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The large houses of Xiahe Site in Baishui County, Shaanxi

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Abstract

This paper discusses the characteristics and significance of the three large pentagonal semi-subterranean houses of the Miaodigou Phase (F1, F2 and F3) at the Xiahe Site in Baishui County, Shaanxi Province. The construction of these houses comprised six steps. The living floors were plastered with lime made from calcareous nodules obtained from the local loess formation. F1 was built on the primary earth surface; wherein F2 was built on the foundation of F3, which was previously burnt to the ground. The living floor of F1 occupied 304.5sq m, making it the largest house structure of its archaeological phase ever found. We maintain that these structures might have been used for religious and communal occasions. The findings of these remarkably large houses are significant to the understanding of the manipulation and organization of resources in the Xiahe community. Furthermore, the technological achievements indicted by them are deemed to be the precursor of palatial architectures in China.

Keywords: Foundations (structural elements)–Neolithic Age; houses; Xiahe Site (Baishui County, Shaanxi); Yangshao Culture

Introduction

Baishui County situates in the northeast of Shaanxi Province. The Shaanxi Provincial Institute of Archaeology has conducted a series of archaeological reconnaissance and excavations in this area since 2003. In addition to material remains diagnostic to Keshengzhuang 客省庄 Phase II Culture, the area in the vicinity of Xiahexi Village also yielded cultural remains diagnostic to Dongzhuangcun, Miaodigou and Xiwang phases. Among the various cultural depositions, that of the Miaodigou Phase occupied areas of 40ha in total and yielded remains of six large-sized house foundations. This paper discusses the characteristics and significance of three of the large houses (F1 to F3) revealed during the 2010 field excavation.

The architectural style and relative chronology

All the three large houses, F1, F2 and F3, were invariably south-facing pentagonal semi-subterranean structures. They consisted of the doorway, hearth, living floor, and the inner and outer walls. In addition to the stratigraphy and material remains, their plans also yielded clues to their relative chronology. Pentagonal semi-subterranean houses were seen in F201 of Quanhucun Site in Huaxian County, F1 of Shuibei Site in Binxian County, both of which in Shaanxi Provicne, F102, F104 and F106 of Xipo Site in Lingbao County, and F301 and F302 of Miaodigou Site in Shanxian County, both of which in Henan Province; hence, placing the relative chronology of the large houses in Xiahe Site in question to the late Miaodigou Phase.

The excavators argue that pentagonal semi-subterranean house was "one of the primary forms of the houses of Yangshao Culture." They are comparable to similar house forms of the Ainu people of Sakhalin Island in Russia, Neolithic Japan, and Khanty in Siberia. Based on historical and ethnographic documents, Prof. Yang Hongxun attempted a reconstruction of F302 of Miaodigou. The pentagonal structures discussed here should be comparable to Yang's reconstruction based on the record in the *Kaogongji* (the Artificers' Record) of *Zhouli* (Rites of Zhou) that "*qiwu san fen, wawu si fen* 葺屋三分，瓦屋四分 (the [height of the] thatched roof is one third [of the longitudinal length of the house], and the [height of the] tiled roof is one fourth [of the longitudinal length of the house])".

Professor Yan Wenming partitioned the houses of Yangshao era (7000–5000 BP) into three classes by size. Structures occupied under 30sq m were small houses, those occupied 30–60sq m were medium houses, and those occupied 60–300sq m were large houses. To date, a small number of large Yangshao houses have been brought to light by archaeologists. Xipo is the most impressive that it yielded four large house foundations. They include F102, which occupied 98sq m; F104, which occupied 106sq m; F106, which occupied 240sq m; and finally F105, which occupied 516sq m, with an estimate of 204sq m living floor. Other examples include F201 of Quanhucun, which occupied 220sq m and F1 of Shuibei, which occupied 190sq m. In all, large houses were rare findings in Yangshao archaeology. They were outstanding architectural features of the time.

