
SINO-PLATONIC PAPERS

Number 344

May, 2024

From Chariot to Carriage: Wheeled Vehicles and Developments in Draft and Harnessing in Ancient China

by

Joost H. Crouwel, Gail Brownrigg, and Katheryn Linduff

Victor H. Mair, Editor

Sino-Platonic Papers

Department of East Asian Languages and Civilizations

University of Pennsylvania

Philadelphia, PA 19104-6305 USA

vmair@sas.upenn.edu

www.sino-platonic.org

SINO-PLATONIC PAPERS

FOUNDED 1986

Editor-in-Chief

VICTOR H. MAIR

Associate Editors

PAULA ROBERTS

MARK SWOFFORD

ISSN

2157-9679 (print) 2157-9687 (online)

SINO-PLATONIC PAPERS is an occasional series dedicated to making available to specialists and the interested public the results of research that, because of its unconventional or controversial nature, might otherwise go unpublished. The editor-in-chief actively encourages younger, not yet well established scholars and independent authors to submit manuscripts for consideration.

Contributions in any of the major scholarly languages of the world, including romanized modern standard Mandarin and Japanese, are acceptable. In special circumstances, papers written in one of the Sinitic topolects (*fangyan*) may be considered for publication.

Although the chief focus of *Sino-Platonic Papers* is on the intercultural relations of China with other peoples, challenging and creative studies on a wide variety of philological subjects will be entertained. This series is *not* the place for safe, sober, and stodgy presentations. *Sino-Platonic Papers* prefers lively work that, while taking reasonable risks to advance the field, capitalizes on brilliant new insights into the development of civilization.

Submissions are regularly sent out for peer review, and extensive editorial suggestions for revision may be offered.

Sino-Platonic Papers emphasizes substance over form. We do, however, strongly recommend that prospective authors consult our style guidelines at www.sino-platonic.org/stylesheet.doc.

Manuscripts should be submitted as electronic files in Microsoft Word format. You may wish to use our sample document template, available here: www.sino-platonic.org/spp.dot.

All issues of *Sino-Platonic Papers* are free in PDF form. Issues 1–170, however, will continue to be available in paper copies until our stock runs out.

Please note: When the editor goes on an expedition or research trip, all operations may cease for up to three months at a time.

Sino-Platonic Papers is licensed under the Creative Commons Attribution-NonCommercial-NoDerivs 2.5 License. To view a copy of this license, visit <http://creativecommons.org/licenses/by-nc-nd/2.5/> or send a letter to Creative Commons, 543 Howard Street, 5th Floor, San Francisco, California, 94105, USA.

From Chariot to Carriage:
Wheeled Vehicles and Developments in Draft and Harnessing in Ancient China

Joost H. Crouwel, University of Amsterdam

Gail Brownrigg, Dorking, UK

Katheryn Linduff, University of Pittsburgh

ABSTRACT

Chariots drawn by horses harnessed in pairs under a yoke appeared in China, without apparent local antecedents, in burials of the late Shang dynasty (ca. 1200–1045 BCE). The system of paired draft and their characteristic design – two large, multi-spoked wheels set on a long axle placed centrally under the wide body – remained virtually unchanged for nearly a thousand years. By the time of Emperor Qin Shihuang (ruled 221–210 BCE), covered traveling vehicles in which the passenger could sit or recline had been developed. The two superb bronze models from his tomb have enabled a study of the details of their construction and harnessing. Under the Western Han dynasty (206 BCE–9 CE), an innovative type of vehicle emerged – the prestigious, lightweight carriage for swift personal transport drawn by a single horse between shafts, harnessed with a breaststrap. Like the chariots, they were driven from the box; the occupants knelt or reclined rather than stood. Though the use of breast traction continued to be the traditional form of harnessing horses, mules and donkeys in China, the fast carriages in their turn went out of fashion after the end of the Eastern Han period (24–220 CE), to be replaced by a stately, slower-moving vehicle with a single draft animal between the shafts, controlled by an attendant on foot.

INTRODUCTION

The earliest animal traction system known comprised two bovids placed side by side under a yoke attached to the front end of the draft pole of an implement such as a seed drill or a sledge and later a wheeled vehicle. The yoke could be placed in front of the withers, or on either the nape of the neck or the forehead and lashed to the horns. The central draft pole served to pull, brake and steer the vehicle, and, for a two-wheeler, provided longitudinal balance (Littauer and Crouwel 1979: 15–36).

Teams of equids – most likely “kungas,” a cross between a domestic donkey and an onager – are shown drawing two- and four-wheeled vehicles on figured documents of the third millennium BCE in the Near East (Littauer and Crouwel 1979: 23–28).¹ On the famous Standard of Ur from southern Iraq, dated to about 2,500 BCE, they are harnessed four abreast with broad neckstraps attached to the yoke (Littauer and Crouwel 1979: fig. 3) (Figure 1). Although sometimes mistakenly called a chariot, the vehicle they pull is better described as a battle-wagon,² having four tripartite disc wheels.



Figure 1. A “battle wagon” depicted on the Standard of Ur (after Littauer and Crouwel 1979, fig. 3).

The first chariots – with two spoked wheels, generally drawn by horses and entered from the rear by the passengers, who travel standing, not seated – are depicted in the Near East by the beginning of the second millennium BCE (Littauer and Crouwel 1979: 68–71; Brownrigg 2019: 85, fig. 2). Excavations

¹ For further bibliography, see: [https://en.wikipedia.org/wiki/Kunga_\(equid\)](https://en.wikipedia.org/wiki/Kunga_(equid)).

² Slow-moving four-wheeled wagons, carrying goods or passengers, had a fixed front axle and were not easily maneuverable.

at Sintashta and elsewhere in the foothills of the southern Urals (Chelyabinsk Oblast, Russia, close to the border with Kazakhstan) have revealed the remains of actual horse-drawn vehicles, their multi-spoked wheels evidenced by discolorations left in the soil, dated to the late third or early second millennium BCE (Anthony 2010: 371–375; Chechushkov 2018; Koryakova and Epimakhov 2007; Lindner 2020; Chechushkov and Epimakhov 2023; Grigoriev 2023). Debate continues as to whether these were influenced by or preceded the Near Eastern models, and whether they were war chariots or prestige vehicles used for parade and display, and perhaps for hunting (see Littauer and Crouwel 1996; Anthony 2010: 397–408; Grigoriev 2023).

Horses were domesticated by the end of the third millennium BCE in the Western Eurasian steppes (Librado *et al.* 2021). Their speed and maneuverability made them ideal for pulling chariots. The yoke was adapted to their head carriage, higher than that of bovids, by the addition of yoke forks in the form of an inverted “Y” placed on the neck in front of their withers, with the “handle” firmly lashed to the yoke and the “legs” lying in front of the shoulders. First attested in the Near East, yoke forks became standard on chariots in the second half of the second millennium BCE, when their use spread to Egypt and the Aegean, as well as to China (Littauer 1968; Littauer and Crouwel 1979: 60, 85, 113–114; Crouwel 1981: 98–99; Spruytte 1983: 26, 28, 41; Brownrigg 2019: 88–91; Brownrigg 2023). With a padding of leather or fabric to protect the horses’ necks from chafing, the yoke forks were often decorated: reel-shaped stone finials in the Near East and Egypt, and bronze finials or a partial or complete bronze sheathing in China (Figures 2–4) (Liu 2002 *passim*; Wang 2002: 35; Wu Hsiao-yun 2013: 80, 89, 101–102, figs. 1.6.3, 2.1.1 (right), 3.21.5, 4.18.13). A strap, fastened to the lower ends of the “legs” and passing under the horses’ necks, held the forks and the yoke in place. The yoke forks, with straight or, as often in China (and the Late Bronze Age Aegean) upturned lower ends, not only helped counteract the tendency of the yoke to slide back but transferred the tractive force to the shoulders of the draft animal. The system could be described as a form of *shoulder traction*.

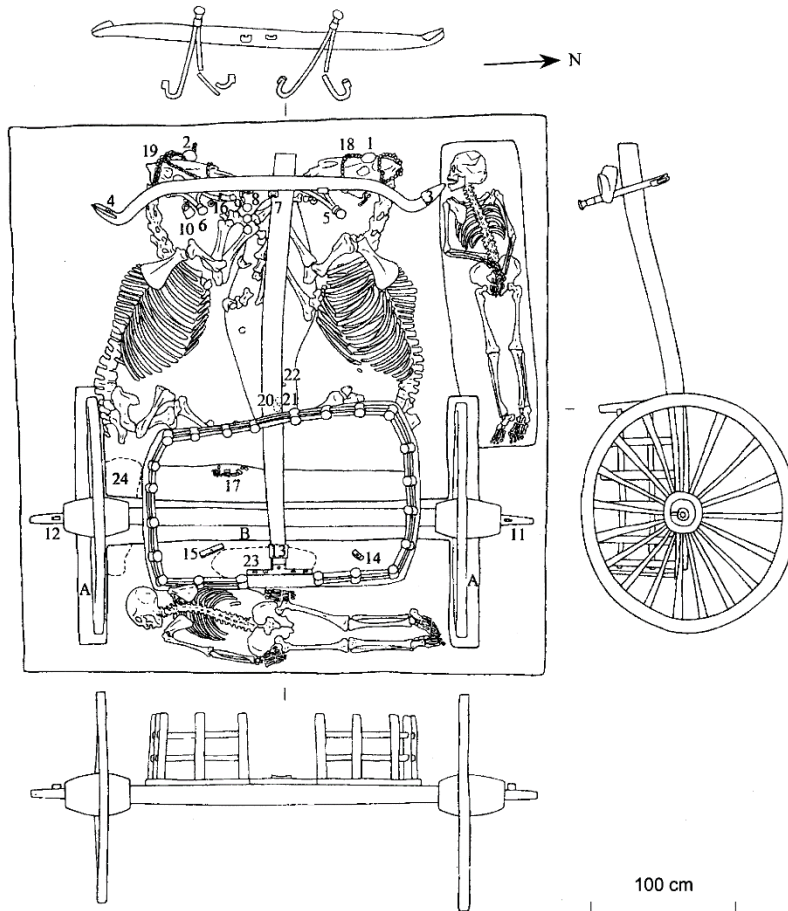


Figure 2. Two-horse chariot and one of its yoke forks, Late Shang tomb 52, Guojiazhuang, Shaanxi Province (after Wagner 2004:figs. 5A and 5.1a-b).

EARLY VEHICLES AND HARNESSING IN CHINA

In China, the use of wheeled vehicles with paired horses under a yoke attached near the forward end of a central draft pole is first firmly attested in burial pits at Anyang, the last capital of the late Shang dynasty (ca. 1200–1045 BCE). Chariot and horse pits of similar date are also known from other sites in northern China (Zhang *et al.* 2023: 673). The evidence becomes more extensive in the subsequent Western Zhou period (ca. 1046–771 BCE), when actual vehicles, often accompanied by their draft animals, were buried in large numbers in specially prepared pits in close proximity to human burials. These are exclusively two-wheeled *chariots* with two multi-spoked wheels, intended for two or three standing occupants. The wooden parts of the chariots had usually decayed but had left discolorations

in the soil (Figure 3).³ Bronze fittings such as axle-caps, linch pins, nave hoops and finials of the pole, yoke and yoke forks were also found, sometimes *in situ* (Figures 2–4) (Wu Hsiao-yun 2009 and 2013; von Dewall 1964 and 1976: 168–171; Lu 1993; Liu 2002: 6–34; Wagner 2004; Wang 2013: 26–53, with a review of earlier studies).



Figure 3. Excavation of a Late Shang chariot, Anyang, Henan Province, China (Wikipedia Commons).

³ A rare instance of many of the wooden parts having survived is a later vehicle, known as a drum chariot, from a waterlogged tomb of the Warring States period (480–221 BCE) at Huai'an, Hubei Province. See below.

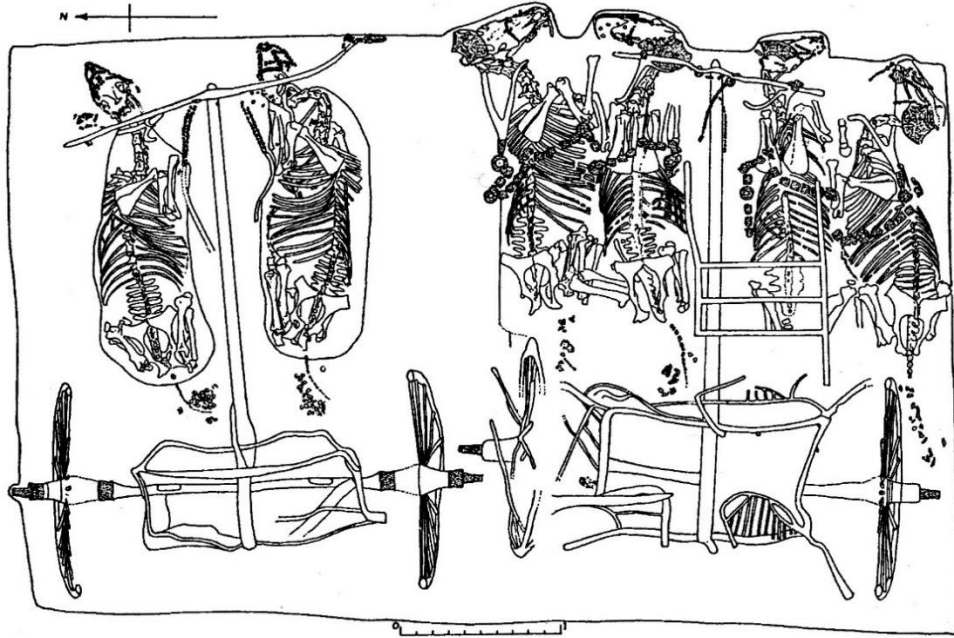


Figure 4. Two- and four-horse chariots, Western Zhou horse-and-chariot pit 2, Zhangjiapo, Shaanxi Province (after Wu Hsiao-yun 2013:fig. 3.1).

Chariots and horses also featured in inscriptions of the emerging Chinese writing system on ritual bronze vessels and oracle bones (Figure 5).⁴ The various schematic renderings of the character for chariot (*che* 車, simplified 车) show the vehicle, with a central draft pole, yoke and sometimes yoke forks, as if viewed from above (Shaughnessy 1988: 215, fig. 4; Liu 2002: 15, fig. 2.15; Wu Hsiao-yun 2013: 52, fig. 2.24).

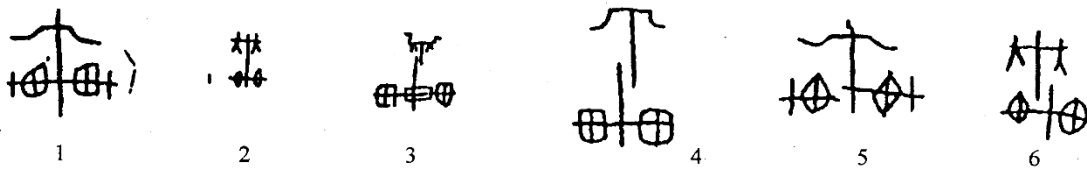


Figure 5. Variants of the Chinese character “車 / 车 *che*”, Late Shang oracle-bone inscriptions (after Shaughnessy 1988: fig. 4, nos. 1–6).

