

Chinese Discoveries and Inventions

How have medieval Chinese discoveries and inventions influenced the modern world?

1. Exploration and Travel

Several Chinese inventions made exploration and travel safer and faster. Some innovations benefited traders and other voyagers who ventured out to sea, while others improved travel on rivers, lakes, canals, and bridges within China.

Improving Travel by Sea

The Chinese developed the first compass as early as the 3rd century B.C.E. The first Chinese compasses were pieces of a magnetic mineral called lodestone. Earth itself is like a giant magnet with north and south poles. Because lodestone is magnetic, it is influenced by Earth's magnetic poles. If you put a piece of lodestone on wood and float it in a bowl of water, the lodestone will turn until it points in a north-south direction.

Europeans also developed a compass using lodestone. Eventually, the Chinese replaced the lodestone with a steel needle because they learned that rubbing a needle with lodestone made the needle act in the same way as the lodestone. However, a needle in a compass gave a more accurate reading than a piece of lodestone.

By the time of the Song dynasty, the Chinese were using magnetic compasses for navigation at sea. Compasses made long sea voyages possible because sailors could figure out directions even without a landmark or a point in the sky to steer by. The compass remains an important navigational tool today.

Additionally, the Chinese made sea travel safer by improving boat construction. By the 2nd century C.E., they started building ships with separate, watertight compartments. Builders divided the ships into sections and sealed each section with caulk, a sealant that repels water. If there were a leak, it would be isolated, and the other compartments would not fill with water, keeping the ship afloat. Modern shipbuilders still use this technique.

Improving Travel on Rivers, Lakes, Canals, and Bridges

Within China, people often traveled by boat on rivers or across lakes. An innovation of a vessel called a paddlewheel boat made this type of travel much faster.

Have you ever paddled a canoe or other small boat? As you push your paddle through the water, the boat moves forward. In the 5th century, the Chinese adapted this idea by arranging a series of paddles in a wheel. People walked on a treadmill to turn the paddlewheel, which in turn moved through the water, moving the boat forward. The Romans had also developed a paddlewheel-powered boat, but it was powered by oxen, which are not as easy to direct as people.

The people-powered paddlewheel boats allowed the Chinese to travel much faster on rivers and lakes, and were also much easier to maneuver than other types of watercraft. People still use this type of boat for recreational activities.

Another way the Chinese improved transportation was by developing a new type of canal lock, during the Song dynasty. The Chinese used canals extensively to connect the many rivers. As the surrounding land sloped up, parts of canals were at different levels. Before the improved locks were invented, the Chinese had to drag their boats up stone ramps to reach water at a higher level, a difficult task that could damage the boats.

The new canal locks solved this problem. When a boat entered the lock, a gate was lowered to hold in water. The water was then allowed to rise until it reached the level of the water up ahead, and the boat floated on. To go “downhill,” water was released by the lock until it fell to the level of the water down below.

The innovative new type of locks made canal travel much easier. Locks could raise boats more than 100 feet above sea level.

The Chinese also found ways to improve bridges. For example, in 618 C.E., a Chinese engineer completed a new type of arched bridge. In Europe, Roman-designed bridges rested on arches that were halfcircles. The new Chinese bridge used arches that were a smaller part, or **segment**, of a circle, making the bridges broader and flatter than semicircular arches could. Called a segmental arch bridge, the new type of bridge required less material to build and was stronger, as well.

Many cultures developed engineering technologies. However, the segmental arch bridge is one of China's most prized achievements. Bridges of that design stretch over expressways around the world.

2. Industry

Some Chinese advances led to new industries. During this period, the medieval Chinese made advances and innovations in the way they produced paper, print, tea, porcelain, and steel.

Paper

By the 2nd century C.E., the Chinese invented the art of papermaking. Historians believe the earliest Chinese paper was probably made from hemp and then the bark of the mulberry tree. Later, the Chinese used rags.

Papermaking became an important industry in China. For more than 500 years, the Chinese were the only people in the world who knew the secret of making paper. From China, knowledge of papermaking traveled to Japan and across Central Asia. Europeans probably first learned about this art after 1100. Considering how important it is for recording and transmitting information, few inventions have been more important in history than paper.

Printing

The invention of paper made another key development possible: printing. In about the 7th century, the Chinese invented a technique called woodblock printing. The printer first drew characters (symbols) on paper and then glued the paper to a wooden block. When the glue was dry, the printer carved out the wood around the characters, leaving the characters raised on the wood.

To print from the block, the printer covered the characters with black ink, spread paper over the block, and smoothed the paper with a brush. Some artists still use block printing today to create fine art prints.

