

# The remains of the ancient bridges on the Wei River in Xi'an City

**The Joint Archaeological Team of the Wei River Bridges organized by Institute of Archaeology, CASS, Shaanxi Provincial Institute of Archaeology and Xi'an Municipal Institute of Cultural Heritage Conservation and Archaeology**

## Abstract

The remains of seven bridges in three groups across the Wei River to the north and northeast of the Chang'an City of the Western Han Dynasty discovered successively since 2012 filled in the blank of the archaeology of the bridges across the Wei River. Among the seven bridges, the Chucheng Gate Bridge No. 1 had huge size, which was the largest wooden structure bridge of the same period known to date. The <sup>14</sup>C data showed that the Chucheng Gate Bridge No. 4 was built in the late Warring-States Period; the Chucheng Gate Bridge No. 1 was built in the Western Han and at least rebuilt for two times in the Eastern Han and the Three-Kingdoms Period and Western Jin Dynasty; the Luocheng Gate Bridge was built around the late Western Han through the early Eastern Han and the Chucheng Gate Bridge No. 3 was built in the Tang Dynasty. The coins of the Qing Dynasty unearthed in the excavated area of the Chucheng Gate bridges hinted that at latest in the Kangxi Era of the Qing Dynasty, the Wei River was still in the course of the Han through the Tang Dynasties, and the large-scale northward moving of the course of the Wei River would be after that period.

**Keywords:** Chang'an (extinct city); Han Dynasty; pile bridges–archaeology; Warring-States Period; Wei River

## A brief introduction

The ancient bridges found on the north side of the Western Han Chang'an City, in the northern suburbs of present-day Xi'an city, are in the oxbow of the Wei River. Prior to the excavation, the site of one group of ancient bridges, the Chucheng Gate bridges, was an abandoned fish pond. South of the pond are the remains of Western Han Chang'an City (Figure 1). In early April 2012, villagers from Xixi Village of Liucunbu Township, Weiyang District, exposed some wooden piles in the fish pond while scouring the sand deposits. In late April, the Institute of Archaeology, CASS and Xi'an Municipal Institute of Cultural Heritage Conservation and Archaeology surveyed the place and confirmed that the wooden piles were the remains of an ancient bridge.

Archaeologists named it the Chucheng Gate Bridge No. 1 since it faces south to one of the northern gates of the Han Chang'an, the Chucheng Gate. On the same day, north of Gaomiao Village, archaeologists found another sand pit with exposed wooden piles. Based on their examination, they believed it was another ancient bridge, and named it the Luocheng Gate Bridge since it faced to the Luocheng Gate of Han Chang'an City. Later, three more piles were found 200m west of the Chucheng Gate Bridge No. 1, and archaeologists named the remains the Chucheng Gate Bridge No. 2.

In June 2012, the above-mentioned two institutions and the Shaanxi Provincial Institute of Archaeology formed a joint archaeological team to commence rescue excavations to the bridges. According to information provided by locals, archaeologists found another site 220m east of the Chucheng Gate Bridge No. 1. Test excavations showed rock formations and more wooden piles. Archaeologists named it Chucheng Gate Bridge No. 3. In October 2012, following another clue provided by local residents, archaeologists found more wooden piles inside a construction site near Wangjiabu Village of Caotan Township, which were identified as parts of an ancient bridge, which was named the "Wangjiabu Bridge." Two months later in December 2012, archaeologists found several more wooden piles in a sand pit southwest of the Chucheng Gate Bridge No. 1, which were named as Chucheng Gate Bridge No. 4. In July 2013, archaeologist found another ancient bridge between the Bridges No. 2 and No. 4, and the new one was named the Chucheng Gate Bridge No. 5 (Figure 2). In all, from 2012 to 2013, archaeologists found seven bridges in three locales in the old course of the Wei River north of the Han Chang'an City Site.

## Chucheng Gate Bridge No. 1

The Chucheng Gate Bridge No. 1 is located north of Xixi 西席 Village in Liucunbu, in the Weiyang District of Xi'an. About 230m south of site is the North Third Ring Road; and the remains of the Western Han Chang'an city gate – the Chucheng Gate is 1200m to its south. About 3000m north of the site is the south bank of today's Wei River; and about 1700m to the east is the Luocheng Gate of the Han Chang'an City. The upper profile of the site has been lost to sand extraction prior to the archaeological excavation, the remaining strata in the southern trench show two layers: the upper of fine sand is 0.4–3.6m thick, and the lower layer of coarse sand is 0.2–1.2m thick where the piles are anchored.

### 1. The features.

The Bridge No. 1 was a wooden bridge crossing the



**Figure 1** The locations of the remains of the ancient bridges on the Wei River in Xi'an City.

Wei River from south to north (Figures 3 and 4), the width of which measured at the second cluster of piles is 15.4m (about 66 *chi* in the Qin and Han period). Based on the field surveys of the north and south ends of the bridge, the estimated length of the bridge is about 880m from north to south.

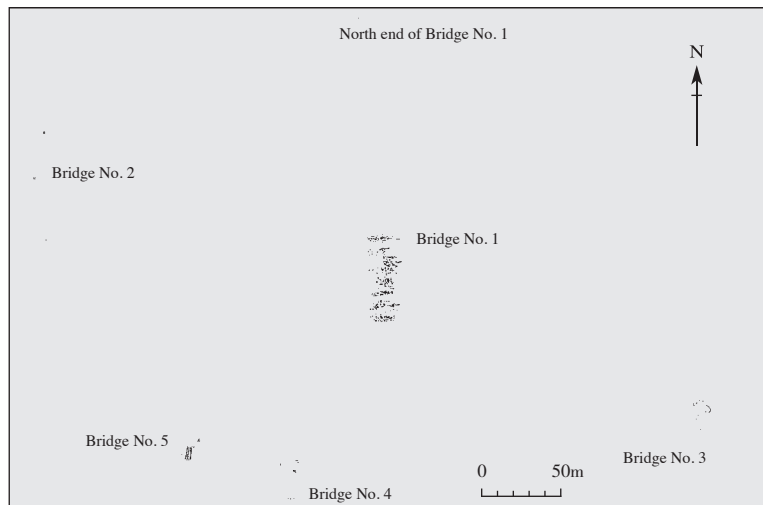
The spacing between the piles from north to south is about 3 to 7m. Materials used for the piles are different in thickness and lengths. The difference of the heights of the piles could be as large as 2m when measured from the top. The differences in building materials and in spacing indicate that the bridge was used for a long period of time, and such differences are the result of repairing and reconstruction.