⁴ For horses, see Mair 2003: 164–166, 174–178.

Sometimes short traces seem to be depicted running back from the inner “legs” of the yoke forks to the pole just in front of the vehicle body (Figure 6), like those on the two bronze model vehicles from the burial complex of the first emperor of China, Qin Shihuang (ruled 221–210 BCE. See below). They would keep the yoke forks in their correct position and prevent them from rotating. At the same time, they would function like the yoke braces that were widely used in ancient harnessing in the Near East (Spruytte 1983: 53; Crouwel 2012: 40), helping to stabilize the yoke, keeping it at right angles to the draft pole, and transmitting some of the tractive force to a point closer to the vehicle, thus rendering the pole less vulnerable to breakage.⁵

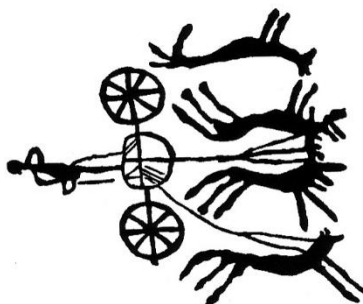


Figure 6. Representation of a four-horse chariot on a rock carving in the Altai (after Wu Hsiao-yun 2013: fig. 3.5.1).

Osteological remains indicate that horses were already known in a wild form (*Equus prjwalskii*) in China in the third millennium BCE, that is, long before their first documented use in draft or remains of chariots. Domesticated and trained horses are, however, first clearly evidenced in tombs of the Shang

⁵ Such braces leading from the yoke fork are probably what is intended on an incised bone plaque of the eighth-seventh century BCE from tomb 102 at Nanshan'gen in Nincheng County, Lianoning Province. It depicts, in plan view, a hunting scene with two-wheeled vehicles drawn by two horses (Bunker 2002: fig. 17; Linduff 2003: fig. 12.4a; 2006: 312, fig. 12A) and on a pair of bronze plaques of similar date from northeast China (Bunker 2002: fig. 23. cf. also plan views of quadrigae on the rock carvings at Somon Bogd (Nowgodorowa 1980: 98, pls. 58, 59; Novozhenov 2012: fig. 44, no. 6.3.HS2; see also our note 8) and at Jamani Us, also in Mongolia (Nowgorodowa 1980: 79–87 with figs., pls. 47, 56; Novozhenov 2012: fig. 59 no. 6.3.YU3(P.); also Littauer 1977: 113, figs. 16 and 17 (trigae).

dynasty (Wang 2002; Linduff 2003; Mair 2003: 166–168; Yuan and Flad 2003 and 2006; Wang 2013: 12–71; Wu Hsiao-yun 2013: 55–56).⁶

There appear to be no prototypes in early dynastic China for the first chariots and their draft and harness system. This strongly suggests that they were not locally developed but were indebted to forerunners from the Eurasian steppes and perhaps ultimately from the Near East (Piggott 1978; Hüttel 1979; Shaughnessy 1988 and 1989; Puett 1998: 705–706, 709; Barbieri-Low 2000: 37–48; Wang 2002; Wu Hsiao-yun 2013; Taylor 2017, especially chapter 6; Rawson 2017: 375–380; Rawson *et al.*, 2020; 2021), where vehicles with two spoked wheels and paired horse draft had been known since the early second millennium BCE (see a.o. Littauer and Crouwel 1979: 62–64; 1996) or western Eurasia (Koryakova and Epimakhov 2007; Anthony 2010, *passim*; Novozhenov 2012; Chechushkov and Epimachov 2023).⁷

In the late second millennium BCE in the Central Plain of northern China, the rise of elite groups is marked by their production of bronze weaponry and craft goods. The chariot – a vehicle requiring considerable skill to build and maintain, needing a team of matched draft horses and a crew with extensive training – became a symbol of their superior standing. The late Shang and Zhou dynasties mark the beginning of a tradition of burying such vehicles, in varying numbers, intact or dismantled and often with their draft teams, that was to last in China for over a thousand years, down to the Western Han period (206 BCE–9 CE). Separate burials of horses also occur. Where the archaeological context is sufficiently clear, chariots are most often associated with high-ranking male and sometimes

⁶ Systematic osteological study of the buried horses from dynastic China appears to have been undertaken only fairly recently (Levine 2005; Li *et al.* 2022; Zhang *et al.* 2023, with further references).

⁷ Some Chinese scholars, such as Sun Ji, have argued that chariots were developed inside China; see Wu Hsiao-yun 2013: 24 with references. The possible use of vehicles in China earlier in the second millennium BCE may be suggested by the remains of one or two wooden wheel hubs for sixteen spokes of disputed date from the settlement at Dolan in Nuomukong, Qinghai Province in far Western China (Barbieri-Low 2001: 11–13, fig. 8; Linduff 2003: 144–145 with n. 2; Mair 2003: 172–174; Wu Hsiao-yun 2013: 35 with n. 60, fig. 2.5), and by narrow wheel ruts at a site of the early Shang period at Yanshi in Henan Province and at Anyang (Barbieri-Low 2011: 15–17, 49–50, figs. 10, 17; Wang 2013: 30 n. 27; Wu Hsiao-yun 2013: 24 n. 116. A vehicle with four disc wheels, dated by the excavators to the sixteenth–fifteenth c. BCE, was discovered in 2022 at Gaotai, Xinjiang (http://www.xinhuanet.com/local/2023-02/25/c_1129397465.htm; <https://www.livescience.com/bronze-age-ice-skates-with-bone-blades-discovered-in-china>; http://kaogu.csn.cn/zwb/xsdt/xsdt_3347/xsdt_3348/202302/t20230227_5599571.shtml).

female burials (see especially Wu Hsiao-yun 2009; 2013, with maps 1–3; also Liu 2002: 35–86; Zhao 2018, 2019; Wang 2013; Wu Xiaolong 2013: 122–131).

No clear structural development of chariots in China can be traced. From the start, the body of the vehicle was mostly rectangular, wider than it was long, but sometimes roughly oval in shape, offering space for a driver and one or two other occupants. A rail-work or closed siding, usually no higher than 40 cm, sometimes with an additional, higher railing to hold on to, extended along the front and sides, leaving the rear (partly) open for access. The axle was always located in a central position under the floor, with two multi-spoked wheels ca. 1.20–1.40 m in diameter revolving on it and held in place by lynch pins, i.e., toggles that also permitted the wheels to be easily removed for repair, replacement or storage. The ends of the 18 to 30 spokes were mortised into the cylindrical nave and into the wheel rim. The large size of the wheels would enable them to roll over stones and other minor obstacles on bad roads or in rough terrain more easily than smaller ones, while the axle would be high enough to give adequate clearance. Long naves were essential if the wheels were not to wobble. The axle projected well beyond the edges of the chariot body. A long axle allowed for a wide wheel track (the distance between the running surface of the wheels), which varied from ca. 2.15 to 2.40 m, giving lateral stability to the vehicle on fast turns.

The Chinese multi-spoked wheels have remarkably close parallels in actual ones that were found in waterlogged condition in burial pits under a barrow, dating to the second half of the second millennium BCE at Lchashen in Armenia (Mnatsakanian 1960; Piggott 1974 and 1968: 95–97; Pogrebova 2003; Wu Hsiao-yun 2013: 4, fig. 1.5). These slightly smaller wheels (0.98–1.02 m in diameter) were made on the same principle, with their 28 spokes mortised into a cylindrical nave and a two-piece bentwood rim. They belonged to small light, two-wheeled vehicles, with their rail-work superstructure restored as extending along the sides and rear, leaving the front open. The rail-work, wheels and central axle may suggest a link with distant China.

This tradition of a making a wheel is very different from that represented by the extant chariots found in Egyptian tombs of the New Kingdom, more precisely of the later fifteenth and fourteenth centuries BCE. Their smaller wheels (0.89 to 1 m in diameter) have only four or six spokes, comprising V-shaped elements fitted back-to-back to form the hub and the spokes, which are not mortised into a separately made nave but form part of a composite nave-and-spokes construction held together by glue,

while the rim was bound with rawhide (Littauer and Crouwel 1979: 78–79; Spruytte 1983: 25 with ill. pp. 26–27; Littauer and Crouwel 1985: 76–79; Hurford 2023).

It should also be noted that the axle of the chariots from Egypt is located not at the center but at the rear. An axle placed at the very rear of the floor, materially documented on the extant chariots from Egypt and elsewhere, provided the crew with a stable platform as near horizontal as possible. Since the load would be ahead of the axle, a proportion of the weight would be placed on the horses' necks. This would lead to more flexing of the pole, giving a smoother, less jarring ride, avoid any tendency of the chariot to lift in front on uneven ground and also help to keep the yoke in place. A central axle is ideal for a stable cargo on smooth and level going, since it can be properly balanced over the axle, and the draft team is almost entirely relieved of its weight. Thus the load that the draft animals can pull is limited only by their weight and the strength of the axle (Spruytte 1983: 61). On the other hand, an unstable load, such as standing occupants switching their weight rapidly in fighting or hunting, would make a central axle less suitable, as would fast movement over rough terrain or on rapid turns. As the load or the angle of the ground shifted, the vehicle would rock back and forth, suffering stress, particularly in areas where the pole is attached, straining the pole and bruising the draft animals.

The central draft pole of Chinese chariots ran under all or part of the floor, curving up at the front towards the yoke which was fastened near its end. Traction was provided by two horses, or increasingly, from the Western Zhou period onwards, a team of four abreast. The inner two were harnessed under a yoke fitted with yoke forks (Figures 2–4), which have been found in excavations and are also indicated on some of the early pictographs for “chariot” (Figure 5). The outer horses (also known as outriggers) were more loosely attached by a single trace from the inner leg of the yoke fork to the body of the chariot. Figure 4 shows these animals with their own yoke forks.⁸ All horses were controlled by reins fastened to a bit, composed of a mouthpiece of organic material or bronze, with cheekpieces of varying design and made of antler, bone or bronze.⁹

⁸ A similar arrangement can be seen with a quadriga rendered in plan view on a rock carving at Somon Bogd in Mongolia: each outrigger is shown attached to the vehicle by a single trace (Nowgodorowa 1980: 98, pls. 58, 59; Novozhenov 2012: fig. 44, no. 6.3.HS2).

⁹ We will not discuss in detail bridles and bits. These are the subject of a study by Wu Hsiao-yun (2023). See also Rawson *et al.* 2021.

Draft teams of more than two horses¹⁰ first appeared with chariots in China at about the same time as in the Near East and the Aegean – during the later second and early first millennium BCE. In the Near East, at first only the inner horses were under the yoke, which was still fitted with yoke forks. The system was then replaced by a new design involving a long, four-horse yoke shaped into padded bays for each animal's neck. There is also material and figured evidence, from the Near East and Cyprus, for the use of four-horse chariots with two poles and a single four-horse yoke or two two-horse yokes (Littauer and Crouwel 1979: 113–116, 147; Spruytte 1978–1979; Brownrigg 2019: 93–95). Such arrangements, with all four horses under the yoke, may have provided more pulling power, but the principle of shoulder traction remained the same. In China, no comparable development can be traced, the combination of a two-horse yoke with yoke forks – sometimes assisted by outriggers each harnessed by a single long trace – continuing in standard use until the Han period. Material evidence attests to the use of a two-horse yoke and four yoke forks. A chariot with a pair of horses buried adjacent to one drawn by a four-horse team was found in a chariot-and-horse pit of the Western Zhou period at Zhangjiapo, Shaanxi Province (Figure 4) (Barbieri-Low 2000, fig. 22; Wu Hsiao-yun 2013: 58–59, fig. 3.1).

¹⁰ Modern usage refers to two horses as a pair, while three or more are referred to as a team.



Figure 7a-b. Reconstruction and test run of a Chinese chariot built by Robert Hurford (photographs R. Hurford).

In China, as in the Near East and Egypt, chariots were used in warfare.¹¹ Recent trials with a reconstruction of a Chinese chariot (Figures 7a, b), drawn not by four but also two horses, with a three-man crew, all seated or kneeling, confirmed the validity of the military role of such vehicles in China as

¹¹ For textual sources bearing on the use of chariots in actual battle, see a.o. Kiermann Jr. 1974; Shaughnessy 1988: 213–237; Yates 2002: 33–34, 40, 46–49; Wang 2013: 95–100; cf. Yates 2023.

mobile firing platforms for archers, provided the terrain is open and level (Hurford and Crouwel 2022).¹² The vehicles also played a role in hunting and ceremonies, as well as being prestigious conveyances and presented as royal gifts to members of the elite (Kiermann Jr. 1974; Shaughnessy 1988: 213–233; 2003: 166; Wang 2013: 95–100; Yu 2015; Yates 2023). However, the low superstructure of most Chinese chariots as compared to actual Egyptian finds, raises the question of how they may have been used in battle. The superstructure of Egyptian chariots rises to 0.65–0.78 m, thereby offering more protection to the crew of two men standing abreast. The rear axle, narrower than that on the Chinese vehicles, would allow greater maneuverability and thus the possibility for a line of chariots to approach the enemy, shoot and quickly turn away, out of range of their weapons. Chinese chariots may have been used to a great extent as mobile command platforms. Despite the evidence of long-handled weapons, it is unlikely that they were used in hand-to-hand fighting (Yates 2013: 11, 13).

Horse-drawn chariots were not suitable for the transport of goods. In China, the textual record, from the Western Zhou period onwards, provides references to “large vehicles” (*dache* 大车), sometimes explicitly stated to be drawn by oxen and clearly less prestigious. The term probably denotes more workaday vehicles, such as two-wheeled *carts* for carrying stable loads, i.e. goods or seated passengers (Lu 1993: 834; Barbieri-Low 2000: 69–71; Yates 2023: 224–227). Evidence, whether archaeological or written, for animal-drawn four-wheeled wagons in ancient China is notably rare.¹³

¹² Strenuous trials were conducted with a chariot drawn by two horses instead of four (Figure 7) as part of the NOVA television documentary “The Chinese chariot revealed” released in 2017 and available on Youtube: <https://www.youtube.com/watch?v=V03pr8rx2ho>). The reconstruction by Robert Hurford was based mainly on the study of the 28 chariots in a pit belonging to a cemetery at Guojiamiao, Zhaoyang County, Jiangsu Province in the ancient state of Zeng and dated to about 700 BCE.

¹³ A vehicle with four disc wheels, dated to the sixteenth–fifteenth c. BCE, was discovered in 2022 at Gaotai, Xinjiang (http://kaogu.cssn.cn/zwb/xsdt/xsdt_3347/xsdt_3348/202302/t20230227_5599571.shtml; http://www.xinhuanet.com/local/2023-02/25/c_1129397465.htm; <https://www.livescience.com/bronze-age-ice-skates-with-bone-blades-discovered-in-china>) and recent reports describe a four-wheeler with a canopy in a Qin tomb in Shaanxi Province (see <https://arkeonews.net/a-rare-sheep-carriage-and-ancient-chariots-found-near-mausoleum-of-chinas-first-emperor/>; https://news.dayoo.com/society/202310/26/140000_54599383.htm). A bronze ritual vessel with four spoked wheels was found in a tomb at Lixian, Gansu Province (Ye 2022). Archaeologists excavating a Xiongnu burial in Chikhertiin Zoo, Tuv Aimag, Mongolia (third–first c. BCE) have found large, spoked wheels which they believe (without direct evidence)

The military role of chariots in China, as elsewhere, declined sharply with the rise of mounted troops in the course of the Warring States period (480–221 BCE). Knowledge of the prowess of the Eurasian horse riders in battle probably played an important role in this (Goodrich 1984; Shaughnessy 1988: 222–231; Yates 2002: 36–66; An 2005; Wang 2013: 100–104, 156–160; Wu Hsiao-yun 2013: 14–15). With sufficient horsemanship, riding had obvious advantages over driving in mobility and maneuverability in different types of terrain and in economy of man- and horsepower. This was recorded in early Chinese texts such as the famous passages documenting King Wuling (d. 295 BCE) of the northern state of Zhao when he noted that both riding astride and a change to wearing appropriate clothing (trousers and short tunics over the typical robes of chariot occupants) were desirable (Shen 1997: 129).