Albeit rare, large houses were one of the elements of the Yangshao architectural tradition. They shared characteristics with other house features of the Banpo

Culture. For examples, pentagonal plan, semi-subterranean foundation, load-bearing post networks, sloped doorway, large composite hearth, and calcareous-treated living floor were often seen in the houses of Banpo Phase. These characteristics could be traced to the earlier Laoguantai Culture distributed in the same geographic region. For example, F4 of Guantaoyuan Site in Baoji was a shallow rectangular semi-subterranean feature (Figure 1) with living floor paved with a lime solution derived from pulverized calcareous nodules. It had 13 postholes symmetrically distributed on the sides of the feature, and a pillar posthole located in the center. Feature F7 of the same site was a circular semi-subterranean structure (Figure 2). It had a sloped doorway, lime-paved living floor, eight postholes symmetrically distributed on both sides of the house. F1 of Banpo was a rectangular semi-subterranean structure that occupied about 160sq m. It had four large postholes located on the living floor, surrounding which were small wattle postholes and wall-shoring postholes. Furthermore, F36 of Jiangzhai Site was a rectangular semi-subterranean structure (Figure 3). Its living floor occupied 39.69sq m. The sloped doorway was connected to a composite hearth. It had 11 perimeter postholes, four internal postholes and two doorway canopy postholes. The living floor was paved with a layer of daub baked to a reddish brown hue. The above descriptive accounts outline the development of house structures from Laoguantai Culture to Banpo Culture and then to F1 and F2 of Xiahe. It included a development from rectangular semi-subterranean foundation to pentagonal semi-subterranean

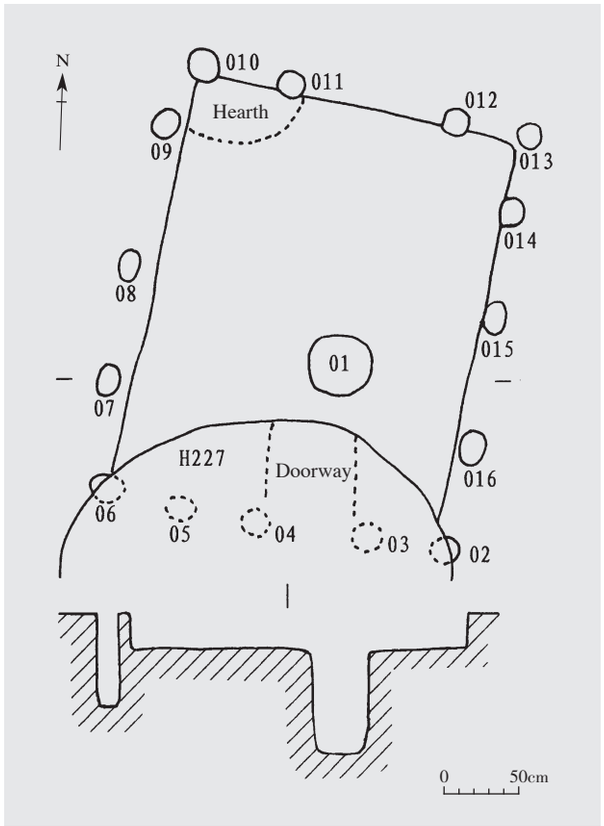

Figure 1 The plan and section of F4 of Guantaoyuan Site in Baoji.

