Exploration and Travel (HA)

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

![Paddlewheel boat](image)

Paddlewheel boats were easy to maneuver, which made them effective warships, perhaps starting as early as the 6th century.

**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. However, the Chinese eventually replaced the lodestone with a steel needle. They had learned that rubbing a needle with lodestone made the needle act in the same way as the lodestone. However, 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.

The Chinese also 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 keeps out water. If there were a leak, it would be isolated. 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 Great Stone Bridge, completed in 618, spans the river Chiao Shui in China. It was the world’s first segmental arch bridge. It has a span of 123 feet.

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. These boats 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. This was difficult and 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. Then 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 half-circles. The new Chinese bridge used arches that were a smaller part, or segment [segment: a part of something that is divided from the whole], of a circle. This made the bridges broader and flatter than semicircular arches could. Called a segmental arch bridge, the new type of bridge took 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.