2. The artifacts. Artifacts are cataloged as those of bridge building materials and those found in the riverbed.

(1) The majority of the building materials are made of wood, but some are made of stone. Of the wooden components, most of them are piles, a few have mortise.

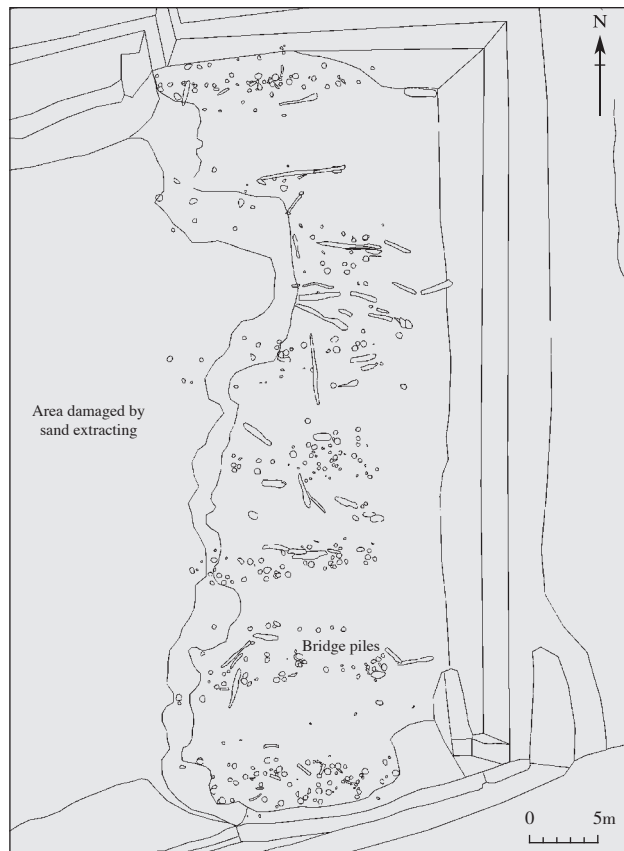
The full lengths of some complete piles are unknown, since archaeologists left them in situ without further

excavation. Measurements of some wrecked piles are from 5.2–6.6m in length, and 0.4–1.8m in circumference. Some of the exposed piles show the construction technique – about 1m at the end of the piles was cut into the shape of a triangle or rectangle, and driven directly



**Figure 2** The general plan of the Chucheng Gate bridge group.





**Figure 3** The distribution of the piles of the Chucheng Gate Bridge No. 1.

into the riverbed (Figure 5). Some remaining piles are tilted due to the current of the river (Figure 6).

The Center for Scientific Archaeology of the Institute of Archaeology, CASS identified the timber used for the piles are arborvitae of the genus *Platycladus*, *Picea*, *Abies*, *Phoebe*, *Toona*, *Ulmus*, etc.

A few piles are left with tenon on the top, measuring  $10 \times 10\text{cm}$  on each side, and 3 to 5cm in height (Figure 7:1). A few others are left with partially carved rectangular mortises 12cm in length, 4cm in width and 3cm in depth (Figure 7:2). However, no matching tenon is found on other wooden components, thus its usage is unknown. In the lower layer, two rectangular wooden components were found, one of which is 2.4m long, 38cm wide, and 19cm thick, with a round mortise in it, 16.5cm in diameter (Figure 7:3).

Stone building components made of basalt and sandstone are of rectangular, square, pentagonal or trapezoidal shapes. All stone components were moved from their original places, upon excavation, archaeologists found them scattered near bridge piles (Figure 8). Most of the rectangular stone parts are 0.9–1m in length, 0.43–0.75m in width, and 0.33–0.47m thick. The square stone measures 0.69–0.7m on each side, and is 0.42m thick; others are 0.93–0.96m on each side, and 0.38m thick. The rectangular stone parts are 0.8m in remaining length, 0.4m



**Figure 4** The orthophoto of the Chucheng Gate Bridge No. 1 (top is north).

in width, and 0.33m thick (Figure 9:1). The pentagonal stone parts are different in size, one measuring 0.93m in height, top edge length is 0.5m, base length 0.73m, 0.53m thick, and it has a square mortise measuring 8cm in side length, and 8cm in depth (Figure 9:2). Another pentagonal part measures 0.97m in height, with a top edge 0.5m in



**Figure 5** The piles of the Chucheng Gate Bridge No. 1 driven into the riverbed (W-E).

length, 0.7m in width, and 0.52m in thickness. The tenon in the center measured 0.12m in diameter (Figure 9:3). Remains of iron tenon and lime bonding are visible.

Inscriptions of serial numbers and workers' names are found on some of the stone parts (Figure 10); two with relief. For example, 2013CQI:38, a rectangular sandstone carved with patterns, is 89cm long, and 49cm wide (Figure 11).

(2) Other artifacts found in the riverbed were scattered among the piles; they are coins, pebbles, a broken millstone, stele, other stone objects, bricks and tiles of various types, and potsherds.