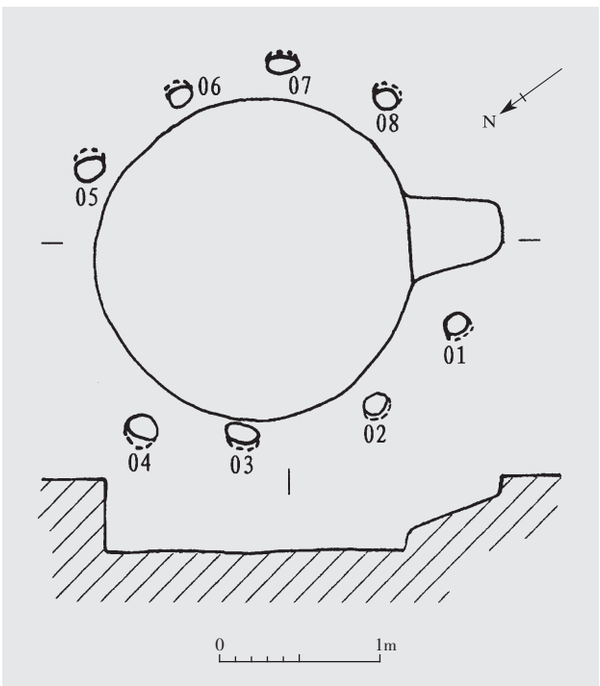

Figure 2 The plan and section of F7 of Guantaoyuan Site in Baoji.

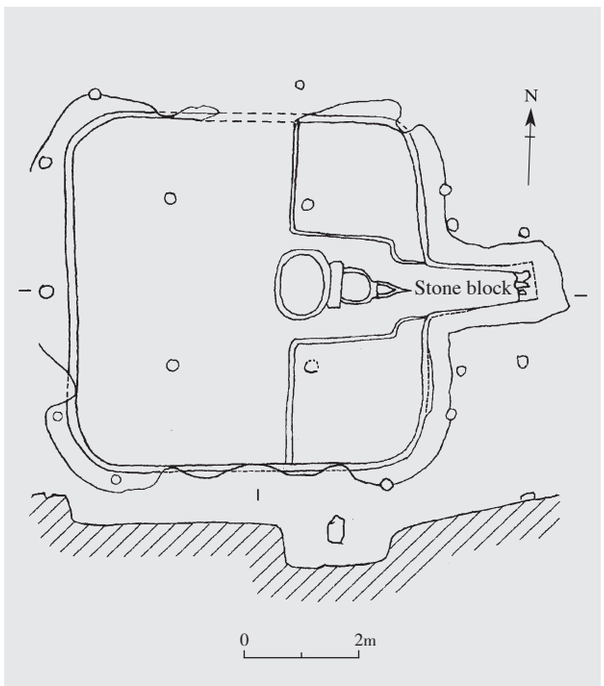

Figure 3 The plan and section of F36 of Jiangzhai Site in Lintong.

foundation, from simple grid of posts to complex lattice of posts, from sloped doorway to canopied sloped doorway, from surface hearth to deep composite fire pit, from calcareous treated living floor to lime-ash floor. All these suggest an indigenous development of technological tradition in architect. This tradition eventually developed into the multi-roomed large houses of F901 at Dadiwan, and F1–F4 at Dahecun of the late Yangshao era. Moreover, the large houses of the middle to late Yangshao era were the technological forerunners of the palatial structures of later times. They marked the beginning of palatial architectures of ancient China.

Construction processes

1. The construction of F1 of Xiahe Site comprised six steps.

The first was the foundation treatment. A semi-subterranean foundation larger than the house itself was dug and the foundation floor was treated, which included lining the floor with two layers of rammed pure loess.

The second was post and wall erecting. There are three suggestions on this step: (1) the processes of foundation treatment alternated with that of post and wall erections; (2) the posts were planted and the walls were built after the digging of the foundation; and (3) upon the completion of foundation treatment, the wall foundation was dug, the posts were planted and then the walls were built. The last speculation can be eliminated from consideration because on the one hand, it is inefficient and on the other hand, it is inconsistent with the evidences. The section of the east part of F1 suggests that the sequence of construction started with the digging of the foundation pit, followed by the digging of wall trenches, and then the planting of posts and the building of walls. The latter two steps alternated each other. The above sequence was the most economical way of construction. The inner and outer walls were likely built simultaneously. For instance, layer 3 of the inner wall was linked to layer 8 of the outer wall, and their colors and textures were indistinguishable from each other. They were likely built with the same batch of daub. The texture of the daubed wall body was compact. Although no obvious posthole was found in the outer wall, a few postholes were found in the eastern section of the south outer wall, indicating posts were used to shore up the outer wall.

