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New evidence for ball games in Eurasia from ca. 3000-year-old Yanghai tombs in the Turfan depression of Northwest China

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ABSTRACT

Three leather balls discovered in tombs IM157, IM209, and IM214 of the prehistoric Yanghai cemetery (42°48'N, 89°39'E) located about 43 km southeast of the modern city of Turfan, were AMS radiocarbon dated to the time interval between 1189 and 911 BCE (95% probability), and thus predate other currently known antique balls and images of ball games in Eurasia by several centuries. Our study approves the antiquity of the Yanghai balls, but the available data is not enough to answer the question how these balls were played. Although, their use in team and goal sport is likely, a suggested game similar to hockey, golf or polo cannot be confirmed, because no appropriate sticks were found in direct association with the balls. The affiliation of curved wooden sticks in Yanghai with ball games suggested earlier remains hypothetical, as all found sticks are noticeably younger in age, and other forms of use should be verified by future studies. Two of the three balls were found in the burials of the possible horse riders. Given that ball games from ancient times were considered an excellent form of physical exercise and military training, we suggest that balls (and ball games) appeared in the region at the same time as horseback riding and mounted warfare began to spread in the eastern part of Central Asia.

1. Introduction

Ball games are the most numerous and most popular professional sport and leisure games in the modern era all over the world. However, their popularity is a very ancient phenomenon. Intriguing questions about the time and place of origin and the way of playing encourage archaeologists and historians to search for the answers in different countries and regions.

The oldest known balls and ball games are reported from ancient Egypt. Found in a child's tomb at the Tarkhan necropolis (grave 518) on the west bank of the Nile 50 km south of Cairo, was a toy ball dating ca. 2500 BCE (Mendoza, 2017, 180). It was made of linen rags, which were rolled into a ball, and tied together with a string. One wall painting from the tomb of Khety at Beni Hasan dating to the Twelfth Dynasty (i.e. 1991–1802 BCE) shows two men with sticks and a ball engaged in what looks like an archaic form of hockey. This indicates that ball games played an important part in certain rituals executed by the Egyptian royalty, apart from serving to develop strength, stamina, and team spirit (Decker, 1992, 115).

Mesoamericans played ball games since at least 1700 BCE as known from figurines depicting players, more than 2300 probable ball courts, i.e. monumental stone architecture, and paraphernalia (Blomster, 2012; Blomster and Chavéz, 2020). It was played in different ways, but most widespread was the version in which the ball had to be hit with one's hips. No additional devices like stick, bat, mallet or racquet was involved. The earliest examples of rubber balls in Mesoamerica date to around 1600 BCE (Ortiz and Carmen Rodríguez, 79, 89, 2000; Filloy Nadal, 27, 2001). For the Maya and Aztec civilisations, the ball game was of fundamental ritual and political importance to maintain life, cosmic order and state power (Uriarte, 2001, 40).

On the Eurasian continent, however, direct evidence of ball games as images and objects are known from much later periods as suggested by pictorial art from Greece dated to ca. 500 BCE (Kosmopoulou, 2003, 167) and by archaeological evidence from China dated to ca. 200 BCE (Gansu Province Museum, 1981). The discovery of three leather balls, ten curved wooden sticks, and horse gear in graves of the late 2nd millennium BCE - early 1st millennium CE Yanghai cemetery (Turfan Administration of Cultural Relics et al., 2019) located in the north-

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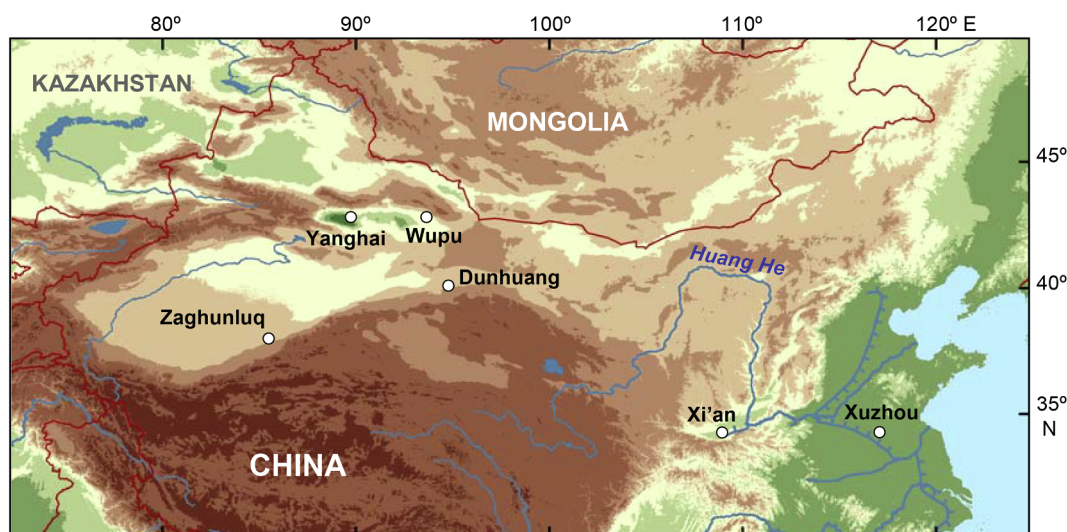


Fig. 1. Topographic map showing the location of the Yanghai cemetery archaeological site in the north-eastern part of the Turfan depression and other sites referred to in this article.

eastern part of the Turfan depression (Fig. 1) attracted great attention of scientists and general public. The excavated items were discussed and suggested as paraphernalia for stick-and-ball game and even as the oldest evidence of polo in Eurasia (Chen, 2014). In the current study, we verified this hypothesis by discussing the age and shape of the curved wooden sticks and their possible alternative use. The main aims of this study are to present technical details, the first determination of the absolute age and the archaeological context of the ancient balls, as well as discuss their possible use by reviewing the archaeological and historical sources of ball games in Eurasia and China.