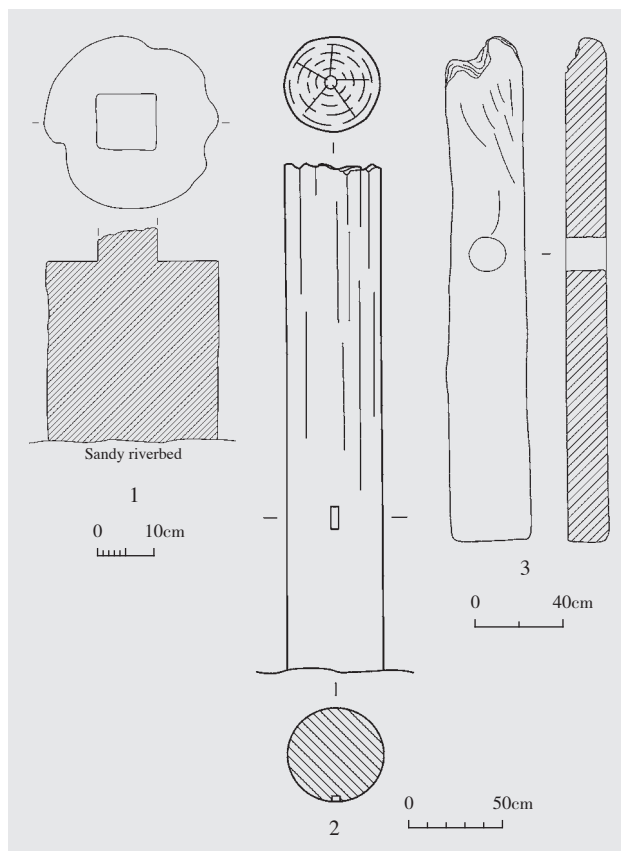
Ceramics. Most ceramic objects are building parts such as eave tiles, flat tiles, cylindrical tiles and tile-ends.

Flat tiles: most of them are gray in color, some of which were decorated with cord marks. Sample 2012CQI:1644, broken, fine clay, outside is decorated with oblique rope patterns and the inside is plain. Its length and width of the tile remains are 17.5cm and 23cm respectively, its thickness is 1.8cm (Figure 12:1).

Cylindrical tiles: most of them are broken; the outside is decorated with cord mark, the inside plain. Sample 2012CQI:1606, gray fine clay with cord mark decoration



**Figure 6** The piles of the Chucheng Gate Bridge No. 1 (N-S).



**Figure 7** The wooden parts of the Chucheng Gate Bridge No. 1. 1. Pile with square tenon on top (2013CQIT8131 M:52); 2. Pile with rectangular mortise (2012CQIT8231 M:1); 3. Wooden component with round mortise (2012CQIT8232M:6).

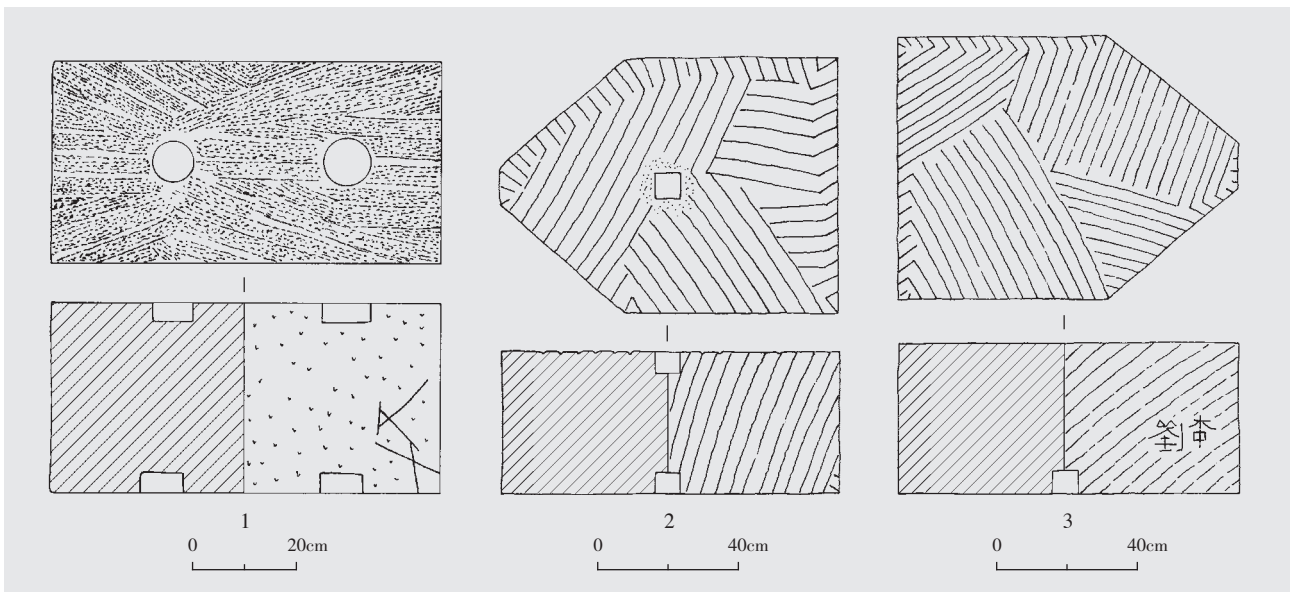
outside and inside fabric impression. The length and width of the remains are 29.2cm and 14.6, the thickness, 1.26cm (Figure 12:2).

Tile-ends: various pattern appeared on the tile





**Figure 8** The stone parts of the Chucheng Gate Bridge No. 1 scattered among the wooden piles (N-S).



**Figure 9** The stone parts of the Chucheng Gate Bridge No. 1.

1. Rectangular stone part (2012 Stone gathered CQI:8); 2 and 3. Pentagonal stone parts (2012 Stone gathered CQI:160 and CQI:6).

ends including cloud, plant, animal and text. Sample 2013CQIT8131 ⑥ :8 is decorated with quatrefoil pattern. Made of fine gray clay, this tile-end has a quatrefoil pattern in the center and leaf pattern on the outer zone. Its diameter is 13.6cm, and it measures 1.8cm in thickness (Figure 13:1).

Sample 2013CQIT8232 ⑦ :11 is decorated with text which read “*yinian wujiang* 亿年无疆” – “hundreds of



Figure 10 The inscription on the stone parts.