As stated above, Chinese vehicles were also used for non-military and ceremonial purposes. A good example is presented on a lacquer box 10.8 cm high from Baoshan tomb 2, Jingmen District, Hubei Province, which can be dated to 316 BCE (*Wenwu* 5 (1988): color plate 1.2; *Journal of Chinese Lacquer* 28(1) (2009): 10–36, 48, fig. 6; Thote 2008: 229–233, figs. 21–22).¹⁴ It shows a welcoming ceremony, with the host driving out to meet his guests. Four vehicles are depicted: two are drawn by a pair of horses, the others by a team of three abreast (probably the host and his visitors, each shown twice).

Actual remains of another type of vehicle – the covered carriage¹⁵ – are known from funerary contexts of the Warring States period. One such vehicle, from horse-and-chariot pit 2 at Jiuliandun in Zaoyang County, Hubei Province, was associated with a high-status female burial. Five others come

to belong to one or two unique (dismantled) four-wheeled vehicles (see <https://montsame.mn/en/read/133737>). A hearse, with four spoked wheels pulled by ten men towards a graveyard, is depicted on a stone sarcophagus of the late Western or early Eastern Han at Weishan, Shandong Province (Wu 1998: 24, figs. 2a-b). For further discussion on four-wheeled vehicles in China during the first and second millennia CE, see Bulliet 2016: 165–183. A wagon with multi-spoked wheels, buried in Barrow 5 of the fifth century BCE at Pazyryk in the Altai region of Siberia, is often thought to have been inspired by Chinese models. See Rudenko 1970: pl. 13; Linduff and Rubinson 2022: 18, 58, 92, figs. 1.11a and 2.21c; Liu 2002: ill. p. 126, top; see also Hookk and Nikolaev 2013.

¹⁴ See also: https://artsandculture.google.com/asset/colored-lacquer-case-of-no-2-baoshan-tomb-in-jingmen-hubei-province-unknown/_AG2xkRIeEbSPQ?hl=en

¹⁵ A carriage may be defined as a vehicle intended for personal transport. Occupants generally sit, kneel or recline. Carriages (as well as chariots) were normally driven from the vehicle, enabling them to travel faster than at a walk.

from two horse-and-chariot pits, at Ma'anzhong in Huaiyang County, Henan Province, where they are associated with paired tombs of a high-ranking couple (Wu Hsiao-yun 2013: 114 with notes 133–134 and fig. 4.29.2). These were reported as being very similar to the large bronze model of a later four-horse covered carriage from the famous burial complex of Emperor Qin Shihuang (see below).

A unique find, three oxcarts¹⁶ were discovered in tombs M57, M18 and M19 of the Warring States period from Majiayuan in Zhangjiachuan County, Gansu (Zhao 2018; 2019: 178–180, figs. 30–33). Cattle skulls were found under the yokes. The draft poles differ in structure from those of the horse chariots, which have a single central pole under the box, curving upward toward the end. These unusual vehicles have two additional poles that are attached on either side, converging in the front to form a triangle, and connected by a transverse bar with the central pole that then rises above them. Resting on the two side poles, the yokes were thus placed quite low (oxen were probably smaller than horses, which would have been some 130–140 cm high at the withers), and were twice as long (2.5 m) as the chariot yokes (0.92–1.42 m), allowing the animals to be further apart due to the A-shape of the draft poles.¹⁷ The yoke forks are simplified into two vertical bars. This type of oxcart is unknown from other sites in China.

Valuable information on Chinese wheeled vehicles is yielded by a uniquely preserved “drum chariot.” Its waterlogged wooden parts were found broken into pieces in a timber-lined pit of the Warring States period at Huai'an, Hubei Province (Sun 2014; Hurford and Crouwel 2022; see also https://www.sohu.com/a/646797411_121448078).

This two-wheeled vehicle with its lacquer painting, decorative wood carvings, bronze linch pins and nave hoops, was subsequently reassembled, with a drum on a vertical pole fixed at the front of the body (Figure 8). Thanks to the exceptional state of preservation of the wood, various species could be identified: *Pteroceltis tartarinowii* (blue sandalwood) for the floor frame, axle and yoke, *Cinnamomum camphora* (camphor wood) for the carved panels, *Morus sp.* (mulberry) for the rails and wheel rim,

¹⁶ A cart is a two-wheeled vehicle designed to carry a stable load such as goods or seated passengers.

¹⁷ The A-frame cart with two side timbers running forward to join just before the yoke is a type of vehicle used until recently in various parts of the world. They are attested in tombs of the second half of the second millennium BCE from Lchashen in Armenia (but not in Mesopotamia or the Levant). See Piggott 1974 and 1983: 37, 39, 74–77, 193; Littauer and Crouwel 1979: 10; Crouwel 2012: 74 with n. 42 and pl. 151.

Quercus (probably *acutissima*, sawtooth oak) for the spokes, *Sophora sp.* (perhaps locust wood) for the axle blocks and nave. All these timbers could have been local (Pan 2014, reported in Sun 2014: 92–104).¹⁸

The floor of the “drum chariot” is longer than it is wide (ca. 1.26 m by 0.98 m), with a flooring of interwoven leather strips which pass through holes in the sides and rear of the frame. The diagonal strips hold the frame together and stabilize it, as well as provide a resilient floor in an otherwise springless vehicle. On top lies a woven mat. The body is raised over the centrally placed axle, resting at the front and rear on the draft pole, which runs all the way under the body, supporting the floor frame at the front and back. Two further points of support are provided by axle blocks, equal in thickness to the diameter of the pole, placed between the axle and floor frame at either side.

¹⁸ Robert Hurford has pointed out to us that mulberry, an easily worked timber, would have been readily available due to its widespread cultivation for silk production.

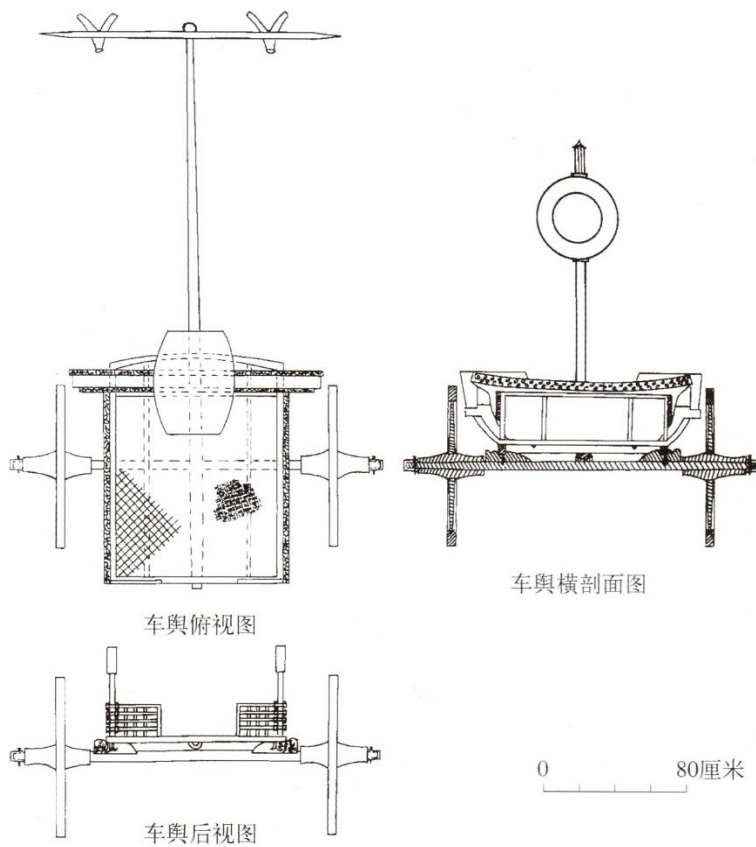
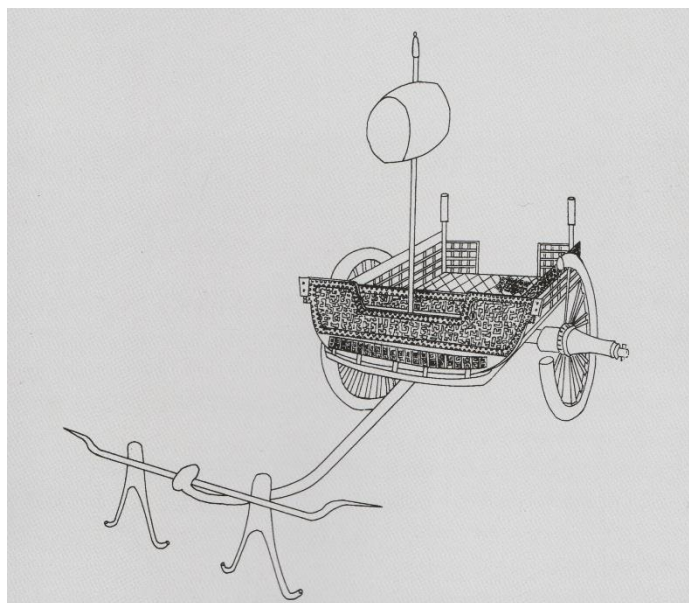


Figure 8. The “drum chariot”, pit of the Warring States period at Huai’an, Hubei Province (after Sun 2014: figs. pp. 40, 51).

Such an arrangement, including the axle blocks and the central draft pole running under the entire length of the floor, but with the axle located at the rear, was also standard on the extant chariots from Egypt.

The three-meter-long draft pole, possibly formed from a naturally shaped piece of timber (a “grown bend”),¹⁹ describes an upward curve upon emerging from under the floor and then runs to the yoke at an oblique angle. Like earlier chariots, the two-horse yoke lashed to its forward end was fitted with yoke forks.

The wheels (some 1.19 m in diameter) have twenty-eight spokes that can be described as “paddle-shaped.” Their inner ends, which resemble the blade of a paddle, are inserted by mortise-and-tenon into the central part of the cylindrical nave. The outer ends of the spokes were similarly mortised into the wheel rim, which was heat-bent. There is no evidence on this and most other Chinese vehicles for a tire (the outer element protecting the running surface of the wheel rim and helping to consolidate the parts of the wheel).

Contemporary with the Eastern Han dynasty (25–220 CE), the remains of iron tires were found in Tomb T₁ at the Hsiungnu cemetery of Gol Mod (Mongolia) on a vehicle that was probably of local manufacture (André and Desroches 2002: 197 with fig. 15). Bronze tires were identified on a four-horse chariot of the Western Zhou dynasty (1046–771 BCE) equipped with about 400 bronze fittings, most of which are inlaid with turquoise – probably a ceremonial vehicle. Unearthed at Zhouyuan in northwestern Shaanxi in 2014 (Wang 2019), it was put on display in 2020 after painstaking restoration.²⁰

The superstructure of the “drum chariot” is unusual. At the front is a wooden dashboard with carved decoration. This board (ca. 0.45 m high) rises somewhat above the railwork at the sides (ca. 0.35 m high), which consists of multiple vertical posts topped by a horizontal rail, with two small carved boards at the rear.²¹

¹⁹ We are indebted to Robert Hurford for this information.

²⁰ <https://archaeonewsnet.com/ancient-bronze-chariot-restored-in/>.

²¹ A later tomb painting from Bangtaizi Village, Liaoyang, from the late Eastern Han period (25–220 CE) or early Three Kingdoms period (220–280 CE) shows a two-wheeled vehicle with seated passengers and a drum on a pole, combined with a single draft horse between shafts (Sun 2001: 4-6,5; Brownrigg 2022: fig. 12.10). For other depictions, see Yates 2023: figs. 4–5.

THE TWO BRONZE MODELS FROM THE BURIAL COMPLEX OF THE FIRST EMPEROR, QIN SHIHUANG (RULED 221–210 BCE)

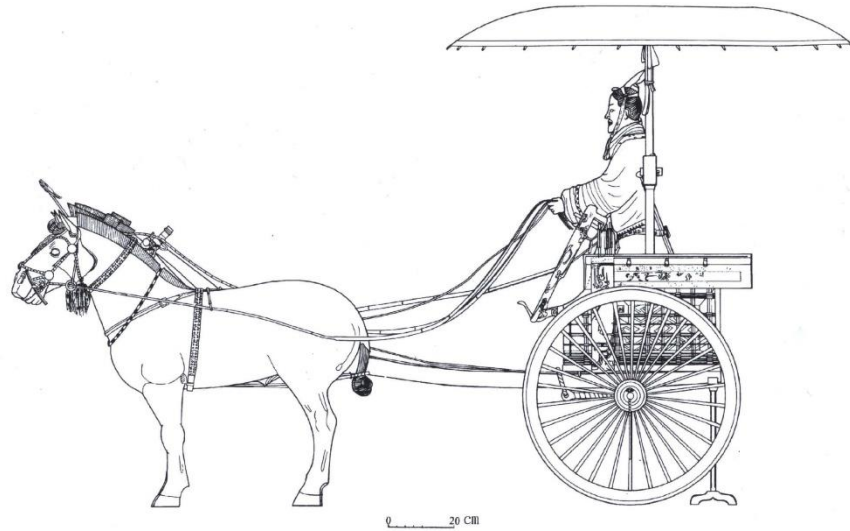


Figure 9a. Bronze chariot model, burial complex of Qin Shihuang, near Xi'an, Lintong District, Shaanxi Province (after Wu Hsiao-yun 2013: fig. 1.7.1)

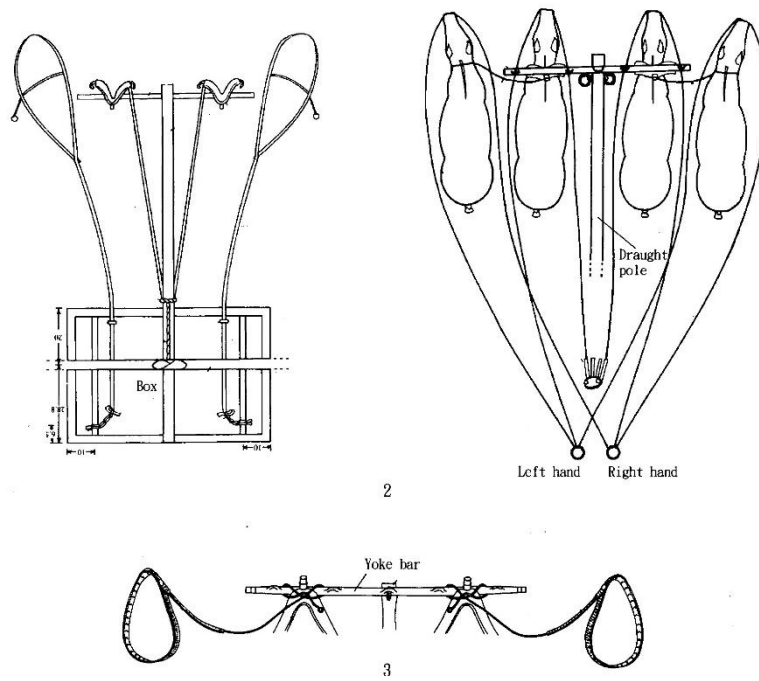


Figure 9b. The harnessing method of No. 1 Bronze chariot model (after Wu Hsiao-yun 2013: fig. 1.7.2-3).