2. Archaeological background, site setting and studied objects

2.1. The Yanghai cemetery

The prehistoric Yanghai cemetery (42°48'N, 89°39'E) is located in the north-eastern part of the Turfan depression, about 43 km southeast of the modern Turfan city. The area has extreme dry and continental climatic conditions. While temperatures reach an average of around −9.5 °C in January, summers are very hot with an average temperature around 32.7 °C in July. The mean annual precipitation is only 16 mm high (Domrös and Peng, 1988). Because of this extremely hot and arid environment, a large quantity of organic materials is naturally preserved in the ancient graves, including textiles, leather, wood as well as human, animal and plant remains (see for example Wang, 2001; Wagner et al., 2009; Beck et al., 2014; Kramell et al., 2014).

The Yanghai site was first discovered in the early 1970s. More than 500 tombs were excavated by a team of the Xinjiang Institute of Archaeology and the Administration of Cultural Relics of the Turfan Prefecture since 2003 on an area of about 54,000 m², which is subdivided into the three zones I–III (Turfan Administration of Cultural Relics et al., 2019): 218 tombs were excavated in zone I (i.e. IM1–IM218), 223 tombs in zone II (i.e. IIM1–IIM223), and 80 tombs in zone III (i.e. IIIM1–IIIM80). Almost all tombs were disturbed. The archaeological works revealed a long period of use. The earliest tombs date from around the 12th century BCE and the latest to the 2nd century CE.

To date, only a small part of the wealthy archaeological information from the Yanghai cemetery has been published internationally (Jiang et al., 2006, 2007, 2009). In 2014, the first results of a direct age determination and manufacturing the oldest known trousers found in tombs IM21 and IM157 (Beck et al., 2014), as well as an analysis of the fibres and dyes of various textile finds (Kramell et al., 2014) were published. The trousers from Yanghai with straight-fitting legs and a

wide reinforced crotch area, together with horse gear and weapons as grave goods in both tombs, specified former assumptions that the invention of bifurcated lower body garments is related to the new epoch of horseback riding, mounted warfare and greater mobility (Beck et al., 2014; Wagner et al., 2020).

The Yanghai cemetery is generally attributed to the Subeixi archaeological culture which is dated to the 1st millennium BCE (Chen, 2002; Han, 2007; Turfan Administration of Cultural Relics et al., 2019). Associated with this culture domain is the Cheshi (Chū-shih) state, which existed until the beginning of the 1st millennium CE as known from Chinese historical sources (Sinor, 1990; Zhang and Rong, 1998). Both the historical and archaeological data confirm that the people from the Cheshi state led an agro-pastoralist life (e.g. Wang, 1999; Ghosh et al., 2008; Li et al., 2013).

2.2. Leather balls from the Yanghai cemetery

Three leather balls were excavated from the tombs IM157, IM209, and IM214 in the central section of Yanghai cemetery zone I (Fig. 2, Table 1). Tomb IM157 was covered by a layer of gravel and sand (Turfan Administration of Cultural Relics et al., 2019, 180). The opening of the grave was 0.9 m below the topsoil. The vertical pit had an elliptic outline (1.52 m long and 0.86 m wide) and was 2.62 m deep. It contained the remains of one male deceased of about 40 years age, who had been placed on top of a wooden framework. He was buried in a flexed position, with his head pointing to the east. He wore a leather coat, coloured woollen trousers and red leather boots with bronze buttons. A coloured braided band adorned with cowries was tied around his forehead. A 41 cm long item made of tamarisk twigs was found next to his head and identified as a head ornament. The twigs were wrapped with black felt, while the lower part of the artefact was made of horsehair and the upper part was woollen yarn. The deceased wore a necklace with beads of turquoise and bone, and an arm protector made of red cow leather on the left forearm, the accessory of an archer (Turfan Administration of Cultural Relics et al., 2019, 13 and 180). A short whip with a wooden handle, a leather bow sheath, a composite bow and a horsetail (length 26.8 cm) decorated with bands and tassels made of red and blue threads, and fixed with a copper band, identify the deceased as a horse rider and possibly as a mounted warrior. The burial further contained a wooden bowl and a sheep skull. The ball IM157:4 (diameter of 8.6 cm) was found in the south-eastern corner of the grave. It is marked with a red cross (Fig. 2.1) on the outer leather cover, which is sewn together at one side, and stuffed with leather strips.