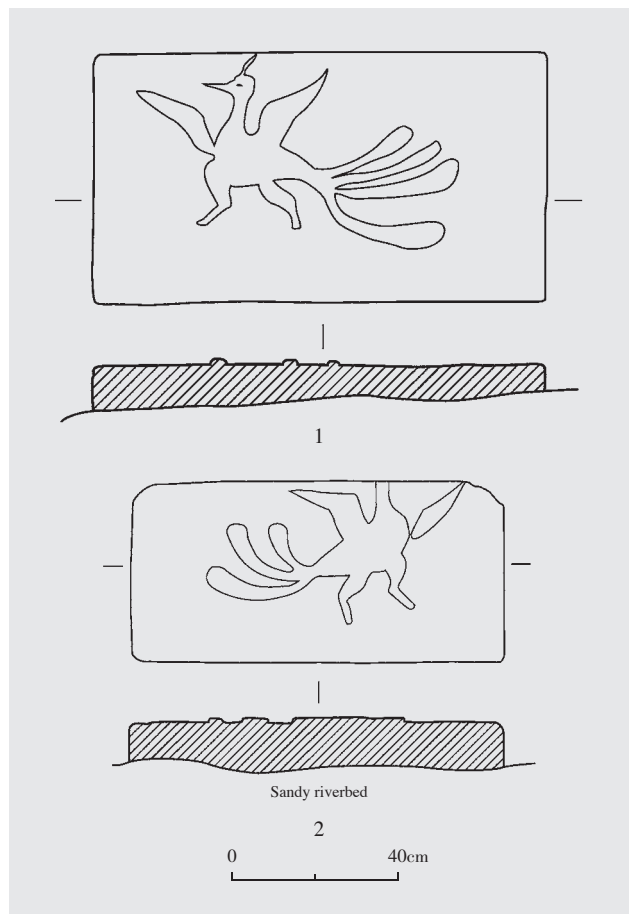


Figure 11 The stone parts of the Chucheng Gate Bridge No. 1. 1. 2013CQI:38; 2. 2013CQI:43.

millions of years with no end.” The middle zone of the fine gray pottery tile-end is divided into four quarters around the center, each of which is filled by a character. The diameter is 12.5cm and it is 1.2cm thick. The back of the disc is rather flat, with a round concave section in the center (Figure 13:2).

Sample 2013CQIT8132:2 is decorated with a bird motif. The bird has a crested head, an eagle beak, a curved neck and two stretching wings. Its diameter measures 15cm, and it is 1.3cm thick (Figure 13:3).

Stone artifacts include rammer head, weights, and mortar.

Rammer head: 2013CQI gathered:1092, gathered in surface survey. Made of coarse granite, it is in cylindrical shape, on the top of which was a handle socket (very

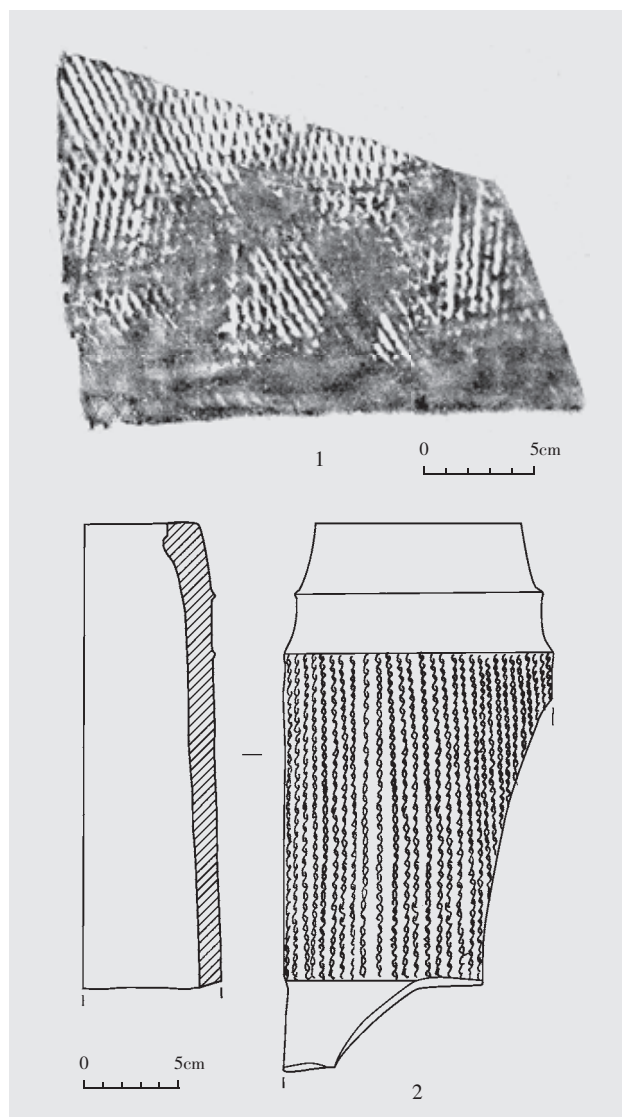
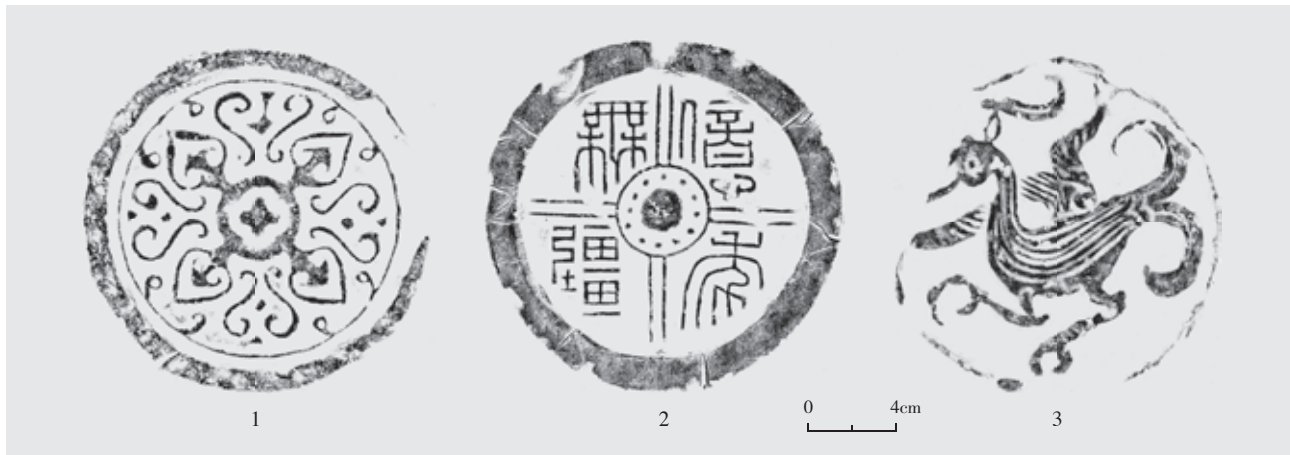


Figure 12 The patterns of the flat tiles of the Chucheng Gate Bridge No. 1.