The third was the living floor treatment and internal post planting. After completion of the inner and outer walls, the foundation floor was leveled, part of the inner wall foundation was dug away, and the living floor (i.e., application of daub and lime plaster) was paved, and finally the internal posts were raised.

The fourth was the construction of the sloped doorway and the hearth.

The fifth was the fixing of the wood structures, thatching the roof, installing the smoke funnel and building the doorway shelter.

The final step was interior finishing and decorating.

2. Feature F2 was a downsized structure built on the occupation floor of F3, which was lost to fire. Therefore, the construction process of F2 was, to a certain extent, conditioned by F3. The construction of F3 also consisted of six steps.

The first was the selecting of the site and the processing of the semi-subterranean foundation that consisted of digging a pit and leveling the floor, baking the living floor with fire to harden and damp-proof it by interrupting the capillary effect.

The second was the erecting of the pilasters (posts engaged in the walls) and building the wall. The wall trenches and the postholes were dug and the wall-shoring posts and the engaged posts were erected, and then the walls were built layer by layer and section by section. Meanwhile, a lattice of small wattle posts was built on the outer side of the wall body.

The third was treating the living floor and raising the internal posts. The internal postholes were dug, and the living floor was paved with mud tempered with straw and a layer of stucco of lime made from the calcareous nodules was coated. When the internal posts were erected, the postholes were filled and rammed to firm.

The fourth was raising the beams, thatching the roof and installing the smoke exhaust.

The fifth was constructing the doorway and the composite hearth. Although no posthole was revealed in the doorway, it was likely a shelter was built here.

The final was the interior finishing and decorating. The platform (i.e., the inner wall body) was plastered with a daub of mud tempered with straw. At last, red pigment was applied on the living floor and walls.

3. F2 was rebuilt on the foundation of F3. Its construction also included six steps.

The first was the foundation treatment. The debris of F3 were cleaned and leveled. Part of the wall body of F3 was removed and the postholes were filled.

The second was erecting the pilasters and building the wall body. The wall trenches were dug and the posts planted in the needed sections (e.g., the west section of the south wall). In some parts, only the postholes were dug and the wall built directly on the occupation floor of F3 (e.g., the east section of the north wall). Wherein, in other areas, part of the primary soil and the wall body of F3 were removed and the wall was erected (e.g., the outer wall of F2 as seen on the east section of the north wall). After the posts were erected, the burnt earth clods of F3 were broken up and used with potsherds, small pebbles and mud tempered with straw to build the inner wall. Pure loess was used to build the outer wall.

The third was the treatment of the living floor and erection of the indoor pillars. The floor of F3 was plastered with a layer of daub followed by a layer of lime stucco and then the internal posts were erected.

The fourth was raising the timber frame and thatching the roof, and installing the smoke exhaust.

The fifth was building the doorway and the composite hearth. The north wall of the hearth of F3 was reused.

The ash remains of the abandoned F3 were overlaid with a layer of daub at 60cm below the living floor of F2. The fire channel was dug to connect the hearth with the doorway. The depths of the doorway and the ground surface immediate outside the doorway were adjusted to meet the heights of the fire channel and floor.

The final step was the interior finishing and applying pigment on the walls.

In general, the construction of the three large houses in Xiahe Site comprised six steps. However, the sequence of the steps cannot be firmly determined yet. Each of the house structures had some unique architectural characteristics. These differences can also be seen in the house structures of other sites of the Yangshao Age. The comparison between these unique features would facilitate a better understanding of the technical tradition of Yangshao architectural engineering.

The origin of lime stucco floor

Lime treatment was a common flooring technology during the Miaodigou Phase II and early Longshan Age in prehistoric China. The first documented finding was that of Anyang in Henan discovered by Liang Siyong in 1931. Lime stucco-plastered floor has been thoroughly studied by a number of scholars and remains of lime kilns have been widely archaeologically uncovered in China. Chronologically, lime floor was first seen on F405 and F901 of Dadiwan Site in Qin'an County, Gansu. They were baked from locally available calcareous nodules.