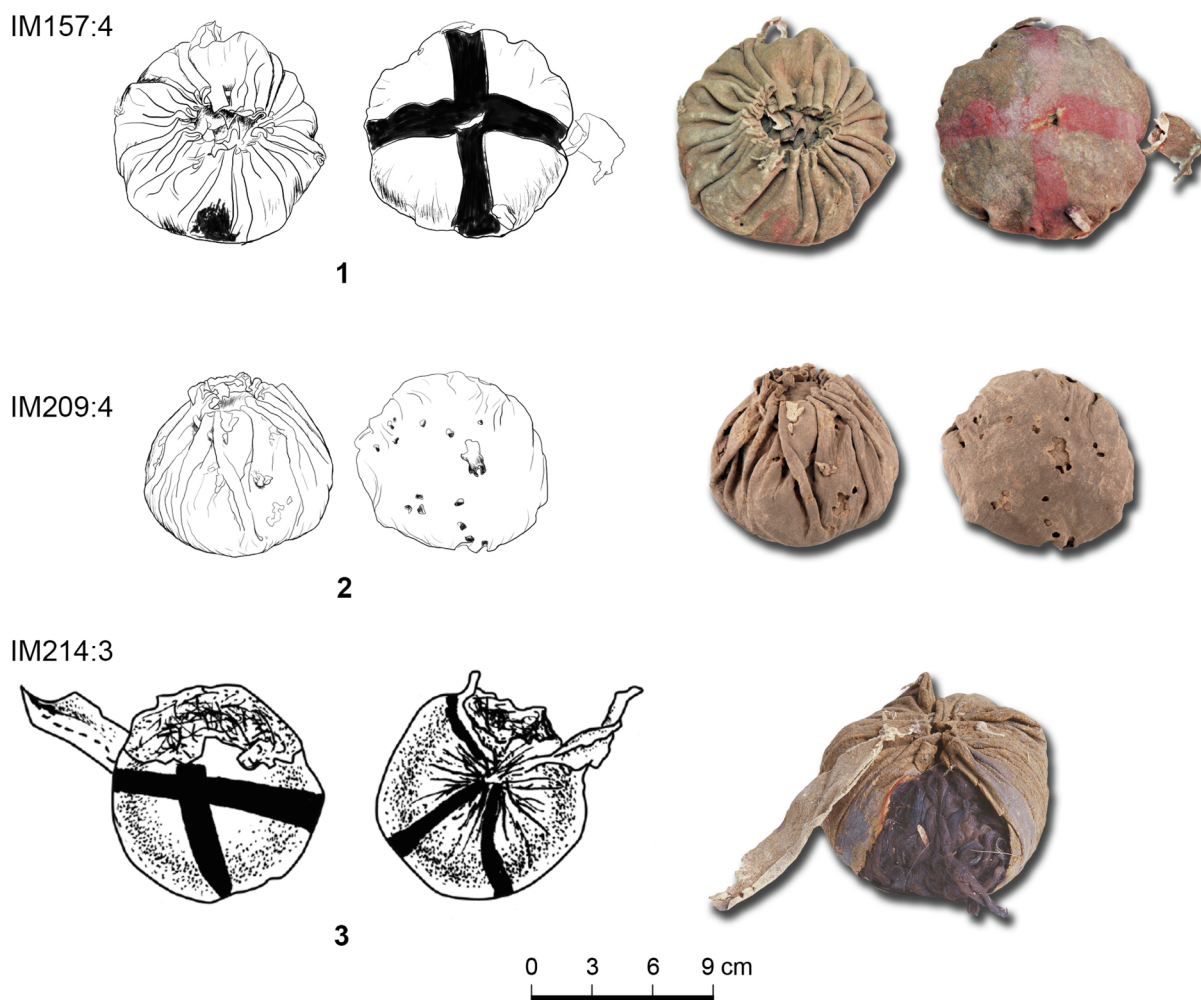


Fig. 2. Three leather balls unearthed from the Yanghai cemetery with their corresponding tomb and object numbers. Photos: X.Y. Chen and P. Wertmann.

Tomb IM209 had an elliptic outline (1.2 m long and 0.7 m wide) and was 0.8 m deep (Turfan Administration of Cultural Relics et al., 2019, 233). Due to earlier looting, the human remains and burial items were not found in their original positions. Only the skull and lower limb bones of a 20–25-year-old deceased male could be found as well as his leather boots and fragmentary woollen clothes. Furthermore, fragments of five braided bands of various colours, a short whip with a wooden handle which points to horse riding, and items related to archery, including a leather bow sheath with a painted red cross on its outside, a wooden bow as well as a red arm protector made of cow hide similar to the one from tomb IM157. Same as the ball from tomb IM157, ball IM209:4 (diameter of 9.2 cm) consists of an outer leather cover, which is sewn together at one side and stuffed with pieces of leather (Fig. 2.2).

The opening of tomb IM214 was 0.18 m below the topsoil (Turfan Administration of Cultural Relics et al., 2019, 239). Found inside were the skeletal remains of an adult male lying in a flexed position. His skull was missing. Two tattoos could be identified on the back of his hand. Among the collected items from the grave are a pair of leather boots and one braided plait of human hair. The leather ball IM214:3 (diameter of 9.2 cm) consists of an outer cover sewn together at one side, and stuffed with threads made of hair. Like the ball from tomb IM157, also this one is marked by a painted red cross (Fig. 2.3).

3. Results and discussion

In this section, we concentrate our discussion on the following main topics: (1) the absolute age of the balls, (2) their possible use based on

comparison with the known historical ball games in China and Eurasia, (3) the evidence related to horse riding in Yanghai as a prerequisite for playing polo, and (4) the possible function of the curved wooden sticks from the Yanghai cemetery, which were suggested as attributes of a stick-and-ball game similar to hockey or polo.

3.1. Radiocarbon chronology

Based on the examination of the tomb constructions and artefact typology as well as ^{14}C -dates where available, tombs IM209 and IM214 are dated to the early occupation phase of the Yanghai cemetery between the 13th and 11th centuries BCE (Turfan Administration of Cultural Relics et al., 2019, 618). Grave IM157 is dated by the archaeologists to the interval between the 10th and 8th centuries BCE (Turfan Administration of Cultural Relics et al., 2019, 615). However, the calibrated age of the wool thread (Table 2) from the trousers excavated from this tomb (Kramell et al., 2014, 226) is noticeably older, i.e. 1225–1028 BCE (95% probability range). For the purpose of the current study, we obtained three additional ^{14}C dates representing tombs IM157, IM209 and IM214, respectively (Table 2). The radiocarbon dates were converted into calendar dates using the IntCal13 calibration curve (Reimer et al., 2013) and the OxCal v4.2.3 software package (<https://c14.arch.ox.ac.uk/oxcal.html>; Bronk Ramsey, 1995) for calculations.

The results of radiocarbon dating and calibration are summarized in Table 2 and in Fig. 3. The recently obtained radiocarbon dates confirm and narrow down the ages of the analysed graves given by the

Table 1
Leather balls excavated from the Yanghai cemetery site, Shanshan county, Turfan (after [Turfan Administration of Cultural Relics et al., 2019](#)).

Tomb no	Ball design and material	Figure in text	Diameter	Deceased	Armor/Equipment related to riding
IM157	sheepskin pulled together with a leather thread, stuffed with leather strips, marked with a red cross	2.1	8.6 cm	1 male, ca. 40 years old	leather arm protector, leather bow sheath, composite bow, horse tail with tassel and copper band, wooden whip
IM209	sheepskin pulled together with a leather thread, stuffed with leather strips	2.2	7.4 cm	1 male, 20–25 years old	leather arm protector, leather bow sheath marked with red cross, wooden whip
IM214	sheepskin pulled together with a leather thread, stuffed with threads of hair, marked with a red cross	2.3	9.2 cm	1 adult male	none

excavators based on the typological features of the tomb constructions and artefacts. Thus, tombs IM209 and IM214 can be securely assigned to the intervals 1189–916 BCE and 1107–911 BCE (i.e. 95% probability), respectively. The additional date for tomb IM157 on horse hair 1127–931 BCE (95% probability) gives an age between the estimates of the excavators and the direct date on the wool trousers. Altogether the three Yanghai balls date to the period from the early 12th to the late 10th century BCE, which makes them the oldest of the currently known antique balls in Eurasia.

