chinese invention that helped to transform the world is paper. Paper was invented during the Han dynasty, probably just at the time the Silk Road trade was beginning to flourish. Far superior to the narrow wooden strips or hard-to-handle rolls of silk that the Chinese had previously used for writing, paper soon became the writing material of choice throughout China and East Asia. It was found also in the Buddhist temples of China's northwest, but seemed not to make inroads beyond that for a long time, perhaps in part because the Chinese tried to protect the secret of its manufacture, and perhaps in part also because other writing materials, such as parchment and papyrus, were well established in the west.

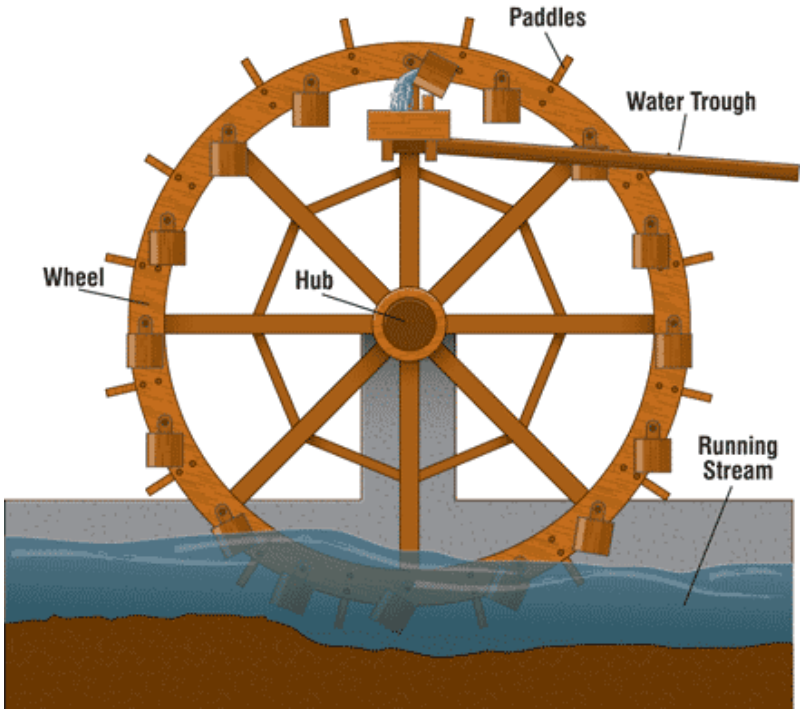


But under the Mongols in the thirteenth and fourteenth centuries, a group of Chinese workmen set up a papermaking establishment in Samarkand [a city in modern day Kazakhstan. Their product quickly spread by trade and imitation, and paper soon replaced other writing materials in most of western Eurasia.

Irrigation without human or animal power

Another invention that spread entirely across Eurasia was the noria, or irrigation waterwheel. This simple, ingenious device, invented in Roman Syria, consists of a vertical waterwheel to the rim of which are attached a series of pots or tubes. As the current of a river rotates the wheel, the pots fill with water at the bottom of the cycle and empty into a chute at the top; a large wheel can lift water as much as forty feet with no input of

human or animal energy. This inspired invention was obviously a good idea, and rapidly spread along the Silk Road and its cities large and small.



While this might not seem like a big deal now, the water wheel was a way to move large amounts of water through the trough (to irrigate nearby fields). Eventually the Hub (see drawing) was attached to an axle and gears many years later, and the technology was used to power the Industrial Revolution! Modern day dams really just use the simple but effective technology of the water wheel, first invented in the Middle East during the time of the Silk Road.

Algebra

While many secondary school students struggling through math classes may not particularly appreciate the importance of algebra, it is one of the most important contributions of the Muslim Golden Age to the modern world. It was developed by the great scientist and mathematician, Muhammad ibn Musa al-Khawarizmi, who lived from 780 to 850 in Persia and Iraq.

In his monumental book, The Compendious Book on Calculation by Completion and Balancing, he set forth the basic principles of algebraic equations. The name of the book itself contains the word “al-jabr”, meaning “completion”, from which the Latin word algebra is derived. In the book, al-Khawarizmi explains how to use algebraic equations with unknown variables to solve real-world problems such as zakat calculation and inheritance division. A unique aspect of his reasoning for developing algebra is the desire to make calculations mandated by Islamic law easier to complete in a world without calculators and computers.