The models of a four-horse chariot and a covered carriage were found in 1980, one behind the other, *in situ* inside a large wooden chamber in a specially dug pit near the burial mound near Xi'an, Lintong District, Shaanxi Province. Crushed by the weight of the earth above, both bronze models have been painstakingly restored by experts over an eight-year period (Figures 9–10) (Qin Shihuang Bingmayong Bowuguan and Shaanxi Sheng Kaogu Yanjiusuo 1998; Qin Shihuang Bingmayong Bowuguan 1998; also a.o. von Dewall 1976: 78–181; Swart and Till 1984; Ledderose and Schlombs 1990: 33, 258–262 *s.v.* catalogue no. 58; Stephen 1992; Lu 1993: 832–833; Meng and Lin (eds.) 2001: 30–39; Sun 2001: 3–27; Liu 2002: 88–95; Wu Hsiao-yun 2013: figs.1.7, 4.29; Duan 2023: 39–40).²²

About half life-size and rendered in great detail, these two cast-bronze models of superb craftsmanship no doubt closely reflect original vehicles. All elements made of wood or other organic materials, such as leather bindings, straps and reins, are carefully imitated in bronze. Together, they provide most valuable information on the actual chariots and carriages excavated in China – their construction, and the ways in which their draft teams were harnessed and controlled. The models thus deserve extensive treatment here.

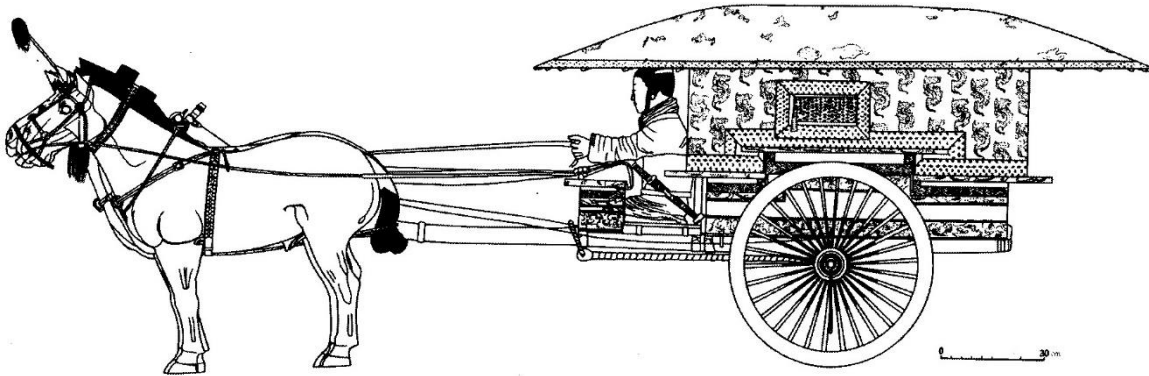
The leading chariot (“Chariot no. 1” or “High chariot”) carries a driver standing on the right, with a large, fixed parasol in the center, leaving space for a passenger to the left (Figure 9). It is 2.25 m. long and 1.52 m. high. At the front is hip-high breastwork of a shape that may be described as a “stepped dashboard.” At the sides are somewhat lower, solid screens, folded outwards at the top to act as mudguards, while the rear is left open. A crossbow is fastened outside the front of the body and a quiver of arrows in a vertical position at the left front corner, while a shield is carried inside.

The enclosed carriage (known as “Chariot no. 2” or “Comfortable chariot”) has a small platform at the front, ahead of the main vehicle body, supported on the central draft pole, with a driver in a kneeling position (Figure 10). The platform has a low curving dashboard that covers his knees, leaving an opening at the side on the left for access. Behind is a much wider, closed chamber, large enough for the occupant to sit or sleep. It has mudguards over the wheels, trellised windows at the front and sides,

²² We also drew on Joost Crouwel's observations on replicas of the models when they were temporarily exhibited at the Art Gallery of New South Wales in Sydney, Australia, in 2011 (the covered carriage) and the National Gallery of Victoria in Melbourne in 2019 (both vehicle models), as well as images available online and Robert Hurford's detailed photographs of both models (2016), which he has been kind enough to share with us.

which can still easily be opened and closed, and a door at the rear. The low, slightly oval, convex roof supported by eighteen pairs of bent ribs extends over the driver. The carriage with its team measures 3.17 m. in length and 1.06 m. in height.

The drivers of the two vehicles are both dressed in civilian clothes (robes) and wear a headcap. Each has a sword suspended at the waist. They were also equipped with a goad (a pointed rod for prodding the draft animals), kept in a socket on the right.



1

Figure 10. Bronze carriage model, burial complex of emperor Qin Shihuang, near Xi'an, Lintong District, Shaanxi Province (after Wu Hsiao-yun 2013: fig. 4.29.1.

Both vehicles have a rectangular floor frame made up of four timbers with additional lengthwise members. The flooring consists of transverse slats and interwoven material. The axle is placed approximately half-way down the length of the body. The multi-spoked wheels are held on by lynch pins with lunate heads, passing through axle-caps. After more than 2,200 years, they still rotate freely. The ribbed outer sections of the asymmetrical naves are longer than the inner part. The thirty spokes, mortised into the nave and the single wheel rim, are “paddle-shaped,” like those of the drum chariot discussed above.

The central draft pole runs directly under the floor all the way to the rear and describes a gentle upward curve where it runs out to the yoke area. On top of its forward end is lashed a straight two-horse yoke fitted with yoke forks, each clearly padded to protect the necks of the pole horses (the central pair) from chafing and held in place by a link of twisted rope or rawhide looped on to their upturned lower

ends and passing under the neck. On the yoke on either side are terrets through which the pole horses' reins are passed, while in the center is a D-shaped loop facing forward, which may have served to facilitate the lashing of the yoke on to the pole.²³

Just behind the yoke are two large, flat rings, in the restoration without apparent function but possibly originally intended for thongs to fasten the yoke to the pole. Such rings, made of bronze and apparently associated with the lashings that bind the yoke to the pole, have also been found *in situ* in excavations of earlier chariots such as the Eastern Zhou/Warring States horse-and-chariot pit found at Zhongzhou, Luoyang, Henan (Liu 2002: ill. p. 44).²⁴ In a reconstruction drawing of a Warring States chariot, Liu (2002: ill. p. 86) interprets the two rings as being used to attach yoke braces.

Draft is by the yoke forks lying in front of the shoulders of the pole horses. Broad traces run back from the inner "legs" of the yoke forks to the pole just in front of the vehicle body. There they are fastened by a twisted rope loop around the pole and held in place by another rope leading back to the axle.

A narrow strap passes under the belly behind the forelegs and is fastened to the yoke on either side. This acted as a braking and reversing element, transmitting the backward movement of the draft animals to the vehicle, at the same time preventing them from backing out from under the yoke. Fastened to it on the outside is a cross-shaped object (a "croisillon") with four sharp points to discourage the outriggers from bumping up against them.²⁵ Each horse has a narrow strap leading from a ring on

23 Similar loops from excavations of the pre-Qin period are illustrated by Sun (2001, fig. 3-20) and Liu (2002, ills. pp. 31, 32 (drawing showing position on yoke), 53 (yoke with yoke forks *in situ*), 59, 86 (reconstruction drawing), 101 *in situ*, 109, 112 *in situ*). Their position corresponds with the large central terret ring found on Celtic chariots in Britain (a.o. MacGregor 1962; Brewster 1971: 290, 291; Stead 2014: 40, 47, fig. 42, pl. 40). In both cases, their function remains to be explained.

24 The burial pit also provided evidence of other items similar to those on bronze chariot model no. 1, including beaded neckstraps on the outriggers of the four-horse team, a parasol, crossbow holder, latticed floor, but no terrets or central loop on the straight yoke. Other pre-Qin rings by the junction of pole and yoke are illustrated by Liu (2002: ills. pp. 22) (one ring *in situ*), 36 *in situ*, 38 above *in situ*, 50 above, 53 below right (same site, two double rings *in situ*), 59 (drawing of one ring), 101 (one ring *in situ*), 102 (reconstruction drawing with one ring), 109 (drawing of one ring), 112 (one ring *in situ*, same find as p. 101), 125 (comparing Qin, Western Zhou and Shang finds). Although their function is not properly understood, it is clear that these rings were an important element in this position.

25 Interestingly, a similar arrangement is found with four-horse racing chariots in sixth century BCE Greece (Moore 1986:

the inside of the yoke fork, between his hind legs and to the end of his bound-up tail, presumably to ensure that the rein does not get caught under it.²⁶

The two outriggers (outside horses) are harnessed differently. Each has a light neckstrap in the form of a loop around his neck and shoulders, to which is joined a single long trace running back to the floor frame of the vehicle, where it passes through a ring and is fastened towards the rear to the lengthwise timbers.²⁷ It is held in place by a surcingle, decorated with studs, encircling the horse's body. Short straps hanging from the neckstrap carry rings which support the rein on either side.

A beaded strap runs from a broad studded band around the throat to the top of the yoke fork on the adjacent pole horse, where it is looped around the “handle” of the yoke fork to prevent the outrigger from swerving outwards. Hanging loosely around the neck is another beaded strap. Like the pole horses, the outriggers wear long, narrow straps passing under the belly and holding their tails down.

The outside horses, each harnessed only by a light neckstrap and a single trace, would not have contributed as much to the pulling power as the central pair under the yoke with the long “legs” of the yoke forks lying against their shoulders like a modern horse collar. However, they would have added greatly to the impressiveness of the equipage.

All four horses are controlled by a bridle decorated in gold and silver, composed of a headstall, a jointed metal bit supported by bifurcated cheekstraps, a browband, throatlash, half-noseband, and a frontlet strap down the front of the face with an ornamental facepiece. On the other strap, junctions are dome-shaped strap dividers (Liu 2002: figs on pp. 120–121. As reconstructed, on either side a short strap holds a ring through which the reins are passed to support them. Each horse wears a tassel hanging from the throatlash.²⁸ The right-hand outrigger has a high plume in a holder on his head.

The bits of the pole horses are simple, consisting of a jointed mouthpiece and curved

109 with n. 124; Crouwel 1992: 45).

²⁶ Liu Yonghua (2002) suggests that a horse will naturally raise his tail when galloping, and if it is held down, he may be conditioned to slow down and remain under better control.

²⁷ The outriggers of Greek racing chariots were also harnessed by a single trace, as exemplified by the bronze model from Olympia of the fifth century BCE (Crouwel 1992: pl. 4)

²⁸ In some earlier reconstructions, this tassel is shown on the neckstraps of the chariot horses (“Chariot no. 1”) instead of under the throat (Sun 2001: fig. 1-1. Wu Hsiao-yun 2013: fig. 1.7).

cheekpieces supported by divided cheekstraps. The biting of the outriggers is more severe, probably because they needed more control. They have two mouthpieces, one made of several studded links, the other consisting of a long, straight canon, also with studs, thickened at its center and projecting to the outside. In addition, they have large circular cheekpieces with a central opening through which both mouthpieces pass (Figure 11).

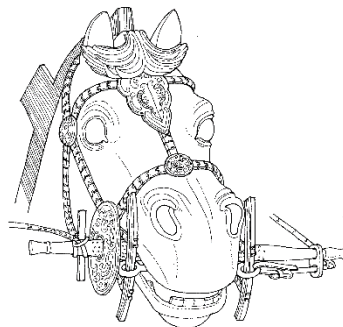


Figure 11. Bridle and bits of the left outrigger of the team (after Liu Yonghua p. 120 bottom left).

Altogether, there are eight reins, two to each animal. Rounded and beaded at the front and attached to the bit by a large loop, they are threaded through rings on a strap at each side of the bridle, becoming flat part way along their length. The reins of the pole horses pass through the four terrets set on the yoke. The outer reins of the outriggers run through a ring at the end of a short strap hanging from the neckstrap. As reconstructed, their inner reins lead directly to the driver's hands, whilst the inner reins of the yoke horses are fastened to the front of the vehicle. Thus the driver holds in each hand the outer rein of one pole horse and both reins of the outrigger, divided between his fingers (Wu Hsiao-yun 2013: fig. 1.7).

All the horses are geldings, as are the terracotta chariot horses in pits 1 and 2 (Yuan and Flad 2003: 114–115, figs. 6.1, 6.2), and they appear to be rather small and sturdy. They have short, standing manes with a raised tuft and a short length left untrimmed under the yoke saddle to protect the neck from rubbing.²⁹

²⁹ A recent zooarchaeological study of 24 horses found in an accessory pit in the burial complex of Emperor Qin Shihuang

The two bronze models with their draft teams and drivers were brightly painted, white being the basic color. Both vehicles, and particularly the covered carriage, are highly decorated in different colors. This and the gold and silver used on the axle-caps, harness and bridles of the horses, attest to the high status of the original vehicles, as do the horses’ crenellated manes and the accessories such as the leaf-shaped pendants hanging from the linch pins, the decorated domed strap crossings on the bridles, the frontlets on the horses’ foreheads, the tassels suspended under their throats and the head plume on the right-hand outriggers.

The equipages are rendered as if at a standstill, with the chariot leading the carriage. Both were supported by a sturdy arched stand, its top fitting the rear floor bar. The real chariot might have been used by the emperor himself, standing to the left of his driver and protected from the sun by the parasol.³⁰ The original covered carriage may have been for use by the emperor or members of his family, offering them privacy while seated or reclining inside.³¹

These two bronze models demonstrate that, in China, traditional traction by a two-horse yoke fitted with yoke forks and attached to a central pole was still in use with horse-drawn chariots and carts in the later third century BCE. Further evidence for this is provided by the actual but incompletely preserved chariots, with their teams of four terracotta horses belonging to the terracotta armies found

has shown that these were adult males with an average height of 144 cm (14 hands) at the withers, with references to earlier horses from other sites where the average height was below 140 cm (13.2 hands) (Li *et al.* 2022). Another earlier site is Shijia, Gansu Province, where eight horses were found with chariots in a burial pit dating to around the mid sixth century BCE. The horses were all males, between 9 and 12 years old (Zhang *et al.* 2023).

³⁰ The combination of a vehicle with a parasol, which provided shade as well as indicating the high status of the passengers, has a long history in China, from the chariot burials of the Western Zhou period onwards but became more prevalent around the late sixth to early fifth century BCE and then increasingly popular in the Qin and Han dynasties. Parasols were not necessarily fixed permanently to the chariot; they could be removed or handheld (<https://www.asianart.com/exhibitions/shandong/16.html>). See Wu Hsiao-yun 2013: 87, 89, n. 16, 107 with fig. 4.21.2 – an example from the tomb of the Warring States period. cf. also Zhao 2018: 52-54, 2019: 169, 178, figs. 1, 30, 31, and Wu Xiaolong 2013 and Wu and Linduff 2023 – horse- and ox-drawn vehicles of the third century BCE from a cemetery at Majiayuang, Gansu Province. The combination is also known from other ancient cultures (Crouwel 2012: 86-87).