By the 8th century, there was an entire woodblock printing industry in China. Printers created religious and other works on scrolls. In the 10th century, the Chinese started printing modern-style books with pages.

In the 11th century, during the Song dynasty, the Chinese invented **movable type**, which consists of separate blocks for each character. (Europeans developed movable type independently in the 1400s.) Printers made their type by carving characters out of clay and baking them. To print, they selected the characters they needed and placed them in an iron frame in the order they would appear on the page. When the printing job was complete, the type could be removed from the frame and rearranged to use again.

With the invention of movable type, printers no longer had to create a new set of woodblocks for each item they printed. This dramatically lowered the cost and labor of printing. Written materials became more widely available, and advances in printing helped spread learning throughout China. Until the last century, all newspapers, books, and magazines were printed using movable type.

The first woodblock prints were made in one color, usually with black ink. Then printers began making several versions of one scene and printed each with a different color. With this method, they could produce a colorful picture.

Tea

Historians have discovered from written accounts that the Chinese have been drinking tea since at least 2700 B.C.E. For several thousand years, tea—made by steeping tea leaves in boiling water—was drunk mostly as medicine. However, by the 8th century C.E., tea had become a hugely popular everyday beverage that was enjoyed throughout China. Tea houses had sprung up throughout the country. A famous writer, Lu Yu, wrote a book, *Cha Jing (Tea Classic)*, describing how to cultivate, prepare, and drink tea. The drink's popularity made tea-plant cultivation a major industry, often involving an entire community.

Basic tea cultivation and processing has not changed much since early times. Tea farmers grow small tea trees or shrubs on high ground, usually above 4,000 feet. When the trees are ready for harvest, only new-growth leaves are picked—by hand. Then the tree is pruned, or cut back, so it will grow new leaves for the next harvest, and the cycle repeats several times a year. Workers

then dry the fresh leaves by leaving them out in sunlight for different numbers of days, depending on the variety of tea. The final drying process occurs in a dry wok or in a small oven.

During the Tang Dynasty, the first tea-plant seeds were brought to Japan where tea cultivation developed into an industry by about 1200. Europeans became involved in tea farming and trade by the 18th century. Dutch traders brought seeds from Japan and China to their colonies in Indonesia. Tea plants were found in the British territories of Burma (now Myanmar) and India. The Dutch and British produced and traded tea throughout their empires, spreading the beverage around the world and competing for the tea trade in the 13 American colonies. During the Boston Tea Party, colonists tossed British tea into Boston Harbor, helping to spark the American Revolution. Today, tea is one of the most popular beverages in the world, and, as in ancient China, people now often drink tea for their health.

Porcelain

Another Chinese invention is a type of fine pottery called porcelain. Some historians believe that the Chinese produced the first porcelain as early as the 1st century C.E.

Porcelain is made by combining clay with the minerals quartz and feldspar, and it is then baked in a kiln, or pottery oven, at very high temperatures. The resulting pottery is white, hard, and waterproof. Despite its sturdiness, light can still pass through porcelain, creating an appearance that is quite delicate and beautiful.

By the 10th century, the Chinese were making porcelain of great artistry. Craftspeople learned how to paint pictures on porcelain and made colored glazes to decorate their work.

Porcelain making became a major industry in China. Hundreds of thousands of people worked to **mass-produce** dishes, bowls, and vases. Some workers washed the clay, while others applied the glaze or operated the kiln.

Since Europeans did not learn how to make fine porcelain until the 18th century, Chinese porcelain became a prized item for trade. Many people consider medieval Chinese porcelain to be the finest in the world, and people today still refer to fine porcelain dinnerware as “china.”

Steel

The Chinese first made steel, a very useful metal, before 200 B.C.E. Steel is made from iron, but it is less brittle than iron and easier to bend into different shapes.

The earliest Chinese steel was made from cast iron. The Chinese were the first to learn how to make cast iron by melting and molding iron ore. Later they learned that blowing air into molten, or melted, cast iron causes a chemical reaction that creates steel, which is a great deal stronger than iron.

These developments eventually made it possible to produce large amounts of steel cheaply. In the 1800s, the mass production of steel was crucial to the Industrial Revolution in the West. Today, iron and steel making are among China's most important industries.

3. Military Technology

During the Song and Mongol periods, the Chinese developed powerful weapons. The invention of **gunpowder**—one of the most significant inventions in history—made these weapons possible.

The Development of Gunpowder

The Chinese who first made gunpowder were alchemists, people who practiced a blend of science and magic known as alchemy. Alchemists experimented with mixtures of natural ingredients in an attempt to locate a substance that might allow people to become immortal. They also searched for a way to make gold out of cheaper metals.