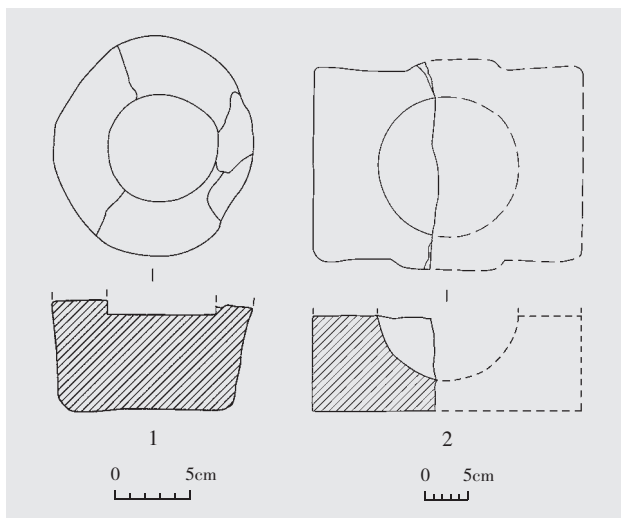
1. Flat tile (2013CQI gathered:1644); 2. Cylindrical tile (2013CQI gathered:1606).





**Figure 13** Rubbings of the tile-ends unearthed from the Chucheng Gate Bridge No. 1.

1. Quatrefoil pattern (2013CQIT8131 ⑥ :8); 2. “*Yinian wujiang*” inscription (2012CQIT8232 ⑦ :11); 3. Bird motif (2013CQIT8132 ⑥ :2).



**Figure 14** The stone implements unearthed from the Chucheng Gate Bridge No. 1.

1. Rammer head (2013CQI gathered:1092); 2. Mortar (2013CQI7930:30).

shallow remainder is remaining) and on the sides are chisel marks. The remaining height is 7.3cm, and the diameter of the ram head is 10cm (Figure 14:1).

Mortar: example 2013CQIT7930:30 is made of sandstone in a rectangular shape, on the top of which was a concave indentation. It measures 11cm in height, and 22cm in width on the side that remains intact. The diameter of the indentation is 16cm and it is 7.4cm deep (Figure 14:2).

Weights: 2013CQI:1601, gathered at surface survey, made of cobble stone. With four characters of “*liushiba jin* 六十八斤 (sixty-eight *jin*)” carved on the top, the weight measures 27cm in length, 26cm in width, and 17.2cm in thickness (Figures 15:2 and 15:3). The other one (2013CQI:1758), also gathered at surface survey, is

made of cobble stone too. Three characters of “*xi'er jin* 卅二斤 (forty-two *jin*)” are carved on the top. It measures 22cm in diameter, and 15.6cm in thickness (Figures 15:1 and 15:4).

Coins. A large number of Qin, Han, and Tang coins of *banliang* 半两, *wuzhu* 五铢, *huoquan* 货泉, *Kaiyuan tongbao* 开元通宝 and so on were found in the lower layer. Some Qing coins were found too in the same layer. One is a well preserved *Kangxi tongbao*, 2.1cm in diameter and the square hole in the center is 0.6cm on each side. On the obverse is the legend *Kangxi tongbao* 康熙通宝 in Chinese characters and on the reverse is that in Manchu scripts.

3. The date. The  $^{14}\text{C}$  Lab at Peking University tested two sets of samples from the Chucheng Gate Bridge No. 1. One set is from the piles and the other from the lime powder remains on the stone components. The samples near the south end from the fir (genera *Picea* and *Abies*) piles on the east and west are 170 BC-30 CE and 170 BC-10 CE respectively, corresponding to the mid Western Han and early Eastern Han Dynasties. The other samples from the Chinese arborvitae piles on the north date later, to 80–230 CE, corresponding to the Eastern Han through the Western Jin Dynasties. The three date data from the lime powders are 370–190 BC, 370–200 BC and 330–200 BC in retrospect, earlier than the dates of the piles and corresponding to the Warring-States Period to the early Western Han Dynasty.

### Chucheng Gate Bridge No. 3

1. The features.

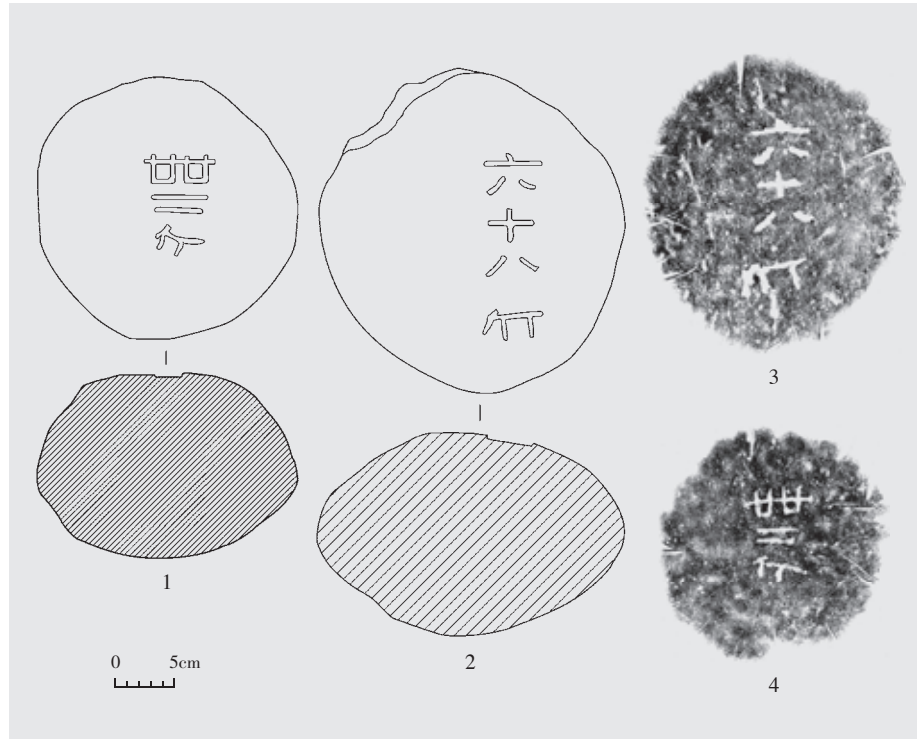
The bridge is located 220m east of the Bridge No. 1. Due to the limited working space, archaeologists excavated only 420sq m of the site. Similar to the Bridge No. 1, this wood-structured bridge crossed the Wei River in a north-south direction. The space between the westernmost and easternmost piles is 8.3m, and that