3.2. Archaeological and historical evidence of ball games in Eurasia and China

A quick overview of known historical ball games in Eurasia and China can help to discuss the balls from Yanghai and their possible functions. The Greeks played a ball game resembling field hockey at least ca. 500 years BCE, as illustrated on the base of a funerary statue from Kerameikos, Athens. Shown is a group of six men with curved sticks, two of them rivalling for a ball between them ([Kosmopoulou, 2003, 167](#)). Ball games were considered an excellent form of physical exercise and pleasure and served as important means of military training ([Wilson, 309–310, 2006](#); [Crowther, 154, 2007](#); [Miller, 120–125, 2012](#)). It is believed that the Celts introduced a stick-and-ball game into Western Europe in the first millennium BCE, which became the Irish hurling, deeply imbued with heroic and mythical connotations ([O'Sullivan, 1998, 32–43](#)). However, the oldest surviving balls and curved wooden sticks are much younger, i.e. between 400 and 800 years old ([O'Sullivan, 2017](#)).

In China, the oldest known ball dates from mid-Western Han dynasty (202 BCE to 9 CE) and was found in 1979 at the Maquanwan site, northwest of Dunhuang, Gansu province ([Fig. 1](#)). It has a diameter of 5.5 cm and consists of a silk and cotton core tied together with a band of hemp and silk ([Gansu Province Museum, 1981](#); [Fig. 4](#)). One of the earliest preserved definitions of a ball is provided by the *Comprehensive Meaning of Customs and Habits* written around 195 CE by Ying Shao, according to which “a ball stuffed with hair is called ball” ([Li, 1960](#)). The two Chinese characters for ball, i.e. “*qiu*” (球) and “*ju*” (鞠), provide further hints to the material used for producing a ball. While the first character contains the ideogram “(animal) hair” or “feather”, the second one includes the ideogram “leather”.

Six pictorial bricks from an Eastern Han dynasty (25–220 CE) tomb close to Xuzhou ([Fig. 1](#)), Jiangsu province, present images of equestrian players chasing after a ball with a curved or ‘hooked’ stick ([Li and Zheng, 2014](#); [Fig. 5](#)) being the earliest pictorial evidence of polo (i.e. a horseback mounted team sport) in Eurasia. They refute older assumptions that polo was introduced to China by the Tubo people from Persia ([Xiang, 1957](#); [Diem, 1982](#)) or from Tibet during 6th/7th century CE ([Laufer, 541–542, 1916](#); [Yin, 41, 1959](#)).

It is argued that polo was first played by the nomadic peoples of Central Asia sometime after the domestication of horses ([Chehabi and Guttman, 2002](#); [Laffaye, 2009](#)). Later this game was patronized by the rulers of the Parthian Empire (247 BCE to 224 CE), who got it from the Scythians migrating to the Iranian plateau from the south-eastern corner of the Caspian Sea ([Laffaye, 2009](#); [Ellerbrock and Winkelmann, 2015](#)). Clear archaeological evidence would be necessary to corroborate this assumption, which so far mainly rests on much later literary works and miniature paintings ([Diem, 104–119, 1982](#); [Chehabi and Guttman, 388, 2002](#)). The *Book of the Deeds of Ardashir, Son of Papak* from the 7th century CE is considered the oldest written evidence for the Parthian fashion of polo ([Diem, 106, 1982](#); [Chehabi and Guttman, 384, 2002](#)). Mentioned here is a polo match between Ardashir I (reign 224–242 CE), founder of the Sasanian dynasty, and the last king of the Parthians Ardavan V (reign 212–223 CE). For the Sasanians, polo became a favoured pastime and an important element in the princely education ([Nicholson, 2018, 1206](#)), and, just like the hunt, an effective means to achieve proficiency in the art of warfare ([Chehabi and](#)

Table 2

The radiocarbon dates used in this study were calibrated to calendar ages using OxCal v4.2.3 software package (<https://c14.arch.ox.ac.uk/oxcal.html>) and IntCal13 calibration curve (Reimer et al., 2013). The calibrated dates are shown in calendar years before Common Era (BCE).

Grave number	Laboratory number	Dated material/ context	Date (^{14}C yr BP)	Calibrated dates (years BCE)				
				68% probability		95% probability		Median
				From	To	From	To	
IM214	Poz-74990	Wool/ball filling	2835 \pm 30	1023	931	1107	911	989
IM157	Poz-74991	Horse hair	2870 \pm 30	1110	1003	1127	931	1042
IM157	Poz-43696	Wool/trousers	2935 \pm 30	1209	1089	1225	1028	1142
IM209	Poz-74992	Thread from tassel	2860 \pm 40	1107	946	1189	916	1029

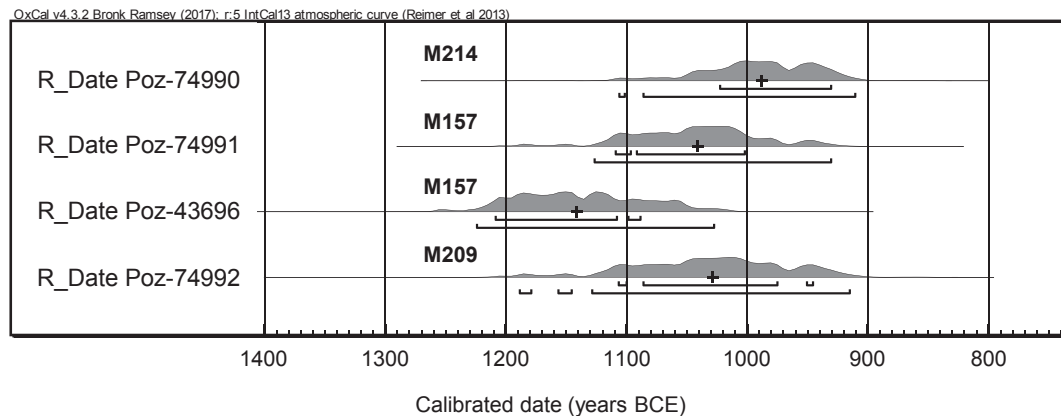


Fig. 3. Probability densities at 68% (upper square brackets) and 95% (lower square brackets) confidence level and medians (+) of calibrated AMS ^{14}C dates associated with the three leather balls from Yanghai discussed in this study.