³¹ It may be noted that after his death the corpse of the first emperor was secretly transported to its final resting place in a covered vehicle (Yates 2006: 40-41; *Every Treasure Tells a Story*, a 2020 video).

in pits 1 and 2 of the same burial complex of Qin Shihuang (Qin Shihuang Bingmayong Bowuguan and Shaanxi Sheng Kaogu Yanjiusuo, 1998: 208-243; Ledderose and Schlombs 1990: 288-292 *s.v.* catalogue no. 74; Yates 2007: 40). These chariots are less ornate but made according to the traditional pattern. They have a rectangular floor frame (1.4 m × 1.1 m) with a flooring of leather mesh above a number of lengthwise timbers and transverse bamboo slats. The front and sides (at least 0.30 m high) are made of painted wood, leaving an entrance at the rear. In addition, there is a separate railing at the front, rising above the breastwork. The axle (2.50 m long) provides for a wide wheel track and has bronze linch pins to keep the wheels in place. 1.36 m in diameter, these have thirty spokes, which were mortised into a nave ca. 0.50 m long and into the wheel rim. An important detail is that the rim is in ten segments, each accommodating three spokes. The pole (3.7 m long) carries a two-horse yoke with two yoke forks with upturned lower ends and bone finials. Four bone terrets are set along the yoke for the reins.³² The outriggers are kept apart from the pole horses with the help of “*croisillons*” also made of bone. The horses wear simple bits with a linked mouthpiece of bronze and wooden cheekpieces.

It should be noted that, compared to the large numbers of infantry and horsemen, the chariots in the terracotta army formations are few in number. They probably functioned as raised mobile command posts rather than taking part in actual battle.³³

SINGLE DRAFT WITH SHAFTS

A new draft and harnessing system, in which a single animal – a horse or an ox – was harnessed between a pair of wooden shafts, appeared during the Han dynasties (206 BCE – 220 CE). (Lefebvre des Noëttes 1931: 107–110; Needham and Lu 1960; Needham 1965: 308–328; von Dewall 1976: 171–172, 181–186; 1989; Piggott 1992: 67–68, 127–130, 137; Wang 1997; Sun 2001: 58–70; Liu 2002: 97–118; Brownrigg and Crouwel

³² Bone yoke fittings were also found in a burial with a chariot and four horses dating to the late Warring States period at Pingliang Miaozhuang, Gansu Province (Liu 2002: 88).

³³ For the army formations, see a.o. Ledderose and Schlombs 1990: 80–87 (Chun-mei Tschiersch); Yuan 1990 and 2002; Yates 2007.

2017; Brownrigg 2022: 251, 259–261; Brownrigg, Crouwel and Linduff 2023). Claims of earlier evidence, dating to the Warring States period, are unsubstantiated archaeologically.³⁴

The earliest surviving representations date from the Western Han period (206 BCE – 24 CE) on a lacquer box from Shazitang, Changsha District, Hunan Province (Needham and Lu 1960: 134, fig. 9; Needham 1965: pl. CCVIII, fig. 546; Shang 1957: nos. 28, 30; Hunan Sheng Bowuguan 1957; Hunan Sheng Bowuguan 1963: 2 (24); Zhang Feilong 2009: 22, fig. 20; Brownrigg, Crouwel and Linduff 2023: 6, fig. 4) (Figure 12) and in the form of model vehicles made from wood, bronze or terracotta excavated from tombs (Figures 13–18).



Figure 12. Detail of a painted lacquer vessel, Western Han tomb, Shazitang, Changsha District, Hunan Province (adapted from Hunan Sheng Bowuguan 1957).

At the time of the Western Han, actual vehicles with a central draft pole, a yoke and yoke forks were also still used and buried (a.o. Wu 1998: 27–28 and figs. 8a–c; Liu 2002: 100, 102 and Wu 1998: fig. 8a, showing a burial at Dabaotai near Beijing). However, the trend of substituting imitation vehicles for the burial of real objects in a tomb, which had emerged at the beginning of the Qin dynasty, had largely supplanted the custom of burial with actual chariots by the late Western Han period.

³⁴ Later examples are reported by Liu (1993: 833), referring to terracotta models of a bovid and two wheels from tomb M103 at Baqitun in Fengziang, Shaanxi Province (cf. von Dewall 1989: 657, Liu 2002, 92 below), and to one of the actual vehicles from Ma'anzhong, Huaiyang District, Henan Province (cf. von Dewall 1986: n. 8.). Liu also describes a wooden model vehicle from Qin tomb No. 30, Zhoujiatai, Jingzhou, Hubei Province (ill. p. 93 below), dated to 209 BCE, as having shafts, probably on the basis that only one (damaged) horse was found. However, see Postscript.

A wooden miniature carriage from a large tomb in Weishan, Jinan District, Shandong Province, reconstructed with a horse between shafts and a parasol, is considered by scholars to be Western Han, though not as early as the Shazitang box.³⁵ In 1951, four badly damaged model vehicles made of wood were found in a late Western Han tomb in Wujialing, Changsha District, Hunan Province: three were restored with straight shafts (Needham 1965: figs. 384, 386; Liu 2002: ill. p. 104), but it is unclear if there is sufficient evidence for single draft or whether they were reconstructed at that time on the basis of other Han finds. One has dished wheels³⁶ – a feature not documented in Europe until the Middle Ages (Lu *et al.* 1959: (1) and (2); Needham 1965: 77–79; Schovsbo 1999).

A pit with grave goods at Shanwang, Linzi District, Zibo City, Shandong Province, may perhaps have belonged to the burial site of Liu Hong, Prince Huai of Qi (123–110 BCE), second son of the influential Western Han Emperor Wu (156–87 BCE). Among the numerous small ceramic objects are foot soldiers, men on horseback and four-horse chariots – a veritable miniature army – all carefully arranged alongside model farm buildings and workers. Most of the vehicles are equipped with a central draft pole, a two-horse yoke with two yoke forks and a team of four horses, but in a corner of the courtyard is an almost intact two-wheeled vehicle with shafts, complete with its driver, drawn by a single horse, as well as a four-horse carriage with a parasol, suggesting that these were for domestic – not military – use (*Wenwu* 6 2016: 4–29; *Wenwu* 4(4) 2017: 65–77).³⁷ Oxen in the farmyard, each equipped with a single yoke, are also harnessed to carts with shafts.³⁸

By the time of the Eastern Han dynasty (25–220 CE), the practice of burying actual vehicles had mostly come to an end in China.³⁹ However, wooden, bronze and terracotta model carriages continued

³⁵ For a reconstruction, see second image:

https://www.360kuai.com/pc/9fe6d71ce58a92467?cota=3&kuai_so=1&sign=360_7bc3b157.

³⁶ The spokes are set into the hub at an angle, giving a profile like that of a shallow dish or saucer. This design gives strength to the wheel, enabling it to withstand lateral pressures such as those created when the vehicle moves from side to side as the draft animal swings its shoulders.

³⁷ See also: <https://www.livescience.com/64071-mini-terracotta-army-discovered-china.html>.

³⁸ The finds are now exhibited in the Qi Heritage Museum, Linzi (www.qiheritagemuseum.com).

³⁹ An exception is the two-wheeled vehicle found in an Eastern Han tomb at Shuangrushan Hill, Cangqing District, Shandong Province, which has been reconstructed with shafts and a parasol: Cui 1997: 16–26, fig. 10; *Art China Archaeology*

to be deposited in tombs (Figures 13–18). One, measuring 97 cm high and 80 cm long, made of wood with bronze fittings, from tomb M48, Mozuizi, Wuwei District, Gansu Province, preserved with a horse between the shafts, has a parasol and dished wheels (Gansu Sheng Bowuguan 1972: 13, 16, pl. 1; von Dewall 1986: 181, ill. p. 182; von Dewall 1989: 653, fig.10; Li 2002: 104, ill. p. 105; Watt *et al.* 2004: 176). The small driver is kneeling on the floor: as in the earlier chariots, there is no seat or footwell (Figure 13). A model of a single ox pulling a cart with straight shafts was also found in the same tomb (www.kgzg.cn/a/385.html).

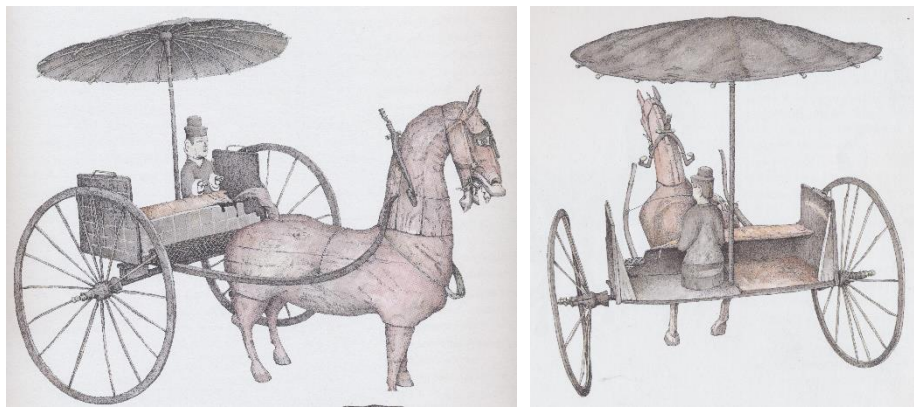


Figure 13. Carriage model of bronze and wood, Western Han tomb M48, Mozuizi, Wuwei District, Gansu Province (after Liu 2002: ill. p. 105).

Alongside mounted guards and musicians, the procession of bronze models unearthed from the Eastern Han tomb in Litei, Wuwei, Gansu Province, includes a variety of vehicles up to 58 cm high, accompanied by their grooms: elegant carriages with a parasol, another carrying an axe (presumably a symbol of military authority) and carts drawn by both horses and oxen (von Dewall 1986: 182–185, ill., pp. 183–186; Liu 2002: 107, ill. pp. 107–108; Watt *et al.* 2004: 105; <http://www.kgzg.cn/a/389.html>) (Figures 16–18).

and Digest 2(1) (Jan.-March, 1997): 65–66. Other vehicles with a pole and yoke were found in the same tomb complex: Cui 1997: 1–9, 26, with 4 pls., 10–15; see also <https://www.asianart.com/exhibitions/shandong/16.html>. At Jiulongshan in Qufu County, the four royal tombs contained some twelve life-size chariots and the remains of fifty horses as well as several miniature chariots (Gansu Sheng Bowuguan 1972: 39–54; and after p. 64, back cover, figs. 1–6). Cf. Polosmak *et al.* 2008: 68.

The Han models representing horse-drawn vehicles vary in size. Some are very large, recalling the two bronze vehicles from the burial complex of Qin Shihuang (Figures 9–10). The terracotta model of a traveling carriage or goods cart from Yangzishan, Chengdu, Sechuan, attributed to the Western Han dynasty, is 174 cm long with a draft horse 98 cm high between the curved shafts (*Jiben jianshe gongcheng zhong chutu wen wu zhanlan tu lu* 1956: fig. 225; von Dewall 1989: fig. 5). Like the actual finds from Jiuliandun and Ma'anzhong from the Warring States period (see above), it has an arched tilt, as has the bronze model from tomb M8, Xingyi, Guizhou Province, 112 cm long, drawn by a horse 88 cm high (von Dewall 1986: 185; von Dewall 1989: 652, fig. 6; Liu 2002: 106, ill. p. 106 below) (Figure 14).



Figure 14. Bronze cart model, Western Han tomb M8, Xingyi, Guizhou Province (after Liu 2002: ill. p. 106, below).

An Eastern Han bronze model from tomb M2 Lanjiapo (Sichuan Province) measures 204 cm long, 131 cm wide and 115 cm high, as found (Figure 15). The wheels have a diameter of 78 cm. The young driver is kneeling. The head of the draft horse is missing (Sichuan Zheng Kaogusuo Yanjiusuo 2019: figs. 13–22, 23 in color; Brownrigg, Crouwel and Linduff 2023: 11, fig. 5).

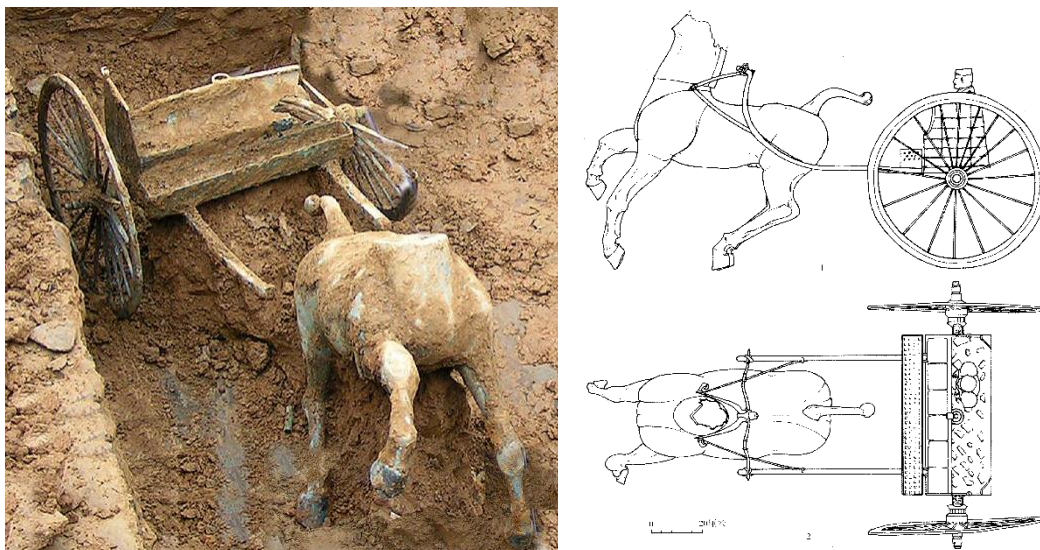


Figure 15. Bronze carriage model, Eastern Han tomb M2, Lanjiapo, Yanjiang District, Ziyang, Sichuan Province (after Sichuan Zheng Kaogusuo Yanjiusuo 2019: figs. 14:1–2).

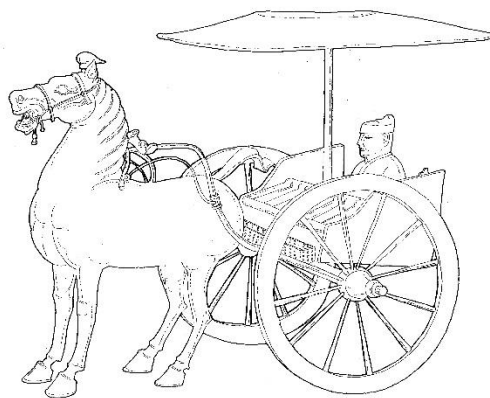


Figure 16. Bronze carriage model, Eastern Han tomb, Leitai, Gansu Province (after Liu 2002: ill. p. 107 below, left).