between each two lines of piles from north to south are 6–7m (Figure 17). The length of the bridge is unknown, since both ends are covered by construction waste and a current road.

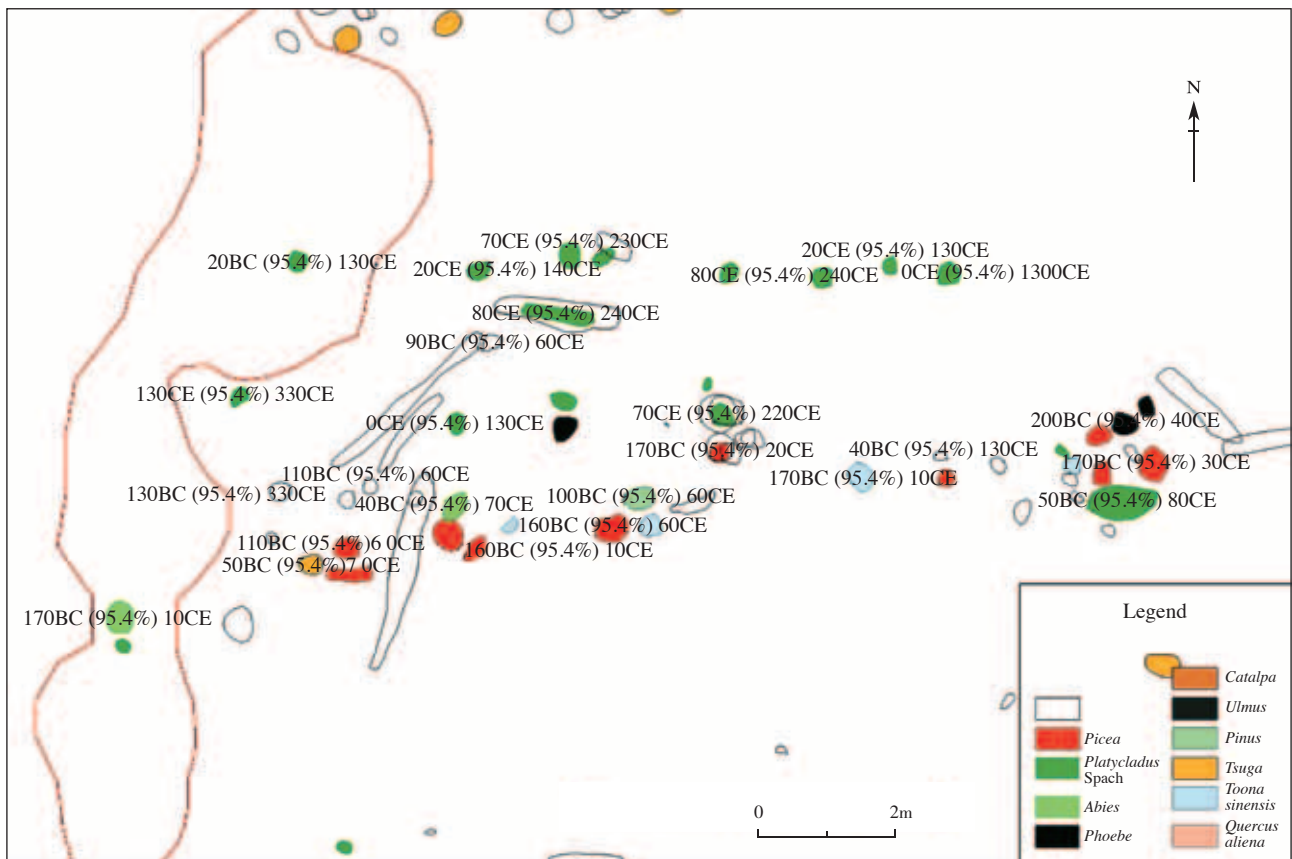
Around the piles is a circular wall made of cobble stones, with sand inside. The piles are imbedded in the sand. The range of the circular wall is unknown due to the limited excavation.

2. The artifacts. Building materials of roof tiles and bricks are the majority of the artifacts; others include pottery and porcelain sherds, coins and iron nails.

Brick: sample T7350 ⑦ :9 is bluish-gray in color and rectangular in shape with one end a little narrower. It is decorated with cord mark. On one end is a seal of two



**Figure 15** The stone weights unearthed at the Chucheng Gate Bridge No. 1. 1 and 4. 2013CQI gathered:1758; 2 and 3. 2013CQI gathered:1601.



**Figure 16** The distribution of the wood species and dating results of the piles of the Chucheng Gate Bridge No. 1.



characters “Zhao Tong 趙同.” The brick measures 27.4cm long, 12.7cm wide and 5.84cm thick at the thicker end (Figure 18).

Flat roof tiles: all of them are broken, gray in color, and are either plain or decorated with fine or coarse cord marks.

Cylindrical roof tiles: sample T7151 ⑦ :5 has part of its end attached. The surface of the roof tile is decorated with cord marks, and inside with specks. The end is decorated with bands and horizontal S patterns. The remaining length is 12cm. The diameter of the tile-end is 12cm and its thickness, 1cm.

Tile-ends: there are four different motifs of cloud, animal figure, lotus and plain with only bands appeared on the roof ends.