Calcareous nodule is a loess concretion (also known as loess doll). It is formed from the slow leaching of minerals hard to weather such as quartz. Studies of the chemical composition of calcareous nodules suggest that they comprised calcite (40–50%), quartz (30%) and clay. The main element of calcite and quartz is calcium carbonate ($CaCO_3$), which is also the main compound of lime stone. Carbon dioxide (CO_2) releases when these minerals were fired to 1000 to 1300° C, forming quicklime. When mixes with water, quicklime turns into slaked lime. The firing temperature of pottery is 900 to 1100° C. This was the atmosphere of the kiln technology of the Yangshao Age could have achieved, and thus satisfied the atmospheric requirement of lime production. Li Zuixiong studied the wear resistance, strength, and ^{14}C dates of Yangshao lime floor and the chemical process of lime from loess calcareous nodule. He concluded that lime baking technology was very similar to that of cement technology and coined it "the earliest cement." The lime floors of all the three large houses discussed above were made of calcareous nodules. They were the earliest evidences of lime flooring in Chinese archaeology.

The use of calcareous nodules in floor treatment can be traced as early as to the Laoguantai Culture (8000–7000 BP). The living floors of F4 and F7 of Guantaoyuan Site in Baoji were paved with plaster made of pulverized calcareous nodules. This way was continued in use during the Banpo Culture (7000–6000 BP). It was observed that F6 of Beigan 北橄 Phase I showed "the living floor was lined with a 10cm layer of calcareous concretions and small burnt clay nodules. It was then followed by a 5cm layer of daub made of mud and straw." The technology of using calcareous nodules for surface treatment was widely seen in the features of Phase II and III of Yuanzitou Site in Longxian County. It was applied to the walls, living floors, doorways, and hearths of house structures and then followed by layers of daub and fine clay. Five houses of Phase II and nine houses of Phase III of Yuanzitou Site were treated with this technology, suggesting that calcareous concretion had been used in house building for a long time.

The above building technology had been further developed and dispersed during the Miaodigou Culture (5500–5000 BP). Features using this technology included F302 of Miaodigou Site, F1 of Nandiancun Site in Xi'an, F102, F104, F105 and F106 of Xipo Site in Lingbao, F1 of Shuibei in Binxian, and the house features of Qinjiatan in Chencang District, Baoji. Yan Wenming viewed the practice of applying a thin mortar made of pulverized calcareous nodules and fine sand to make a leveled living floor during the Miaodigou Phase was the precursor of lime flooring of the late Yangshao Age.

The use of lime for floor and wall treatment was wide-spread during the Xiwangcun (5500–5000 BP) Culture.

The use of calcareous concretion in architecture originated from Laoguantai Culture, further developed during the Banpo Culture, and evolved into the use of lime during the Miaodigou Culture. Lime baking and using became wide-spread during the Xiwangcun Culture. The technology was further refined during the Longshan Age that lime became increasingly pure and fine. Lime plaster is still commonly seen on the modern walls of China. This technology began in the Wei River valley and gradually spread eastward during prehistoric and historic times. The present archaeological data indicate that the sites widely using calcareous technology included Yuanzitou Site in Longxian and Dadiwan Site in Qin'an. We therefore argue that the origin of this long-lasting architectural technology originated in the region of western Guanzhong Plain and eastern Gansu.

Conclusion

The excavation of the large house structures of Xiahe Site at Baishui County provided a unique angle for the in-depth discussion of ancient society. From these remains, we can see the forerunner of palace structures and the continuity of architectural style, and the beginning, development and diffusion of lime flooring technology. It also inspires the discussion on the human behaviors after the abandonment of the houses, the manipulation and organization of resources in the construction of large structures among ancient human groups. The Xiahe excavation opens a window to monitor the operation and various traditions of past human group, as well as raising new questions for future studies.

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Postscript

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