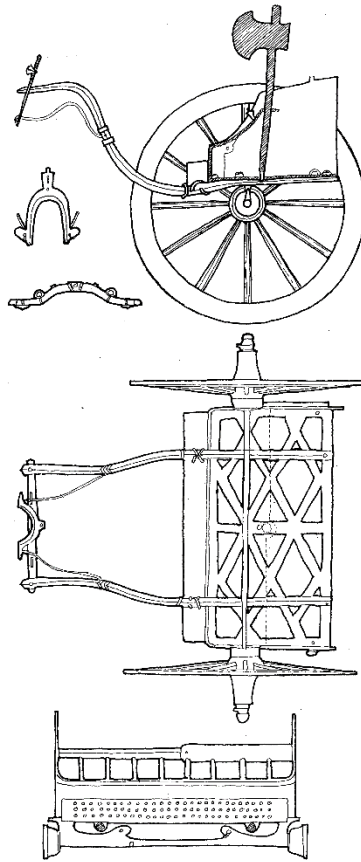
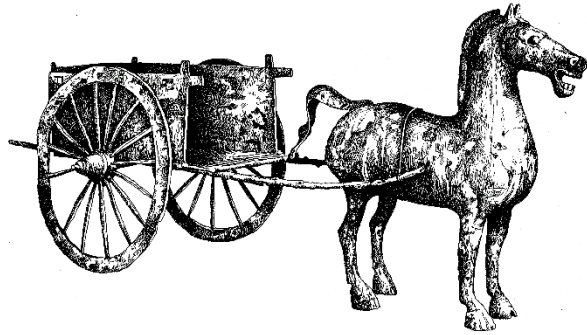


Figure 17. Axe carriage. Bronze model, Eastern Han tomb, Leitai, Gansu Province (after Liu 2002: ill. p. 107 below, right).

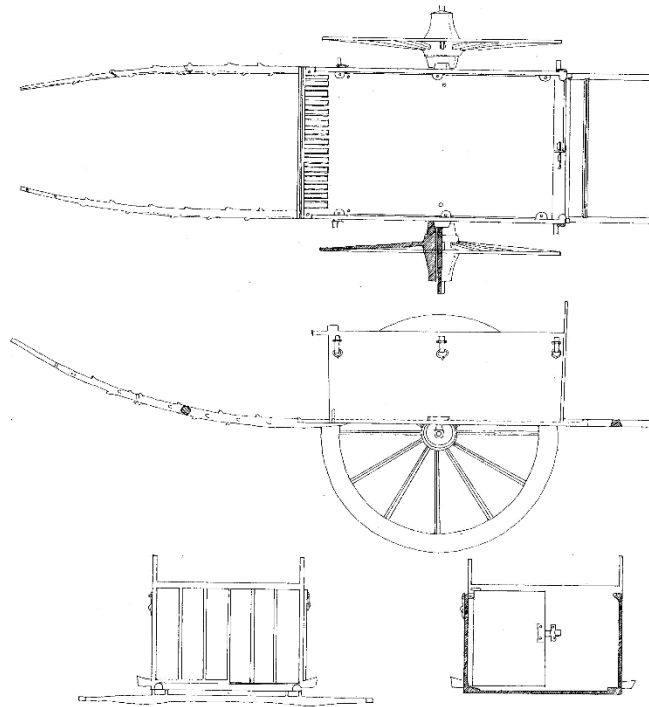
The tombs also functioned as shrines, the brick or stone walls of which were often painted, stamped or carved with designs involving vehicles (Figures 19–20, 23–25) (a.o. Rudolph and Yu 1951: nos. 82, 84, 88–90; Lim 1987: *passim*; Wu 1994: 93–104; 1995: figs. 4.8, 4.18, 4.48–4.49, 4.51; Wu 1998; Sun 2001: 58–70, 91–96; Liu 2002: ill. pp. 118, 127 below, 128; Finsterbusch 1971: *s.v.* Wagen).

The evidence from the Eastern Han period strongly suggests that pole-and-yoke traction had virtually disappeared in China, as had the military and ceremonial chariot. From this time onwards the vehicles were almost exclusively two-wheeled carriages and carts, their wheels traditionally being multi-spoked. They carried passengers or goods and were used for various civil purposes. Several types of vehicles with shafts can be identified, chiefly on the basis of differences in their size and

superstructure. The types and their use are sometimes named in the inscriptions that may accompany the pictures on tomb walls (Zhao 1979; Xin 1999: 47–63; Wu Hsiao-yun 2013: 114, n. 137 with further references).



a.



b.

Figure 18 a-b. Bronze cart model, Eastern Han tomb, Leitai, Gansu Province (after Liu 2002: ill. p. 108).

Type 1

Type 1 (Figures 13, 15, 16, 19) is an open carriage, with room for a driver and passenger kneeling side by side, with the driver on the right. Often there is a fixed parasol in the center. This feature and the “stepped dashboard” at the front recall the large bronze chariot model with a standing driver (“Chariot no. 1”) from the burial complex of Emperor Qin Shihuang. The sides are somewhat higher than the front and have a slanting or horizontal top edge, leaving the rear open.

Type 2

Type 2 (Figure 20, third and fourth from left) is similar but has a canopy raised on four posts over the two occupants.

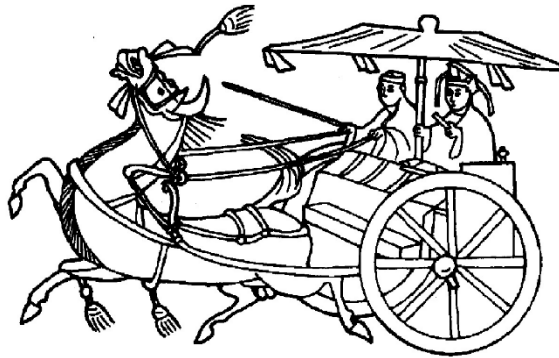


Figure 19. Detail of stone relief, Eastern Han, Yinan, Shandong Province (after Sun 2001, fig. 4-6.2).



Figure 20. Stone relief, Eastern Han tomb, Cangshang, Shandong Province (after Wu 1994: fig. 4.52 - detail).

Remains of a vehicle with two multi-spoked wheels, a pair of shafts, a (presumed) seat – destroyed by the robbers’ hole – and a canopy raised on four supports have been found in the richly fitted burial mound 7 of the first century CE in the Tsaraam valley in the Trans-Baikal area of the Russian Federation (Figure 21). The vehicle has been described as Chinese and as a gift from the Han court to one of the rulers of the Xiongnu. (See a.o. Miniaev and Zhakarovskaia 2006: 49–50; 2007: 46–50, figs. 5–8; Miniaev 2009: 51, figs. 4–6; Brownrigg, Crouwel and Linduff 2023: 8 with n. 13, fig. 8). For other actual Chinese (?) two-wheeled vehicles (without clear evidence for shafts) found in elite burials in Mongolia, see Miller (2012: 29, 34–38, with further references).

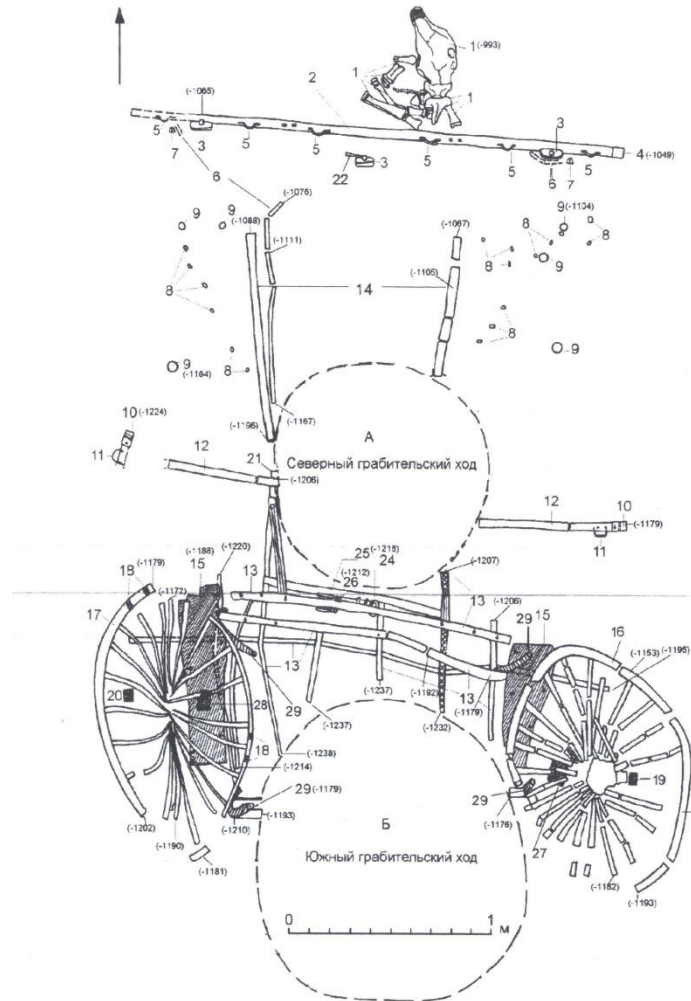


Figure 21. Remains of carriage from burial mound no. 7 Tsaraam Valley, Trans-Baikal area (Russian Federation). (After Minaev and Sakharovskaia 2007: fig. 6).

Type 3

Type 3 (Figure 20 – extreme left) is strongly reminiscent of the covered carriage represented by one of the large bronze models from the burial complex of Qin Shihuang (“Chariot no. 2”) (Figure 10). It has a similar small platform at the front for the seated or kneeling driver and a roofed chamber with windows behind; the head of a passenger may be shown in a side window.

These three types of carriage are all horse-drawn and share the traditional wide rectangular floor shape of earlier chariots (the models showing it with a woven or solid flooring), the central axle and multi-spoked wheels. What is different is the draft and harness system, involving a single horse between a pair of wooden shafts. These can be seen running to the rear of the floor, in between its side beams and central lengthwise timber. At the forward end, the shafts bend sharply upward in an elegant double curve. Their tips are joined by a straight bar, which is supported by a traditional yoke fork lying high on the horse’s neck, the lower ends of which are joined to the shafts by a short brace. Traction is by a breastband, supported as in modern harnessing by a narrow strap over the horse’s neck, and attached by short traces to the midpoint of the shafts where these begin to curve upwards, giving a straight line of draft. A strap from the crossbar on either side, passing under the horse’s belly, would prevent the shafts from lifting if the vehicle became unbalanced. Breeching – a broad strap around the hindquarters, attached to the shafts and supported by lighter loinstraps – facilitated reversing or holding back the load.⁴⁰

Practical experiments by Jean Spruytte have demonstrated the viability of the new draft and harness system in China, which may be called *breast traction* (Figure 22) (Spruytte 1983: 61, 73, pl. 15: 1–3; Brownrigg 2023: 262–263.⁴¹

⁴⁰ Breeching hanging from the shafts of an unharnessed vehicle is shown on a stone relief from an Eastern Han tomb at the Shrine of Wu Liang in Shandong Province (Lefebvre des Noëttes 1931, fig. 122; Needham 1965, 309, fig. 543, with his note b referring to another representation from this tomb, showing the breeching hanging on a stand).

⁴¹ Spruytte’s photographs show him not seated but standing in a two-wheeled vehicle with upward-curving shafts but otherwise of entirely non-Chinese type.



Figure 22. Experiment with harnessing of Han period, Jean Spruytte (after Spruytte 1983: p1. 15:3).

The single horse was controlled by a bitted bridle, sometimes with the help of a stick or goad. The open or closed carriages of types 1–3, which are shown sometimes at a standstill but more often moving at speed, were surely a means of transport for high-status individuals, as well as a symbol of their social standing. Figured as well as textual documents indicate that there could be more than one draft horse, depending on the importance of the occupants: the more horses employed, the higher the status, with members of the imperial family allowed to drive three and wealthy landowners only one (Lim 1987: 116; cf. Jie 2015: 438–439 with further references).⁴²

The find from Tsaraam (Figure 21) helps to throw light on the harnessing of multiple horses abreast.⁴³ The crossbar (referred to by the excavators as “the front yoke pole”) was long enough to accommodate three animals side by side and would have rested on the three yoke forks, the remains of which were discovered in a fragmentary state. The traces of the central horse would be attached to the shafts, as in single draft, while long traces from the breaststraps of the two outside horses must have led

⁴² It was reported that ... “in carriage, the Son of Heaven drove six horses; kings drove four; great gentlemen [*dafu* 大夫] drove three; gentlemen [*shi* 士] drove two; and commoners drove one” (Jie 2015: 438, n. 17).

⁴³ See a.o. Lim 1987: 188, 192; Wu 1998: fig. 9; Liu 2002: ill. p. 128, top right; Jie 2015: 428–439, figs. 2, 3.

back to the 3 m long “rear yoke pole,” which lay transversely across the shafts. Seven cm. in diameter, the ends had bronze caps and 3–4 cm from them were two arc-shaped iron fastenings, which would have held the traces in place. Any additional horses would have been outriggers, presumably harnessed by a single trace. They would have contributed little pulling power but added to the prestige of the turnout.

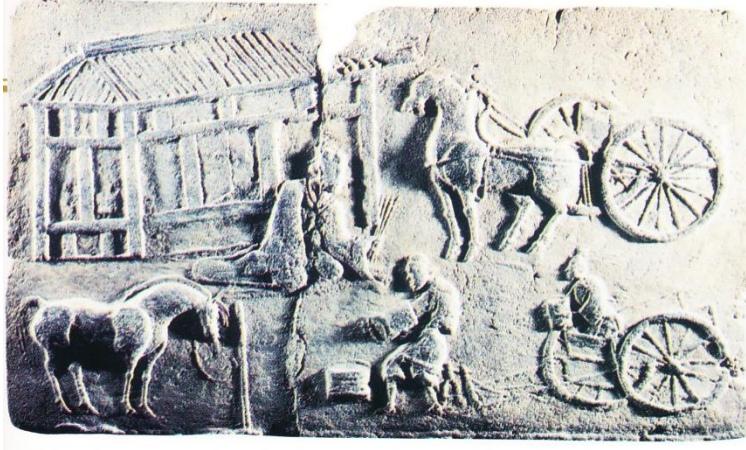


Figure 23. Stamped brick, Eastern Han tomb, Guanghan County, Sichuan Province (after Lim (ed.) 1987: colour pl. 15).

Type 4

Type 4 (Figures 18, 23 – below, right) is a cart with a long rectangular floor and solid, flat-topped sides and rear. There may be a top rail at the back. Access can be by the front, which is then left open. A kneeling driver may sometimes be seen.

Type 5

Type 5 (Figures 14, 24, 25 – above, left) is basically similar but is fitted with an arched tilt.

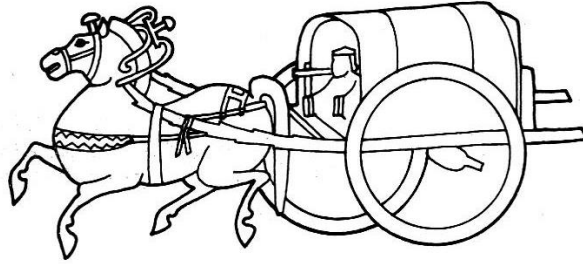


Figure 24. Detail of an Eastern Han stone relief, Xiaotangshan shrine, Feicheng, Tai'an City, Shandong Province (after Sun 2001: fig. 4-6.3).