Sample T7350 ⑦ :1 is decorated with four groups of cloud patterns and various bands and nipples. The diameter is 12.4cm and thickness is 1cm (Figure 19).

3. The date. The Center for Scientific Archaeology of the Institute of Archaeology, CASS tested the piles, confirmed that most of the materials they used are hard pines (Subgenus *Pinus* L.). The <sup>14</sup>C Lab at Peking University tested the wood samples and dated them to 660–780 CE, corresponding to the Tang Dynasty (Figure 20).

#### Chucheng Gate Bridge No. 4

The Chucheng Gate Bridge No. 4 was found 40m to the west of the Bridge No. 1. Due to the limited working space, only five piles in north-south direction are revealed. The space between the easternmost and westernmost piles is 4m, and that between two lines of piles in north-south direction is 5.2m. The calibrated <sup>14</sup>C date of the latest pile is 390–200 BCE, corresponding to the late Warring-States Period.

#### The Luocheng Gate Bridge

The Luocheng Gate Bridge is located north of the Gaomiao Village of Weiyang District, Xi'an. The bridge directly faced the Luocheng Gate of the Han Chang'an city to the south. The distance between the bridge and the gate is 750m. 3500m to the north of the bridge is the dyke of the south bank of the present day Wei River. The ancient bridge had been damaged prior to the excavation, and three piles were exposed by sand extracting.

The wooden bridge runs north-south. The space between the outer surfaces of the easternmost and



Figure 17 Full-view of the Chucheng Gate Bridge No. 3 (S–N).

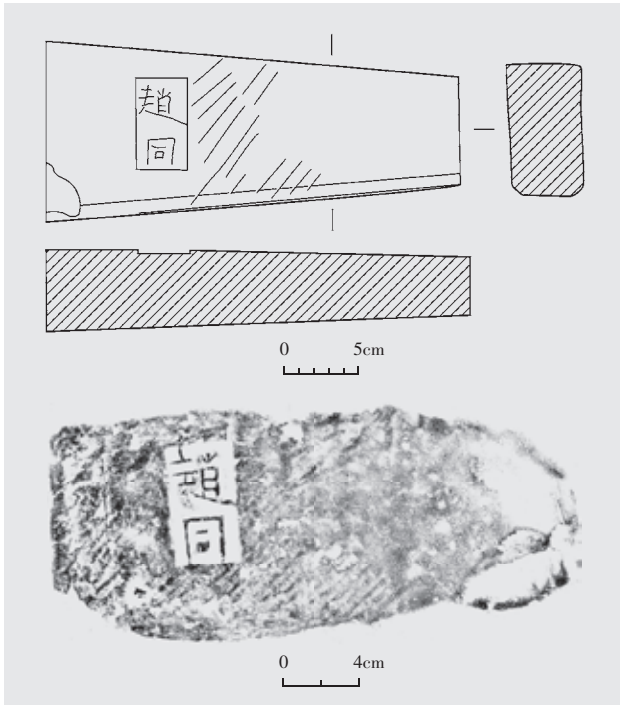


Figure 18 Brick unearthed at the Chucheng Gate Bridge No. 3 (T7350 ⑦ :9).

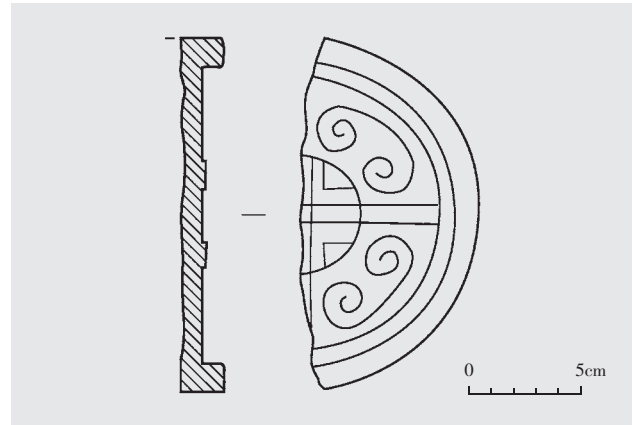


Figure 19 Tile-end unearthed at the Chucheng Gate Bridge No. 3 (T7350 ⑦ :1).

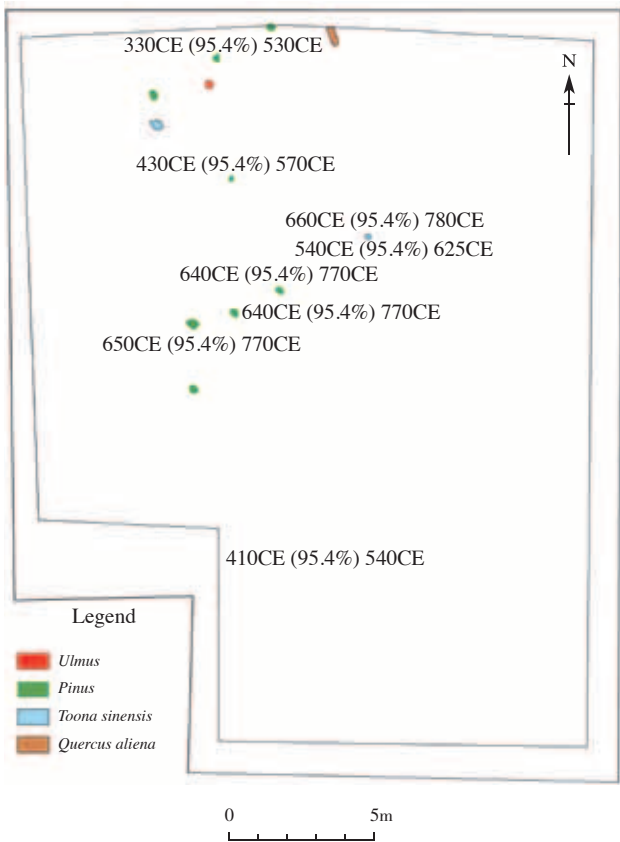


Figure 20 The distribution of the wood species and dating results of the piles of the Chucheng Gate Bridge No. 3.

