supported by the cluster system. The bracket cluster appeared as early as the Warring States Period in the 3rd century BC, and over time became increasingly more elaborate. By the Ming Dynasty, brackets were multiplied to the point of forming a continuous line, and their major purpose was decorative rather than functional.

The two wooden clusters on display are examples of brackets. The cluster on the left dates from the 9th century AD, or late Tang Dynasty. The cluster on the right is in the style of the Ching Dynasty. The various parts were fitted together snugly like the pieces of a puzzle, requiring no nails or adhesives.

In the late Tang Dynasty extremely large bracket clusters were used, and the model on the left is in fact only 1/4 the size of the actual bracket cluster. The Ching Dynasty bracket cluster, on the right, was used between the 17th and 19th centuries. At this time, bracket clusters were characterized by smaller size, the size of this model is true to scale, and decorative touches such as the cloud pattern on the far right end, showing that the bracket cluster had decreasing importance as a support for heavy overhanging eaves.

**Bronzemaking**

In this exhibit area is a reproduction of a bronze chariot. The original was one of two bronze chariots found near the tomb of the first emperor of China, Qin Shih Huang, who ruled during the 3rd century BC. The chariot was modeled from a vehicle used by Qin Shih Huang’s circuit chaises, and was intended to serve as transportation for the imperial guard in the afterworld. The figures of the horses and imperial driver are amazingly lifelike and half scale of the real chariot. Even the reins were constructed from intricate metal links, which were exact models of their real life counterparts. The detail and fine workmanship of this chariot demonstrate the advanced state of bronze casting technology in the 3rd century BC.

The technique of casting bronze in ancient China involved a series of steps. First, a solid model was made from clay. Next, the model was encased in a thick layer of clay, which was allowed to dry, then cut into sections and pried off. This became the outer mold. The next step involved carving detailed decorations into the outer mold.

After that, inscriptions were added to the model, and some of its surface was scraped off, to make it slightly smaller than the mold. The differences in the sizes of the two determined the thickness of the bronze vessel that was to be created. The next step involved fastening the pieces of the mold around the model, and drilling a hole in the top. The sealed mold was fired at 600 degrees Celsius before molten metal was poured into the hole and the space between the two solid pieces of clay. Once the bronze cooled, the mold and model were removed, and the bronze vessel was polished.

**Pottery, porcelain and Chinese lacquer wares**

Porcelain making is one of China’s most important contributions to the world. Porcelain is made of fine clay. It is the fine clay which distinguishes it from pottery, and produces porcelain’s unmatched hardness and translucency. In ancient China, it took several days to fire porcelain vessels in a kiln that was heated up to 1,200 degrees Celsius.

In the center of the front row, mounted on black velvet, is a shallow bowl from the Sung Dynasty, the time when China’s ceramic production reached its peak. In the back row, at the far right, is a bowl from the Tang Dynasty, made in the San Tsai, or three-color method. Because the glaze used in the three-color method contained a toxic lead, it could only be applied to burial objects.

Lacquer wares were widely used in China, as early as 5,000 years ago. The sap from the lacquer tree was first used as a coating over objects made from wood, bronze, cloth and even precious materials, to protect them from water and heat. Then, artists began adding various mineral pigments to the lacquer resin, creating vibrant colors and decorative surfaces. Up until the 2nd century AD, at the end of the Han Dynasty, Chinese elite used lacquer wares as everyday objects. Decorations were painted on the surface, as on the large tray and chipped plates seen in this exhibit. During the 10th century AD, carved lacquer became popular and reached a peak in production 200 years later. Numerous layers of lacquer had to be applied before a design could be carved. The manufacture of the best lacquer ware required many hundreds of layers, each one drying before the next was added, a process that sometimes took as long as 10 years to complete.
**Four Great Inventions of China**

Just inside the entrance to this exhibition area are four of China’s most famous inventions—the compass, paper, printing and gunpowder. The compass was invented in the 3rd century BC. The model here, in the shape of a small ladle, is one of the earliest types of compasses used in China, and is called the South Governor, as the long handle of the ladle points south. In ancient China, south was thought to be an auspicious direction, because the warm winds and rains came from that direction. North was thought to be less auspicious because of the chilling winter winds and foreign invaders.