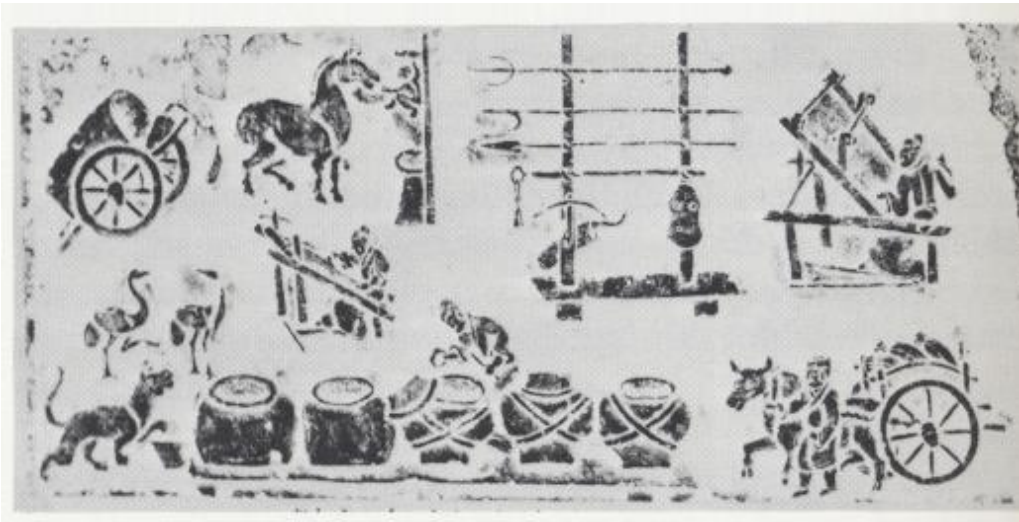


Figure 25. Detail of stone relief, Eastern Han tomb, Zengjiabao near Chendu, Sichuan Province (after Lim (ed.) 1987: ill. p. 97).

Vehicle types 4 and 5 have the traditional central axle and multi-spoked wheels, but a longer floor plan (von Dewall 1986: 184) (Figure 18). They are drawn by a horse or an ox between shafts, which, on the models, are fastened to the front ends of the side beams of the floor (Figures 14, 18). In the case of ox-draft, the shafts run horizontally or at a slight upward slant and are combined with a neck yoke shaped to suit the animal's anatomy (von Dewall 1965: ill. p. 186). With horse draft the shafts are straight or mildly curved, in marked contrast to those of carriage types 1–3, with their sharply upward-curving forward ends. They are of natural wood, showing decorative nubs from branches that have been

trimmed off, indicating that they may well be made from timber deliberately grown with the required bend (Needham 1965: fig. 493; Wu 1998: figs. 3a, 4; Sun 2001: fig. 4–6.3) (Figures 18, 24).⁴⁴

Traction is again by a breaststrap (see Needham 1965: fig. 493; Rudolph and Yu 1951: nos. 83–84, cf. no. 90, showing ox draft; Wu 1998: fig. 3a, 4, 5, 6), but the harnessing is different: while there is a yoke fork on the neck, the cross-bar seems to have been complemented or replaced by a bow supporting the shafts (Sun 2001: figs. 4–6.3 and 4–6.4) (Figure 24). Cart type 4 appears to have been for the transport of goods rather than people. Covered type 5 may have carried both goods and passengers. The models from Xingyi (Figure 14) and Yangzishan, however, have smooth shafts with a double curve like carriage types 1–3, which might indicate that they are early or that they were intended for personal transport rather than for goods.

The pictorial imagery on the walls of the Eastern Han tombs includes several scenes involving not one but two or three types of carriages, all carrying people engaged in various journeys (Figures 20, 23). Of special note is the discovery of no fewer than fourteen bronze models of horse-drawn vehicles, together with armed men on horseback, musicians and other attendants on foot, including the famous “flying horse of Gansu,” in a rich tomb of Eastern Han date at Leitai in Wuwei County, Gansu Province (Gansu Sheng Bowuguan 1972(2): 16–24; von Dewall 1976: ill. pp. 183–186; Liu 2002: ill. pp. 107–108; Watt 2004: 105–106, 228–229 and catalogue no. 2; De Caro and Scarpati 2010: 228–229). Most of the vehicle models represent the open horse-drawn-carriages of type 1, with and without a fixed parasol (Figure 16). One such carriage has instead an axe in an upright position, probably as a sign of the rank of the man in whose honor the procession is held⁴⁵ (Figures 17, cf. Figure 20 – second from left). Two of the cart models, drawn by a horse and an ox respectively, are of the open, more workaday type 4 (Figure 18).

Of particular interest is the rural scene on a stamped brick of an Eastern Han tomb in Guanghan County, Sichuan Province (Figure 23) (Lim 1987: color pl. 15, pl. 26 and rubbing ill. p. 113 above). The scene includes two stationary vehicles, one of them empty and with its horse harnessed between sharply curved shafts in the manner of type 1 carriages. This probably belongs to a tax collector who is

⁴⁴ We are indebted to Robert Hurford for this suggestion.

⁴⁵ See von Dewall 1986: 184; Yates 2023: fig. 8.

shown seated in front of a building. The other, a cart of type 4, is unharnessed, the draft horse tethered to a post, thereby allowing a clear view of its different, straight shafts. Two smaller and less well-dressed men, one of them beside the cart and the other in front of it, must be farmers. Both are busy with containers, probably containing measures of grain for the tax collector who is holding the bamboo tallies that record the amount owed.

The use of carts in daily life is also well illustrated on a stone relief of Eastern Han tomb M2 at Zengjiabao near Chengdu in the same province (Figure 25) (Lim 1987: ill. pp. 95, 97). The central of the three registers into which the relief is divided depicts various daily-life activities and includes two carts. One is a covered vehicle of type 5, its draft horse unharnessed and tethered to a hitching post decorated with a carved monkey. The other, an ox-drawn open cart of type 4, is probably bringing up grain (rice, millet or sorghum) for making wine, which is stored in several large jars.

Unlike Europe, where Roman ox-carts are often depicted with tripartite disc wheels, both carts and carriages in China had large, multi-spoked wheels. On a moulded brick found at Hongshan, Jiexiang County, Shandong Province, a wheelwright is shown repairing a broken wheel by replacing the damaged rim (Figure 26).⁴⁶ He is assisted by a woman carrying a child on her back. She stands behind him holding a segment ready for him to put in place. Other segments, bent ready for use, are shown hanging on the wall and on the ground beside him (Needham 1965: fig. 388; Barbieri-Low 2007/2021: 92, fig. 3.15).



Figure 26. A wheelwright repairs a broken wheel. Rubbing from a moulded brick from Hongshan Village, Jiexiang County, Shandong Province, Eastern Han (after Needham 1965, fig. 388 - detail).

⁴⁶ We are indebted to Robert Hurford for this interpretation of the scene.

CONCLUDING REMARKS

It is remarkable that no significant structural development of chariots can be observed in China from their first appearance in the later second millennium BCE down to the Western Han period (202 BCE – 9 CE). The vehicles were built to a traditional pattern, with a central axle and two large, multi-spoked wheels, often with a certain degree of uniformity based on a system of modular production (Ledderose 2000). The only variation on a large number of similarly standardized chariots found at Majiayuan, Gansu, for instance, was to be found in their decoration, in painted designs in lacquer or application of golden attachments (Wu Xiaolong 2013). A system of regulated production can also be seen, for instance, in the bronze weaponry found in the pits with terracotta warriors belonging to the complex of the First Emperor Qin Shihuang (Li *et al.* 2014). In all, traction was by paired horses at either side of a central draft pole.

Interestingly, a chapter of the *Rites of the Zhou* (*Zhouli* 周禮), “The Artisan’s Record” (Kaogongji 考工記), the composition, editing and compilation of which supposedly took place between the fourth and first centuries BCE and edited between the Western Han and Tang dynasties, recorded a framework in which technologies could be classified.⁴⁷ This was based on the materials and techniques that workers used: wood, metal, leather, clay, coloring, scraping and polishing. High value was placed on certain sophisticated industries, including chariot making, which were thereby thought to have been produced by sages because they encompassed (and achieved) beauty and art. As with other forms designated as “art,” a canon of design and execution had to be met and could be measured, thus leading to regularization of form and design.

During the Western Han dynasty, the military role of chariots came to an end. By the time of Emperor Wu (156–87 BCE), well-trained and numerous mounted troops could defeat the strong cavalry of the tribal confederation of nomadic peoples from the Eurasian steppe, known as the Xiongnu, with whom the Chinese had often been in conflict (An 2005; Yates 2002, 2007).

Chariots were gradually replaced by two-wheeled carriages intended for personal transport in civilian life, in which the occupants sat or reclined. The vehicles still had the traditional central axle and two multi-spoked wheels, but they were drawn by a single horse between shafts, sometimes

⁴⁷ Guan and Herrmann 2020: 21.

accompanied by one or more additional animals. Alongside more workaday carts, these elegant equipages, with their many different designs, were surely not only a means of transport for high-status individuals, but also symbols of their social standing (see Yates 2023).

Over the centuries, horses had been imported from Central Asia and Mongolia (a.o. Linduff 2003; Rawson *et al.* 2021). Expensive luxury items, they had never been bred successfully in the Central Plains of China, perhaps due to lack of various minerals – particularly selenium – in the pasture (Whitfield 2021; Rawson *et al.* 2021).⁴⁸ Emperor Wu sent two expeditions far to the west in search of bigger, better mounts for military use. Indeed, it may have been the descendants of these strong, tall, so-called “heavenly horses” from Central Asia, with their characteristic ambling gait, that facilitated the transition from paired draft to the use of a single horse between shafts (Linduff 2019; Liu 2020: 191–192; Li *et al.* 2022; Yates 2023: 224).

After the end of the Han period the extensive ancient Chinese road infrastructure began to deteriorate. Roofed passenger vehicles drawn by a robust ox harnessed between shafts with a single yoke replaced horse-drawn carriages as the preferred mode of travel for the elite. The stately covered oxcart became an emblem of the leisured literati culture of the south (Needham 1965: fig. 563; Sun 2001: figs. 21-15 – 21-17; Liu 2002: 145–157; Watt *et al.* 2004: 209, cat. no. 115; Brownrigg 2022: 261; Yates 2023: 226), while (Bactrian) camel carts were used in the northerly desert regions (Needham 1965: fig. 569; Sun 2001: fig. 21–25; Liu 2002: ill. pp. 158–159; Wu Hsiao-yun 2013: 37, fig. 2.7). The vehicles used for passenger transport in the Wei (386 to 535 CE) and subsequent dynasties would be better described as simple carts in which the passengers sat or reclined as they traveled slowly over what were often unmade roads and tracks in difficult terrain.

The innovative method of harnessing a single animal between shafts introduced under the Western Han dynasty remained a permanent feature of Chinese vehicular transport. It is still the method used throughout China today for farm implements as well as wheeled vehicles, which may have additional draft animals harnessed alongside or in tandem by means of long traces. European travelers in the nineteenth and early twentieth centuries described and illustrated the springless country carts

48 For a similar problem when breeding horses in India, see: <https://thegrailquest.wordpress.com/2020/06/06/horses-in-medieval-india-imports-and-local-breeding/>.

(a.o. Griffin 1873) (Figure 27), which resembled the covered baggage vehicles of earlier periods and are reminiscent of the “comfortable carriage” (“Chariot no. 2”) of Emperor Qin Shihuang.



Figure 27. The Mandarin Ching’s mule-drawn cart. (After Griffin 1873: 264).

The use of swift and impressive equipages by the nobility and high-ranking civil servants went out of fashion at the end of the Han dynasty. It was not until the formation of European settlements in the nineteenth century that elegant horse-drawn carriages – driven by the owner or a coachman – were seen again on the streets of Chinese towns and cities.

POSTSCRIPT

In this article, we have focused on the development of horse-drawn vehicles, of which hundreds have been excavated in Chinese tombs.

A new find, if correctly interpreted, throws light on the design and construction of ancient vehicles. It has been described by the excavators as indicating the use of a single draft animal harnessed between shafts nearly a thousand years earlier than previously thought (<https://mp.weixin.qq.com/s/c7DFkrDPm9bijHcdfdPgFw>; https://www.sohu.com/a/764555220_119659; <https://m.weibo.cn/status/O58PlbXH4?jumpfrom=weibocom>).

The excavation at Zhaigou, in Qingjian, Shaanxi Province, in northwest China, has brought to light a number of well-preserved chariots in rich tombs dated to the late Shang dynasty (ca. twelfth-eleventh century BCE). Among them, found in the northeast corner of tomb M3, is what is claimed to be the earliest vehicle with shafts known to date. Archaeologists speculate that it may be an ox cart of a type recorded in bronze inscriptions and various documents – the first archaeological discovery of an ancient ox-drawn baggage cart.

The body is oval in shape, like the chariot from pit M20 at Hsiao-t'un, Anyang (Liu Yonghua 2002, ill. on pp. 3, 4). The axle is four meters long, with a wheelbase of about 1.8 meters. The straight shafts are reported to run under the floor and are connected at the front by a wooden bow, interpreted as a yoke. The dimensions of the two multi-spoked wheels are not given in the press release. No animal remains are reported.



The recently excavated vehicle from the Wayaogou Cemetery, Shaanxi Province

Though the existence of two widely spaced shafts does not in itself prove the widespread use of single animal draft in early China, the Zhaigou find may help provide some clues about the origins of this technological innovation.

We await with great interest the full publication of this exciting new material.

ACKNOWLEDGMENTS

We are most grateful to Robert Hurford, master wheelwright and chariot expert, for sharing his expertise in building Chinese and other ancient chariots and carts, and to Wu Hsiao-yun and Zhou Xiuqin for supplying us with Chinese papers and translations.

REFERENCES

- An Zhongyi 安忠義. 2005. Han Wudi shiqi qibing de xingqi yu junzhi gaige 漢武帝時期騎兵的興起與軍制改革 (The rise of cavalry in Han Wudi's time and the reforms in the military). *Yantai shifan xueyuan xuebao (zhexue shehui kexue ban)* 烟台师范学院学报(哲学社会科学版) (Journal of Yantai Normal University: Philosophy and Social Sciences Edition) 22(4): 44–49.
- André, G., and J-P. Desroches. 2002. Une tombe princière à Gol Mod, Mongolie (campagnes de fouilles 2000–2001). *Arts Asiatiques* 57: 194–205; doi: 10.3406/arasi.2002.1489. http://www.persee.fr/doc/arasi_0004-3958_2002_num_57_1_1489
- Anthony, D.W. 2010. *The Horse, the Wheel, and Language: How Bronze Age Riders from the Eurasian Steppes Shaped the Modern World*. Princeton, N.J.
- Barbieri-Low, A.J. 2000. Wheeled vehicles in the Chinese Bronze Age (c. 2000–741 BC). *Sino-Platonic Papers* 99. http://www.sino-platonic.org/complete/spp099_wheeled_vehicles_china.pdf
- Barbieri-Low, A.J. 2007/2021. *Artisans in Early Imperial China*. Seattle and London.
- Brewster, T.C.M. 1971. The Garton Slack chariot burial, East Yorkshire. *Antiquity* 45: 289–292, pls. XLII–XLIV.
- Brownrigg, G. 2019. Harnessing the chariot horse. In Raulwing *et al.*, eds. 2019: 85–96.
- Brownrigg, G. 2022. The origin of the horse collar. In A. Ropa and T. Dawson, eds., *The Horse in Premodern European Culture: Studies in Medieval and Early Modern Culture* 70: 55–67. Berlin and Boston.
- Brownrigg, G. 2023. Jean Spruytte: Horseman, scholar, chariot builder. In Raulwing *et al.*, eds., 255–271.
- Brownrigg, G., and J.H. Crouwel. 2017. Developments in harnessing and draught in the Roman World. *Oxford Journal of Archaeology* 36: 197–220. DOI: 10.1111/ojoa.12112.