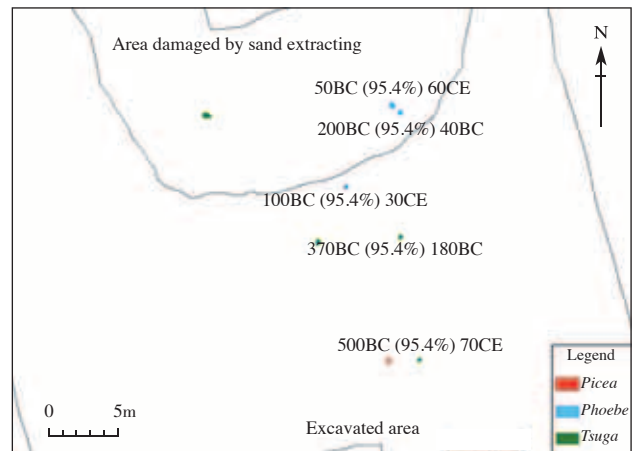


Figure 21 The distribution of the wood species and dating results of the piles of the Luocheng Gate Bridge.

westernmost piles is 15m. So far, eight piles in three rows have been recovered, and the space between the adjacent rows is 9-10m. The length of the bridge is unknown since the site on each end of the bridge is covered by garbage and road. The calibrated date of the bridge is 50 BCE–70 CE (Figure 21).

### Conclusion

Based on the <sup>14</sup>C dates of the four bridges excavated from 2012 to 2013, the earliest bridge built across the Wei River is the Chucheng Gate Bridge No. 4 dated to the late Warring-States Period. The next are bridges of Chucheng Gate Bridge No. 1 and the Luocheng Gate Bridge corresponding to the Eastern Han to the Western Jin Dynasties. Chucheng Gate Bridge No. 3 is the latest, corresponding to the Tang Dynasty.

The restoration map of the Han Chang'an City names the river north of the city as Zao 洮 River. This is incorrect. The only river to the north of the Han Chang'an city during the Qin and Han Dynasties was the Wei River. A story told in the chapter *Chengdi ji* 成帝纪 (Annals



of Emperor Cheng) of *Hanshu* (Book of Han, by Ban Gu) said that in the third year of Jianshi Era (30 BCE), a young girl named Chen Chigong 陈持弓 who lived near the bank of the Wei River, heard that a flood was coming. She quickly entered the Guang 横 Gate of Chang'an City, and from there to the Weiyang Palace in the south. The story shows that there was no other river between the Wei River and Chang'an City. Similar records could be found in the *Shuijing zhu* (Commentary on the Water classic, by Li Daoyuan of the Northern Wei Dynasty), and the Chang'an Gazetteer. In the former, the author mentioned in chapter 19 that the Wei River flows east on the north side of Chang'an city. The city was built by the Emperor Hui of the Western Han. It took six years for him to finish the construction. The latter states in chapter 12 that "Chang'an is the name of an old settlement, which was located south of the Wei River. Across the river on the north of the settlement is the Xianyang Palaces of the Qin Dynasty. The Han court placed its Weiyang Palace in the land of the settlement, and called the outer city Chang'an." All pointed out that the Chang'an City faces the Wei River to the north. Thus, the bridges excavated should be that crossing the Wei River.

According to historic documents, there were three bridges crossing the Wei River from the Han to Tang Dynasties. One of them, the Zhong Wei Qiao (or the Middle Wei Bridge) was built by the King Zhao of the Qin State or Emperor Qin Shihuang. The capital construction plan of the Qin Dynasty was to build the capital with "the Wei River passing through the capital city, as if to simulate the Heavenly River (the Milky Way); by crossing the bridge, one recaptures the story of the Girl Weaver and the Cowherd (in heaven)." The other two bridges, the Eastern and Western Wei Bridges were built in the reigns of Emperor Jing and Emperor Wu. The three bridges were all in use during the Tang Dynasty.

Archaeologists identified and excavated the Eastern Wei Bridge in the early 1980s, but until the recent excavations of the bridges mentioned above, we had no actual knowledge of the other bridges. The number of bridges excavated from 2012 to 2013 has exceeded the number of bridges recorded in the historic document. The large scale and the rather complete layout of the

bridge structure of Chucheng Gate Bridge No. 1 provided valuable information of bridge construction in Qin and Han Dynasties. It is so far the largest wooden bridge we know about from that period. The unearthed hefty stone components nearby indicate that the sophisticated bridge construction techniques had already been applied to the erection of the bridges.

Based on the <sup>14</sup>C data, the Chucheng Gate Bridge No. 3 was built during the Tang. It is likely the Middle Bridge of the Tang. The other two bridges, the Chucheng Gate Bridges Nos. 1 and 4 should be the bridges mentioned in the historic documents prior to the Tang. Due to its large scale, the Chucheng Gate Bridge No. 1 is more likely the Middle Wei Bridge of the Qin and Han. However, many historic texts documented that the Middle Bridge is also called the Guang Bridge since it was built outside the Guang Gate of the Han Chang'an City. We should be cautious to make such a relationship. Until we confirm archaeologically that there is no bridge outside the Guang Gate, we cannot be sure that the Chucheng Gate Bridge No. 1 is the famous Middle Wei Bridge in history.

The Wei River was located just outside the Han Chang'an City, but it has moved quite far from the old city today. Many scholars believe that Wei River shifted northward about 2m per year. The unearthed Qing coins near the bridge indicate otherwise. It shows that at least in the 18th century, the main course of the Wei River still stayed where the historic bridges (Qin, Han and Tang) were. In other words, the shifting of the Wei River did not occur prior to the Qianlong Era of the Qing Dynasty. This fact adds new information to our understanding of environmental history of the Wei River Valley in the Guanzhong area.

## Postscript

The original report published in *Kaogu* 考古 (Archaeology) 2014.7:34–47 with 25 illustrations was authored by Rui Liu 刘瑞, Yufang Li 李毓芳, Zhiyou Wang 王志友, Yongchu Xu 徐雍初, Zili Wang 王自力 and Yi Chai 柴怡. This abridged version is prepared by Rui Liu, Zhiyou Wang and Zili Wang and translated into English by Wa Ye 叶娃.