The process of making paper was developed in China around the 2nd century BC. Materials for making the paper, such as bark, rags, and old fishing nets, were soaked, cut, cleaned and pounded into a pulp, then shaped into delicate sheets of fiber using straw mats, and finally dried.

The first printing plates were used soon after the invention of paper. They were originally carved from stone which involved hard work. After the Han dynasty, stone tablets were replaced by wood plates, on which characters or figures were more easily carved. However, to carve separate plates for each page of a book was still very time-consuming. Movable type was invented by Bi Sheng in the 11th century, which greatly speeded up the printing process.

Gunpowder was developed in the 7th century. It is the combination of charcoal, nitrate and sulfur. Ironically, it was first discovered by an alchemist searching for an elixir of immortality. In the beginning, it was used to make fireworks for special celebrations, but by the 9th century was being used on the battlefield.

**Chinese Boatbuilding**

The sand junk can be traced back at least 3,000 years. The boat’s width with its square body and stern were important for stability. The rudder was a stern-post rudder which was a Chinese development that was eventually adopted throughout Europe. The opening on the side of this model shows another Chinese innovation in shipbuilding. Partitions or bulkheads divide the bottom of the boat into a series of compartments. These bulkheads help to prevent leakage and also protect the bottom from damage. Marco Polo noted this breakthrough towards the end of the 13th century, but was not adopted by Western shipbuilders until five centuries later.

The other ship represented here is a 13th century cargo ship from southeastern China. The original ship was built from three types of wood: fir, pine and camphor. The bamboo sails could be lowered or raised, much like modern Venetian blinds. In contrast to the flat bottom of the sand junk, this ship had a curved bottom for travel in deeper waters.

**Astronomy**

Astronomical charts were originally carved from stone. On display is a reproduction, the original of which was carved in 1247. At the top is a map of the night sky, divided into 28 segments called lunar mansions. The lunar mansions were considered temporary resting places for key stars, including the sun, moon and planets, as they traveled across the sky. This system of the lunar mansions organized the stars into constellations and enabled their movements to be tracked. The innermost circle on the diagram represents the North Pole, and inside this circle is a large oval marking the North Star. Symbolically, the North Star was associated with the emperor and his place in the center of the capital, at the heart of the universe. Surrounding it are the stars and constellations, equated with the emperor’s court and his highest officials, arranged in rank from the center outward. Below the map is a text which provides a concise explanation of Chinese astrological knowledge of the time. For example, there is a calendar based on a year of 365 and 1/4 days, and a note that moonlight is in fact a reflection of sunlight.

The Equatorial Torquetum was developed by Kuo Shou-ching in the 13th century. It is the simplified form of the armillary sphere, which was an important device for observing and determining the locations of the constellations. The large rings could be used to choose a constellation for viewing depending on the time. The smaller rings were used to adjust the equipment depending on the geographical position.

**Seismograph**

A seismograph is an instrument for detecting earthquakes. The world’s first working seismograph, a model of which is on display, was developed by Chang Heng in the 2nd century AD. It has eight dragon heads facing eight different directions, each with a ball in its mouth. Behind each of the dragon heads is an intricate set of levers. In the center of the jar is a thin stick that is loosely secured. The tremors of an earthquake would cause the stick to fall in the direction of the quake and trigger a lever behind the corresponding dragon’s head. The triggering of the lever caused a ball to be released from the dragon’s mouth and fall into the open mouth of the toad below. The sound of the ball dropping into the toad’s mouth signaled that an earthquake had just occurred. By observing from which dragon head the ball was released it was also possible to determine the general direction of the earthquake. This instrument was so precise that it was able to detect in 138 AD an earthquake that took place 1,000 miles away.

**Architecture**

The large wooden piece, spanning almost the entire wall, is a reconstruction of a Tang Dynasty architectural structure. It is called a bracket system, used to support the massive overhanging eaves typical of traditional Chinese architecture. Above each column is a bracket cluster consisting of several arms extending out from a central support and fitted neatly together. The arms act as levers to balance and distribute the weight of the eaves above, thereby reinforcing the column below. The height of the bracket cluster to the length of the columns below is a 1:3 ratio. This gives an indication of the substantial weight...