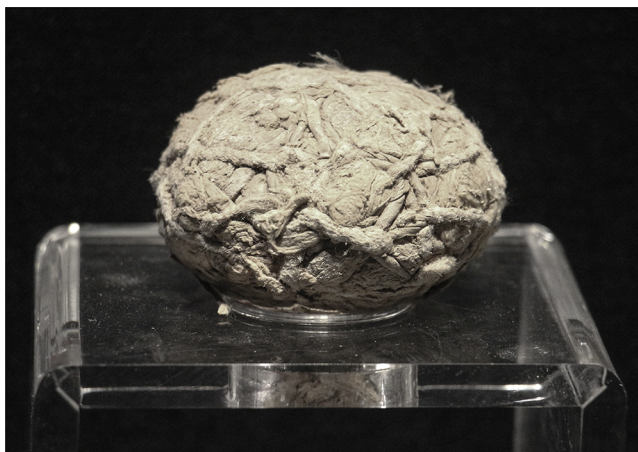


Fig. 4. Western Han dynasty ball discovered at the Maquanwan site, Dunhuang, Gansu province. Photo: P. Wertmann.

Guttmann, 386, 2002; Canepa, 180, 2009). From Persia, the game spread to the Byzantine Empire in the west, where Emperor Theodosius II (reign 408–450 CE) had a polo stadium built in his capital Constantinople in the 5th century CE (Diem, 121, 1982; Chehabi and Guttmann, 390, 2002; Laffaye, 6, 2009). The royal support of polo was continued by the Turkic and Mongol rulers in the 11th century CE (Chehabi and Guttmann, 386, 2002; Laffaye, 6, 2009).

In China a number of images of polo playing can be found in the tombs of the Tang aristocracy. Examples are found in the tombs of Li Xian, Crown Prince Zhanghuai, at the Qianling mausoleum (Shaanxi Museum et al., 1972; Fig. 6), and that of Li Yong (died 728 CE), one of the satellite tombs of emperor Gaozu's Xianling mausoleum in Fuping county, Shaanxi province (Shaanxi Institute of Archaeology, 2012; Fig. 7). The depicted balls in both tombs show the same mark, i.e. a painted cross, like the two Yanghai balls

from tombs IM157 und IM214. Red colour is confirmed in a text dating from the Yuan dynasty (1271–1368 CE), the *Records of Rites and Ceremonies in the Book of Jin*, in which balls used for playing polo are described “as small as a fist, produced of light but strong wood, and painted in red” (Fang, 2002). In 1972, a Tang dynasty figurine of a polo player was excavated from tomb 230 at the Astana cemetery in Turfan, and an actual polo field from the 14th century CE was identified in the Tashkurgan Tajik Autonomous County (Cultural Relic Survey Office of the Autonomous Region, 1993, 34). A foundation stone discovered in 1956 on the former grounds of the imperial Daming palace in the capital Chang'an (modern Xi'an, Shaanxi province), commemorates the building of the Hanguang hall and a polo field in 831 CE (Liu, 1985, 207).

Texts of the Tang dynasty and later periods define the shape and use of sticks in ball games. Yan Kuan mentioned in his *Rhapsodies on the Imperial Ball Game at the Thermal Springs* in 747 CE, that a ball is “hit with a crescent-shaped stick” (Wang, 1965). The *Records of Rites and Ceremonies* from Yuan dynasty (1271–1368 CE), in reference to polo, specifies that “each person rides the horse that he is familiar with. He holds a stick which is several chi long [1 chi equals to ca. 30.7 cm], and the end of it is shaped like a crescent moon.” (Fang, 2002). Both sources describe the sticks, at least the head of it, as crescent-shaped.

Depictions of polo players on an 8th–10th century CE stone relief at the Dai An site, Quang Tri province, Vietnam, and on the 13th century CE northern staircase of the elephant terrace of Angkor Thom indicate the arrival of polo in South East Asia (Green, 2013; Guy, 34, 2014). It was not until the 13th century CE that Indians began to play polo, then introduced by the Mughal conquerors (Diem, 234, 1982; Chehabi and Guttmann, 396, 2002; Laffaye, 8, 2009). Again, all evidence mainly rests on literary works and paintings.

In China another game, the so-called chuiwan (literally “beating a ball”), developed out of polo sometime during the Tang dynasty (Gui, 2012; Tianjin Museum, 2017, 121). A detailed description of the chuiwan-game is given in the 13th century CE account “The Book of Chui Wan” (Wan Jing; Gui, 2012, 285). According to this, each player had his own ball, which had to be struck into a hole in the ground, similar to modern golf (Gui et al.,