Al-Khawarizimi’s books were translated into Latin in Europe in the 1000s and 1100s, where he was known as Algoritmi (the word algorithm is based on his name and his mathematical works). Without his work in developing algebra, modern practical applications of math, such as engineering, would not be possible. His works were used as math textbooks in European universities for hundreds of years after his death.

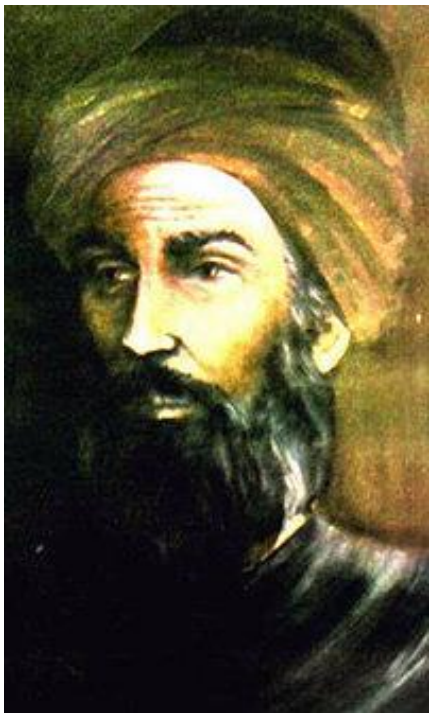
Gunpowder

In Chinese, gunpowder is called huo yao, meaning flaming medicine. Unlike paper and printing, the birth of gunpowder was quite accidental. It was first invented inadvertently by alchemists while attempting to make an elixir of immorality. It was a mixture of sulphur, saltpeter, and charcoal. At the end of the Tang Dynasty,

gunpowder was being used in military affairs. During the Song and Yuan Dynasties, frequent wars spurred the development of cannons, and fire-arrows shot from bamboo tubes.

In the 12th and 13th centuries, gunpowder spread to the Arab countries, then Greece, other European countries, and finally all over the world. During the early period of the thirteenth century, Mongolian hordes used gunpowder to flatten resistance against them in their westward conquests. That was equivalent to weapons of mass destructions in those days.

Surgery



Around the year 1,000, in what is now Spain, which was at the time controlled by Muslim kingdoms, the celebrated doctor Al Zahrawi published a 1,500 page illustrated encyclopedia of surgery that was used in Europe as a medical reference for the next 500 years. Among his many inventions, Zahrawi discovered the use of dissolving cat gut to stitch wounds -- beforehand a second surgery had to be performed to remove sutures. He also reportedly performed the first caesarean operation and created the first pair of forceps.

Compass

During the Warring States period, a device called a Si Nan became the forerunner of the compass. A Si Nan was a ladle-like magnet on a plate with the handle of the ladle pointing to the south. In the 11th century, tiny needles made of magnetized steel were invented. One end of the needle points north while the other points south. The compass was thus created. The compass greatly improved a ship's ability to navigate over long distances. It was not until the beginning of the 14th century that compass was introduced to Europe from China.

Silk

The creation, development and technique for making silk was a Chinese state secret for centuries. No records exist indicating the specifics of when the creation of silk was first discovered, but many believe it was actually an accident. To create silk thread you need to start with silkworms.

Chapter 2 Innovation on the Silk Road

The business of raising silkworms and unwinding cocoons is now known as silk culture or sericulture. It takes an average of 25-28 days for a silkworm, which is no bigger than an ant, to grow old enough to spin cocoon. Then, in China, the farmers will pick them up one by one place in piles of straw, where the silkworm will attach itself to the straw, with its legs to the outside and begin to spin cocoons .

The next step is unwinding the cocoons; the cocoons are heated to kill the pupae, this must be done at the right time, otherwise, the pupas are bound to turn into moths, and moths will make a hole in the cocoons, which will be useless for thread. To unwind the cocoons, Chinese weavers put them in a basin filled with hot water, then found the loose end of the cocoon, twisted them, then carried to a small wheel, and finally the cocoons would be unwound. At last, two workers measured them into a certain length, twist them, into something called raw silk. Only then is the silk dyed and woven into cloth.