Chinese alchemists experimented with a mineral called saltpeter, which they may have believed could extend life. Perhaps by accident, they discovered that it could be used to make an explosive powder. In 850 C.E., during the Tang dynasty, alchemists recorded a formula for gunpowder but warned others to avoid it because it was extremely dangerous.

By the 10th century, the Chinese had developed the first weapon that used gunpowder: the flamethrower. Early flamethrowers contained gunpowder mixed with oil and were used to spray enemies with a stream of fire.

Between the 11th and 14th centuries, the Chinese created many other weapons using gunpowder. Artillery shells, for example, exploded after being hurled at enemies by a war machine called a catapult. The sound of the exploding shells confused the enemy and terrified their horses. Small bombs, or grenades, were lit and thrown by hand.

In the 13th century, the Chinese used large bombs that were as explosive as modern bombs. Around the same time, they developed weapons much like today's rifles and cannons.

By the early 1300s, travelers had brought the knowledge of gunpowder to Europe. Gunpowder forever changed the way people waged war and, eventually, weapons like crossbows, swords, and spears gave way to guns and cannons.

Rocket Technology

Rocket technology was developed in China during the Song dynasty. Rockets were powered by a black powder made of saltpeter, charcoal, and sulfur. Initially, rockets were used only in fireworks, but later, the Chinese used them as weapons and even developed a two-stage rocket for their armies. The first stage propelled the rocket through the air, and the second stage dropped arrows down on the enemy.

By 1300, rockets had spread through much of Asia and into Europe. The rockets used to explore space today are based on principles discovered by the Chinese.

4. Everyday Objects

Do you ever play games with a deck of cards? If so, you are using a Chinese invention. The Chinese invented a number of everyday objects people use today, including game cards, paper money, and mechanical clocks, all of which were developed during the Tang dynasty.

Game Cards and Paper Money

Game cards were invented in China in about the 9th century. Printers used woodblock printing to make the cards from thick paper, and famous artists drew the designs that appeared on the backs of the cards. Europeans were introduced to card games by the late 1300s. Today, card games are played throughout the world.

The Chinese invented paper money in the late 8th or early 9th century. Before that time, coins were the only form of currency. Like game cards, paper money was printed with wood blocks. By 1107, Song printers were using multiple wood blocks to print each bill. A single bill would include many colors. Paper money is the most common form of currency in the world today.

The Development of the Mechanical Clock

The Chinese developed the first mechanical clock in about the 8th century. The new clock was more accurate than earlier timekeeping devices, such as sundials and hourglasses. The Chinese devised a wheel that made one complete turn every 24 hours. Dripping water made the wheel turn. Every quarter hour, drums would beat; and every hour, a bell would chime. The sounds let people know what time it was.

The Chinese improved the mechanical clock in 1092, during the Song dynasty. Although the new clock worked on the same principles as the earlier one, it was much more complex and accurate.

Europeans first developed mechanical clocks in the late 1200s. As with Chinese clocks, a bell rang to indicate the hour. Later, dials and hands were added. Modern-day mechanical clocks are based on the same **fundamental** principles as early Chinese clocks.

5. Disease Prevention

Chinese knowledge of medicine and disease prevention dates to ancient times. Before the 1st century C.E., the Chinese developed a way of fighting infectious diseases, which can spread from person to person. When an individual died from an infectious disease, the Chinese burned a chemical that released a poisonous smoke that they believed would destroy whatever was causing the illness.

Today, it is well known that many diseases are caused by germs and that people can prevent the spread of disease by using disinfectants—substances like chlorine bleach that kill germs. The poisonous smoke used by the Chinese was a type of disinfectant.

During the Song dynasty, the Chinese discovered another way to prevent the spread of disease. A Chinese monk recommended steaming the clothes of sick people because he believed that the steam would prevent others from becoming ill. The idea was sound, because hot temperatures kill many germs. Today, people boil medical instruments to kill disease-causing germs.

Sometime around the 10th century, the Chinese discovered how to **inoculate** people against smallpox, a dreaded infectious disease. Inoculation is a way of stimulating a person's immune system to fight a particular disease. It works by exposing the person to a disease-carrying substance. To inoculate people against smallpox, Chinese physicians took a small part of a scab from an infected person, crushed it into a powder, and then inserted the powder into the nose of the person they wanted to immunize, or protect against the disease.

The Chinese knew that they had to be careful when exposing people to smallpox. Sometimes the treatment itself caused people to become ill. To be as cautious as possible, the Chinese took the infectious material from people who had already been inoculated.

Chinese knowledge about smallpox inoculation eventually led to the development of drugs called vaccines. Modern medical professionals have developed vaccines for many diseases, including smallpox and the flu.