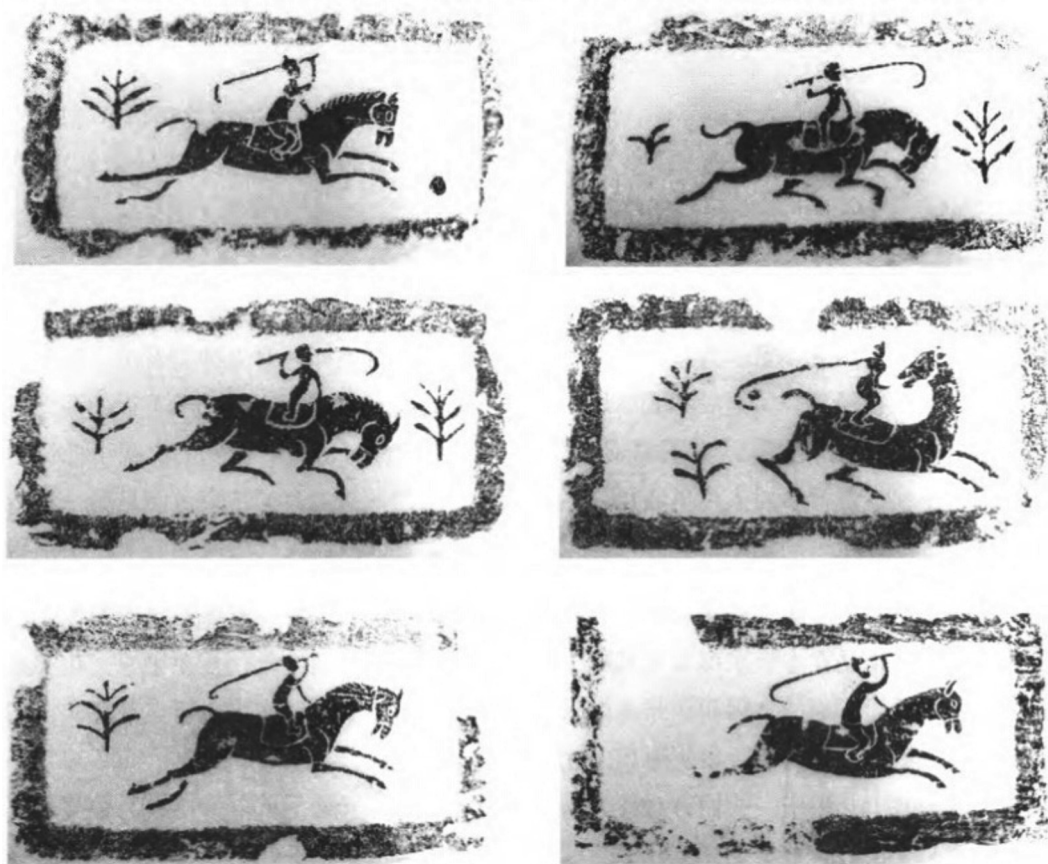


Fig. 5. Pictorial bricks from an Eastern Han dynasty tomb close to Xuzhou, Jiangsu province. Rubbing: Li and Zheng (2014, 104-105).



Fig. 6. Polo scene from the Tang dynasty tomb of Li Xian, Crown Prince Zhanghuai, at Qianling Mausoleum, Shaanxi province. Photo: X.Y. Chen.

2012, 285). A Song dynasty pictorial brick from the collection of the Henan Museum is assumed to present a chuiwan-player (Fig. 8.1), and original chuiwan-balls made of burned clay or wood from the Tang and Song dynasties have been found (Fig. 8.2-3). A Song dynasty depiction in Yulin cave no. 15, Guazhou county, Gansu province, ca. 100 km east of the oasis town of Dunhuang (Fig. 1), shows a boy playing with a ball and crescent-shaped stick (Fig. 9). Whether he was playing chuiwan or hockey cannot be decided. Still today, games like chuiwan and field hockey are played in China, among them, the so-called Boikoo Tarkbei of the Daur people in

China's north-eastern Heilongjiang province, who claim to be descendants of the nomadic Khitan people, i.e. the founders of the Liao dynasty in the 10th century CE (Yi, 1997; Liu, 2011; Bai, 2014). Used for this game is a wooden stick, and a ball made of wood or animal hair, which can be tied with threads of hemp (Yi, 1997, 71). The Uyghur people in Khotan in the south-western part of Xinjiang, play Marra Ball or Qumake similar to the hockey played by the Daur. Since when these games have been played is unclear, but they are both believed to have evolved from the earlier chuiwan (Abuduwali and Qian, 2014, 90).



Fig. 7. Polo scene from the tomb of Li Yong, Fuping county, Shaanxi province. Photo: P. Wertmann.



Fig. 8. Chuiwan player and balls. 1 – Pictorial brick from the Song dynasty, Henan Museum; 2 – Chuiwan-ball from the Tang dynasty, Shaanxi History Museum, Xi'an; 3 – Tang dynasty Chuiwan-balls, Qiong kiln site, Chengdu, Sichuan province. Photos: P. Wertmann.

Summing up, we can say that the prehistoric balls excavated in Yanghai are very similar in size (i.e. small as a fist), material (i.e. have a core of hair or other soft material and are enclosed in a leather case tied together with a band) and decoration (i.e. painted with a red cross) to some of the analogues known from much younger historical periods. Such balls could be used for ball games, although at the moment we cannot say what kind of game it was. Given the historical parallels above, identifying the Yanghai balls as game balls is compelling enough, while other potential functions are less likely. The light weight of the leather balls from Yanghai speaks against their use as hunting weapon, such as bolas (e.g. [Stanford, 38, 1976](#); [Jensen, 2007](#); [Vecchi and González, 2018](#)), or with a sling ([Dohrenwend, 2002](#); [York and York, 2011](#)). Their function as archery targets is possible but cannot be proved due to the lack of visible arrow marks.

3.3. Evidence of horse riding from the Yanghai cemetery

In the entire Yanghai cemetery altogether 24 cheek pieces, 4 bits, 11 bridles, and 28 whips were excavated from 40 tombs that date to the period between the 12th and 10th centuries BCE ([Turfan Administration of Cultural Relics et al., 2019](#)), which correlates to the three graves with

leather balls. Finds from other archaeological sites in Xinjiang imply that the use of horses was widespread across the area of present-day Xinjiang around this time (e.g. [Wagner et al., 2011](#); [Schröder et al., 2016](#)).

Securely dated examples are a horse bridle unearthed from tomb IM21 in Yanghai (1038–926 BCE, [Kramell et al., 2014](#)), from tomb 86HWM3 of the Wupu cemetery, Hami region (1108–901 BCE, [Schröder et al., 2016, 1724](#)) and single horse skulls, bridles and snaffle bits as well as the detection of palaeopathological features on human remains associated with frequent horse riding at the Liushui site of mobile pastoralists located in the Kunlun Mountains about 2850 m above sea level and dated to between ca. 1110 and 500 BCE ([Wu et al., 2006](#); [Schultz et al., 2007](#); [Wagner et al., 2011](#)). The three cemetery sites of Mohuchahan ([Xinjiang Institute of Cultural Relics and Archaeology, 2016](#)), Chawuhu ([Xinjiang Institute of Cultural Relics and Archaeology, 1999](#)), and Qunbake ([Xinjiang Team of the Archaeological Institute of the Xinjiang Academy of Sciences et al., 1991](#)) located at the southern slopes of the Tianshan Mountains all exposed clear evidence related to the riding of horses for the time between the 10th and 6th centuries BCE.

So far no chariot or parts of chariots from this time have been found in Xinjiang as they are known from late Shang dynasty elite burials at Yinxi in Anyang, ca. 1250 to 1050 BCE ([Linduff, 147, 2003](#); [Yuan et al.,](#)



Fig. 9. Painting of a boy with a stick and ball from cave no. 15, Yulin caves, Guazhou county, Gansu province. Photo: X.Y. Chen.