Chinese clothes using silk thread became popular soon. At that time, silk technology was developing fast. Emperor Wu Di of western Han Dynasty decided to first develop trade with other countries.

A trading route and road was needed to quickly and effectively trade silk. For nearly 60 years the world famous ancient Silk Road was built up at cost of many losses of life and treasures.

From then on, Chinese silk, along with many other Chinese inventions, were passed from China to the region now known as India, to the Middle East and finally to the Mediterranean. Romans, especially women, were crazy for Chinese silk. Before that, Romans used to make clothes with linen cloth, animal skin and wool fabric. Now they all turned to silk. It was a symbol of wealth and high social status for them to wear silk clothes. One day, an Indian monk came to visit a Roman Emperor. This monk had been living in China for several years and knew the method of raising silkworms. The Emperor promised a high profit of the monk, the monk hid several cocoons in his cane and took it to Rome. Though the Chinese government didn't want the secret out, the technology of raising silkworms spread quickly, and the "state secret" was no more. But even today China is considered the producer of the finest quality silk.

THE BETTMANN ARCHIVE/Corbis

Printing Technique

Inspired by engraved name seals, Chinese people invented fixed-type engraved printing around 600 A.D. The skill played an important role in the Song Dynasty but its shortcomings were apparent. It was time-

consuming to engrave a model, not easy to store, and not easy to revise errors.

During the reign of Emperor Ren Zong of the Northern Song Dynasty, Bi Sheng invented moveable, reusable clay type after numerous tests. Single types were made and picked out for printing certain books. These types could be used again and again for different books. Because of the large number of different characters in the Chinese written language, this technique did not have a dramatic impact at the time. However, today, this typesetting technique is regarded as a revolution in the industry.

In the Chinese Tang Dynasty, Printing Technique had been introduced into the Central Asia. In the thirteenth century, many European travelers reached China through the Silk Road and brought back Printing Technique to Europe. In 1444, Gutenberg, a German inventor of letterpress printing, printed the Bible using a similar printing technique.

About 200 years later, this moveable-type technique spread to other countries and advanced the development of world civilization.

Optics

Many of the most important advances in the study of optics come from the Muslim world. Around the year 1000 Ibn al-Haitham proved that humans see objects by light reflecting off of them and entering the eye, dismissing European Euclid and Ptolemy's theories that light was produced from the eye itself. This great Muslim physicist also discovered the camera obscura phenomenon, which explains how the eye sees images upright due to the connection between the optic nerve and the brain. This led to future inventions of things like cameras and photography.

Hospitals

Hospitals as we know them today, with wards and teaching centers, come from 9th century Egypt. The first such medical center was the Ahmad ibn Tulun Hospital, founded in 872 in Cairo. Tulun hospital provided free care for anyone who needed it -- a policy based on the Muslim tradition of caring for all who are sick. From Cairo, such hospitals spread around the Muslim world.

The Silk Road: Voluntary trade adding wealth

These examples and dozens more that could be mentioned make the point clear: ideas, inventions, devices and techniques spread readily and far along the Silk Road, and the traffic was very much a two way, or perhaps one should say a multi-way, street. In the process the Silk Road enriched not just the merchants who carried and exchanged goods, but the people of countries and cultures all across Eurasia.

It is perhaps worth noting, however, that long-distance trade can have unexpectedly bad side effects as well as direct beneficial effects. For example, the Black Death plague that devastated Europe in the 14th century is believed to have come via the Silk Road from Central Asia, where plague is endemic among local rodents. One theory holds that a load of marmot pelts (destined to be used on fur-trimmed garments), contaminated with plague-bearing flea eggs, were brought from somewhere in Central Asia to a Middle Eastern port. There the eggs hatched into fleas that infested some local rats; some of the rats eventually went on shipboard and were carried to port cities in Italy. There the plague spread, via fleas, to other rats, and then to people; and a disaster was in the making.