2008, 86). The rather late introduction of domesticated horses and their use for chariotry and riding in China is a still understudied subject which merits special attention in a separate paper. However, for the time period of the Yanghai balls presented in this paper, horseback riding is ascertained in the region. Although, ball game on horses in the Yanghai area between the 12th and 10th centuries BCE cannot be ruled out, since a horse-riding equipment was found in the same graves with the balls, the balls could have also been used in other types of games, for example, by tossing them with the hands or by hitting them with the feet, such as the traditional Chinese game featherball (chin. *Jianzi*) in which the players aim to keep a shuttlecock in the air by using their feet, or the western hacky sack in which a small, round bag filled with sand is kicked into the air.

3.4. Curved wooden sticks from the tombs of the Yanghai cemetery

The oldest depictions of ball game from Eastern Han dynasty (25–220 CE) show equestrian players with curved sticks, meaning the early history of ball game in China was so far associated with polo. Logically, when three balls and ten wooden curved sticks were unearthed from the Yanghai burials (Table 3, Fig. 10; Turfan Administration of Cultural Relics et al., 2019), they were discussed as paraphernalia of stick-and-ball games, and possibly evidence of the earliest polo game in China and Eurasia (Chen, 2014). Next, we evaluate the available archaeological information to test this hypothesis.

The fact is that none of the sticks were found in direct association with the balls. For none of the tombs with the curved sticks absolute age determination was done and the chronological periods were determined by the excavators based on position of the tombs, features of tomb construction, and artefacts. According to the excavation report, the oldest curved stick (IM173:4) is from the time interval 10th–8th century BCE, eight sticks are from 7th–4th century BCE, and one (IIM42:3) from a much later period (3rd century BCE to 2nd century CE). All owners of the tombs including a wooden curved stick were male; two were accompanied by a second person, in one case a child of unidentified sex and in the other case a woman. Six of the ten burial assemblages contained bows, one of them also contained horse gear (a bone snaffle bit was found in tomb IIM13, compare Turfan Administration of Cultural Relics et al., 2019, 256) identifying the men as hunters, but only one as a possible equestrian (grave IIM13, 7th–4th century BCE).

Table 3
Curved wooden sticks excavated from the Yanghai cemetery site, Shanshan county, Turfan (after Turfan Administration of Cultural Relics et al., 2019).

Tomb no	Material and Design	Figure in text	Deceased	Armor/signs of riding	Period
IM173	polished wood, 100° angle, slightly bend grip, flattened head	10.1	1 male, 25–35 years old	leather bow sheath, composite bow, 3 wooden arrows	10th–8th century BCE
IIM13	tamarisk wood, 115° angle, short broad head with almost round ending	10.2	(1) male, 40–50 years old; (2) female, 18–22 years old	bone bit, 1 horn cheek piece, composite bow, 23 wooden arrows	7th–4th century BCE
IIM45	willow wood, 135° angle	10.3	1 male, 45–55 years old	composite bow	7th–4th century BCE
IIM61	only grip and part of handle preserved, leather band tied around	10.4	1 male, 34–45 years old	composite bow	7th–4th century BCE
IIM72	120° angle, shaft ends in a grip	10.5	1 male, ca. 30 years old	composite bow, 1 wooden arrow	7th–4th century BCE
IIM166	only shaft preserved, thick end serves as grip	10.6	(1) 1 male, 25–30 years old, (2) sex unclear, 11–12 years old	none	7th–4th century BCE
IIM180	130° angle, flat shaft and head relatively thick grip	10.7	1 male, 25–35 years old	none	7th–4th century BCE
IIM190	willow wood, 100° angle, relatively thin handle and grip, thick and node-shaped head	10.8	1 male, 20–25 years old	composite bow, 10 wooden arrows	7th–4th century BCE
IIM210	85° angle, flat, with grip, reinforced with leather strips pulled through drilled holes	10.9	1 male, 25–35 years old	none	7th–4th century BCE
IIM42	90° angle, flat head slightly thinner than shaft, grip not preserved	10.10	(1) male, above 55 years old; (2) female, 50–65 years old	none	3rd century BCE – 2nd century CE

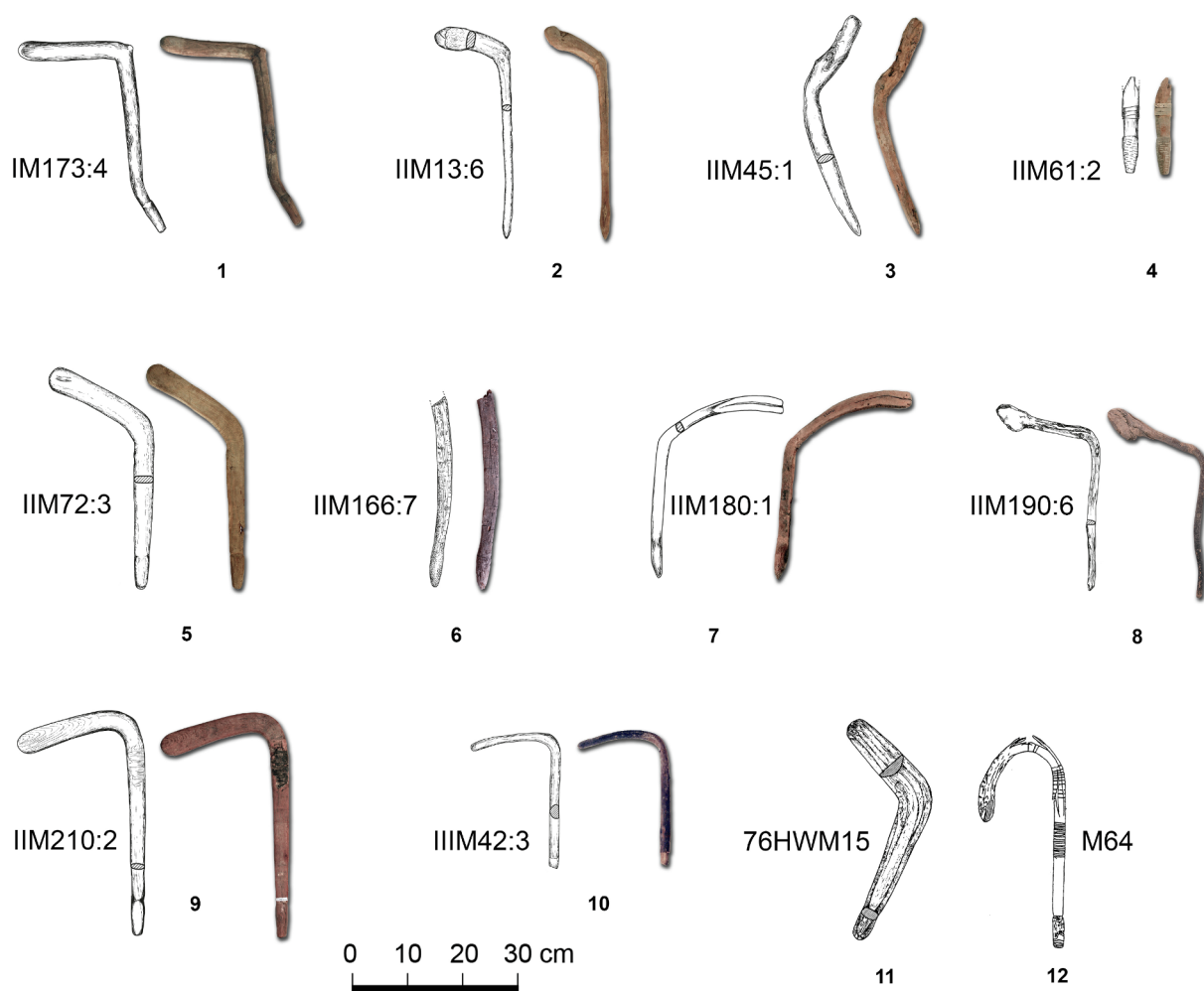


Fig. 10. Wooden curved sticks with their corresponding tomb and object numbers unearthed from the archaeological sites in Xinjiang: 1–10 are from the Yanghai cemetery, 11 – from the Wupu cemetery and 12 – from the Zaghunluq cemetery. Drawings 1–10 are after Turfan Administration of Cultural Relics et al. (2019, 200, 256, 286, 302, 312, 400, 413, 422, 441, 517, 567, 581), 11 – after Luo (2009, 85) and 12 – after Xinjiang Museum et al. (2003, 26).

Despite different states of conservation, all curved sticks are similar in shape and manufacturing. They are made of polished wood. IIM13:6 (Fig. 10.2) was identified as tamarisk and IIM45:1 (Fig. 10.3) and IIM190:6 (Fig. 10.8) were made of willow. When comparing the Yanghai curved sticks with traditional hockey sticks, the part ending in a grip might be considered the handle. The partly flattened wider part might be the head. However, handles and heads appear to be of nearly same length. In two cases (Fig. 10.2 and 10.9) the handle is longer, but in three cases (Fig. 10.1, 10.3, 10.5) the handle is shorter than the head. Furthermore, the heads are straight and do not show the typical J-shaped hook of the field hockey sticks as depicted on the Greek relief (Kosmopoulou, 2003, 167) and of the polo sticks of Eastern Han and Tang dynasty time (Figs. 5–7). With their short handle and wide angles ranging between 85° (IIM210:2) and 135° (IIM45:1), the Yanghai sticks instead resemble the hockey (chuiwan) sticks from the Song dynasty (Fig. 8.1).

Another hypothesis concerning the usage of the curved Yanghai sticks was suggested by the excavators, who favour an interpretation as throwing tool to hunt small prey such as rabbits and hedgehogs (Luo, 2009; Turfan Administration of Cultural Relics et al., 2019, 311). A similar suggestion was made for a comparable item excavated from Wupu cemetery site in Hami dated to the 4th–2nd century BCE (Fig. 10.11; Luo, 2009, 85). The handle of the Wupu stick has a length of 20 cm and a width of 7.2 cm, the head is 25 cm long and 9 cm wide, 135° angle. One more hooked stick was excavated at Zaghunluq cemetery site (8th–1st century BCE), Qiemo county (Fig. 10.12), and interpreted as tool for tanning leather (Xinjiang Museum et al., 1998, 26).

A further possible use could be linked to the grooming of horses, i.e. as a sweat scraper. Due to the lack of a direct association and temporal connection between the curved sticks with balls in Yanghai, their use for playing ball games cannot be confirmed. Furthermore, the absence (in all cases but one) direct association of sticks with horse riders leaves the existence of 'polo', 'hockey' or 'golf' in the Turfan region during the 1st millennium BCE unprovable. Their original function remains to be further investigated.

4. Conclusions

Three leather balls discovered in tombs IM157, IM209, and IM214 of the Yanghai archaeological cemetery site, Shanshan county, Turfan, were AMS radiocarbon dated to the time interval between 1189 and 911 BCE (95% probability), thus predating other currently known antique balls and images of ball games in Eurasia by several centuries.

The approved old age of the Yanghai balls in combination with horse-riding equipment and curved wooden sticks, reported from the same archaeological site got scientific and public attention and raised a discussion on whether these finds could be the oldest evidence for stick-and-ball games such as polo in China and Eurasia. Our study supports the antiquity of the Yanghai balls, but the available data in hand is not enough to answer the question of how these balls were played. Their use in team and goal sport is likely, but a game similar to hockey, golf or polo cannot be confirmed, because no contemporary curved sticks were found in association with the balls. Other usages of the sticks (for

example, for hunting, leather tanning, horse grooming) cannot be excluded and should be verified by future studies.

Two of the three balls were found in the burials of armed riders. The deceased in tomb IM157 wore trousers, which were identified as one of the earliest known examples and belonged to a new era of riding, equestrian warfare and greater mobility. Given that ball games have been considered an excellent form of exercise and military training since ancient times, we can assume that they emerged at the same time as horseback riding and the rider caste began to spread in eastern Central Asia. The obtained results once again highlight that this region was one of the centres of innovations several millennia ago.

CRediT authorship contribution statement

Patrick Wertmann: Conceptualization, Investigation, Writing - original draft. **Xinyong Chen:** Conceptualization, Investigation. **Xiao Li:** Resources. **Dongliang Xu:** Resources. **Pavel E. Tarasov:** Formal analysis, Writing - review & editing. **Mayke Wagner:** Writing - review & editing.

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