- https://www.researchgate.net/publication/316437411_Developments_in_harnessing_and_Draught_in_the_Roman_World_Equid-harnessing_and-draught.
- Brownrigg, G., J.H. Crouwel, and K.M. Linduff. 2023. Developments in harnessing and draught in the Roman Empire and Han China: Independent or interconnected? *Oxford Journal of Archaeology*, 42(2): 166–182. <https://onlinelibrary.wiley.com/doi/abs/10.1111/ojoa.12266>.
- Bulliet, R.W. 2016. *The Wheel. Inventions and Reinventions*. New York and Chichester.
- Bunker, E.C. 2002. *Nomadic Art of the Eastern Eurasian Steppes: The Eugene V. Thaw and Other New York Collections*. New York.
- Chechushkov, I., and A. Epimakhov. 2023. Archaeological evidence for the horse-drawn chariot from Inner Eurasia. In Raulwing *et al*, eds., 125–149.
- Chen Ning 陳寧. 2015. *Qin Han mazheng yanjiu 秦漢馬政研究* (Studies in the management of horses in the Qin and Han). Beijing.
- China's Buried Kingdoms* 1993. Time-Life Books. Alexandria, Va.
- Crouwel, J.H. 1981. *Chariots and Other Means of Land Transport in Bronze Age Greece*. Allard Pierson Series 3. Amsterdam.
- Crouwel, J.H. 1992. *Chariots and Other Wheeled Vehicles in Iron Age Greece*. Allard Pierson Series 9. Amsterdam.
- Crouwel, J.H. 2012. *Chariots and Other Wheeled Vehicles in Italy before the Roman Empire*. Oxford.
- Cui D.Y. 崔东源. 1997. Shuangrushi yihao hanmu yihao mache de fuyang yu yanjiu 双乳山一号含木一号马车的富阳与研究 (Reconstruction and study of the horse-drawn carriage no. 1 from Han tomb no. 1 on Shuangrushi Hill). *Kaogu* 3: 16–26.
- Dang Shixue 黨士學. 2011. Qin ling tong liche cheyu jiegou ji yibi jiexi 秦陵铜立车车舆结构及衣蔽解析 (Analysis of the structure and trappings of the bronze standing chariot from the Qin Mausoleum). *Qin Shihuangling bowuyuan 秦始皇陵博物院* (Qin Shihuang Mausoleum Museum), 191–212.
- https://www.sxlib.org.cn/dfzy/sxdwljgb/qgdwl/yjwx_5407/yjlz_5408/qshdlbwy2011/201704/t20170426_706014.html
- De Caro, S., and M. Scarpari, eds. 2010. *I due imperi. L'aquila e il dragone* (catalogue of exhibition in the Palazzo Reale, Milan, 15 April-5 Sept. 2010. Milan.

- De Decker, Kris. 2011. How to downsize a transport network: The Chinese wheelbarrow [edited by S. Joubert]. Posted on December 29, 2011.
<https://www.lowtechmagazine.com/2011/12/the-chinese-wheelbarrow.html>.
- Duan Qingbo and Anthony Barbieri-Low. 2023. Sino-Western cultural exchange as seen through the archaeology of the first emperor's necropolis. *Journal of Chinese History* 7: 21–72. doi: 10.1017/jch.2022.25.
- Every Treasure Tells a Story: Qin Bronze Chariots and Horses: The Road to Eternity*. 2020. CGTN video.
https://www.youtube.com/watch?v=_bgtnl7A7EY.
- Finsterbuch, K. 1971. *Verzeichnis und Motivindex der Han-Darstellungen 2*. Abbildungen und Addenda. Wiesbaden.
- Gansu Sheng Bowuguan 甘肃省博物馆 (Gansu Provincial Museum). 1972. Wuwei Mojuizi san zuo Han mu fajue jianbao 武威磨咀子三座汉墓发掘简报 (Excavation of three Han dynasty burials at Majuizi near Wuwei, Gansu Province). *Wenwu* 12: 9–23 with pls. 1–3.
- Goodrich, C. 1984. Riding astride and the saddle in ancient China. *Harvard Journal of Asiatic Studies* 44: 279–305.
- Griffin, M. Sketches of eastern travel. 1873. *Lippincott's Magazine of Popular Literature and Science* XII, No. 30: 263–275. <https://www.gutenberg.org/files/14036/14036-h/14036-h.htm#image-0020>.
- Grigoriev, S. 2023. Horse and chariot: Critical reflections on one theory. *Archaeologia Austriaca* 107: I–XXXII.
- Guan Zhengjian and K. Herrmann. 2020. *Kaogongji: The World's Oldest Encyclopaedia of Technologies*, with translations and comments. Leiden and Boston.
- Hookk, D., and N. Nikolaev. 2013. “Bird’s eye view” on the reconstructions of the cart and ceremonial tent from the 5th Pazyryk kurgan. *Asian Archaeology* (Changchun, Jilin, PRC. Research Center for Chinese Frontier Archaeology of the Jilin University) 1: 85–93.
- Hunan Sheng Bowuguan 湖南省博物馆 (Hunan Provincial Museum). 1957. Yun xiang yu hua 云翔衣花. (A word about Yunxiang): 第三讲 多姿多样的款式 (Special lecture on three various styles).
https://www.hnmuseum.com/sites/default/files/statics/zhuantijiangzuo/Lesson007/chapter3_2.html#6

- Hunan Sheng Bowuguan 湖南省博物馆 (Hunan Provincial Museum). 1963. Changsha Shazitang Xi Han mu fajue jianbao 长沙砂子塘西汉墓发掘简报 (A brief report on the excavation of the Western Han tomb at Shazitang, Changsha). *Wenwu* 2(13–24): 57–63.
- Hurford, R. 2023. The ancient V-spoked chariot wheel: Why was it made that way? In Raulwing *et al.*, eds., 245–254.
- Hurford, R., and J.H. Crouwel. 2022. New light on Chinese chariots. *Eurasia Antiqua* 24: 57–66.
- Hüttel, H.-G. 1979. *Zur westlichen Komponente des chinesischen Pferd-Wagen-Komplexes des Shang- und frühen Chou-Zeit. Beiträge zur allgemeinen und vergleichenden Archäologie* 1: 1–29. München.
- Jiben jianshe gongcheng zhong chutu wen wu zhanlan tu lu* 基本建设工程中出土文物展览图录 (Catalogue of the exhibition of cultural relics unearthed in the National Capital Construction Project). 1956. 2 vols. Beijing. <https://www.paihaoshu.com/detail/12025.html>.
- Jie Shi. 2015. Rolling between burial and shrine: A tale of two chariot processions at Cula tomb 2 in Eastern Han China (171 C.E.). *Journal of the American Oriental Society* 135: 433–452. <https://doi.org/10.7817/jameroriesoci.135.3.433>.
- Kierman Jr., F.A. 1974. Phases and modes of combat in early China. In F.A. Kierman Jr. and J.K. Fairbank, eds., *Chinese Ways in Warfare*, 27–66. Cambridge, Mass.
- Koryakova, L., and A.V. Epimakhov. 2007. *The Urals and Western Siberia in the Bronze and Iron Age*. Cambridge.
- Ledderose, L., ed. 2000. *The Thousand Things: Module and Mass Production in China*. Princeton, N.J.
- Ledderose, L., and A. Schlombs, eds. 1990. *Jenseits des Grossen Mauers. Der Erste Kaiser von China und seine Terrakotta Armee* (Dortmund 12 August – 11 November 1990) exhibition catalogue. Gütersloh, Germany.
- Lefebvre des Noëttes, R. 1931. *L'attelage, le cheval de selle à travers les âges*. Paris.
- Levine, M. 2005. Chinese chariot horses and the evolution of horse husbandry. <http://www3.arch.cam.ac.uk/~mll12/ChinPalaeoWebsite/introduction.htm>.
- Li Cheng 李成. 2010. Cong qingtong che qi guishi xian-Qing mache de fazhan 從青銅車器窺視先秦馬車的發展. (A look at the development of the pre-Qin bronze chariot from the perspective of bronze chariot equipment). *Wenbo* 6: 15–22.

- Li, Xiuzhen, Janice A. Bevan, M. Martín-Torres, *et al.* 2014. Crossbows and imperial craft organisation: The bronze triggers of China's terracotta army. *Antiquity* 88(339): 126–140. DOI: 10.1017/S0003598X00050262.
- Li, Ying, Yu Liu, Min Wang, Xiaoran Lin, Yuanyan Li, Tao Yang, Mo Feng, Yao Ling and Chunjiang Zhao. 2022. Whole-genome sequence analysis reveals the origin of the Chakouyi Horse. *Genes* 13, 2411. <https://doi.org/10.3390/genes13122411>. <https://www.mdpi.com/2073-4425/13/12/2411>.
- Li, Yue, Lina Wu, Chengrui Zhang, Huan Liu, Zexian Huang, Yifu Han and Jing Yuan. 2022. Horses in Qin mortuary practice: New insights from Emperor Qin Shihuang's mausoleum. *Antiquity* 96 (388): 903–919. doi: 10.15184/aqy.2022.72.
- Librado, P., N. Khan, A. Fages, *et al.* 2021. The origins and spread of domestic horses from the Western Eurasian steppes. *Nature* 598: 634–640. <https://doi.org/10.1038/s41586-021-04018-9>.
- Lim, Lucy, ed. 1987. *Stories from China's Past: Han Dynasty Pictorial Tomb Reliefs and Archaeological Objects from Sichuan Province, People's Republic of China*. Exhibition catalogue, the Chinese Cultural Center of San Francisco, April 11-May 21, 1987, San Francisco.
- Lindner, S. 2020. Chariots in the Eurasian steppe: A Bayesian approach to the emergence of horse-drawn transport in the early second millennium BC. *Antiquity* 94 (374): 361–380. doi: 10.15184/aqy/2020.37.
- Linduff, K.M. 2003. A walk on the wild side: Late Shang appropriation of horses in China. In M. Levine, C. Renfrew and K. Boyle, eds., *Prehistoric Steppe Adaptation and the Horse*, 139–162. Cambridge.
- Linduff, K.M. 2006. Imaging the horse in early China: From the table to the stable. In S.L. Olsen, S. Grant, A.M. Choyke and L. Bartosiewicz, eds., *Horses and Humans: The Evolution of Human-Equine Relationships*, 303–322. British Archaeological Reports International Series 1560. Oxford.
- Linduff, K.M. 2019. The heavenly horses visualized in Han China (220 BCE–220 CE). In Raulwing *et al.*, eds., 171–180.
- Linduff, K.M., and K.S. Rubinson. 2022. *Pazyryk Culture Up in the Altai*. London and New York.
- Littauer, M.A. 1968. The function of the yoke saddle in ancient harnessing. *Antiquity* 42: 27–31. Reprinted in Littauer and Crouwel 2002, 479–486.
- Littauer, M.A. 1977: Rock carvings of chariots in Transcaucasia, Central Asia and China. *Proceedings of the Prehistoric Society* 43: 243–262. Reprinted in Littauer and Crouwel 2002, 106–135.

- Littauer, M.A., and J.H. Crouwel. 1979. *Wheeled Vehicles and Ridden Animals in the Ancient Near East*. Leiden and Köln. <https://epdf.pub/wheeled-vehicles-and-ridden-animals-in-the-ancient-near-east.html>.
- Littauer, M.A., and J.H. Crouwel. 1985. *Chariots and Related Equipment from the Tomb of Tut'ankhamūm*. Tut'ankhamūn's Tomb Series 7 Oxford.
- Littauer, M.A., and J.H. Crouwel. 1996. The origin of the true chariot. *Antiquity* 70: 924–939. Reprinted in Littauer and Crouwel 2002, 45–52.
- Littauer, M.A., and J.H. Crouwel. 2002. *Selected Writings on Chariots, Other Wheeled Vehicles, Riding and Harness*. Edited by P. Raulwing. Leiden, Boston and Köln. <https://brill.com/edcollbook/title/7089>.
- Liu Yan. 2020. The Han empire and the Hellenistic world: Prestige gold and the exotic horse. *Mediterranean Archaeology and Archaeometry* 20(3): 175–198. DOI: 10.5281/zenodo.4016080. [http://maajournal.com/Issues/2020/Vol20-3/12_Liu_20\(3\).pdf](http://maajournal.com/Issues/2020/Vol20-3/12_Liu_20(3).pdf)
- Liu Yonghua 劉永華. 2002. 中國古代車與馬具 *Zhongguo gudai che yu maju* (Ancient Chinese carriages and horse fittings). Shanghai. Reprinted 2013, Beijing.
- Lu Gwei-Djen, R.A. Salaman and J. Needham. 1959. The wheelwright's art in Ancient China, in the invention of “dishing.” *Physis* I: 103–126.
- Lu Liancheng. 1993. Chariot and horse burials in ancient China. *Antiquity* 67: 824–838.
- MacGregor, M. 1962. The Early Iron Age metalwork hoard from Stanwick, N[orth] R[iding], Yorks[hire]. *Proceedings of the Prehistoric Society* 28: 17–57. <https://doi.org/10.1017/S0079497X00015644>.
- Mair, V. 2003. The horse in late prehistoric China: Wrestling culture and control from the “Barbarians.” In L. Levine, *et al.*, eds., *Prehistoric Steppe Adaptation and the Horse*, 163–187. Cambridge.
- Meng Janmin and Zhang Lin, eds. 2001. *Awakened: Qin's Terra-cotta Army*. Xi'an.
- Miller, B.K. 2012. Vehicles of the steppe elites: Chariots and carts in Xiongnu tombs. *The Silk Road* 10: 29–38. <http://www.silkroadfoundation.org/newsletter/vol10/>.
- Miniaev, S.S. 2009. Tsaram: A burial ground of the Hsiung-Nu elite in Transbaikalia. *Archaeology Ethnology and Anthropology of Eurasia* 37(2): 49–58. <https://doi.org/10.1017/S1545293009001564>.

[//www.academia.edu/3269218/TSARAM_A_BURIAL_GROUND_OF_THE_HSIUNG_NU_ELITE_IN_TRANSBAIKALIA](http://www.academia.edu/3269218/TSARAM_A_BURIAL_GROUND_OF_THE_HSIUNG_NU_ELITE_IN_TRANSBAIKALIA).

Miniaev, S.S., and L.M. Sakharovskaia. 2006. Investigation of a Xiongnu royal complex in the Tsaraam valley. *The Silk Road* 4(1): 47–51.

https://www.academia.edu/3269337/Investigation_of_a_Xiongnu_Royal_Tomb_Complex_in_the_Tsaraam_Valley.

Miniaev, S.S., and L.M. Sakharovskaia 2007. Investigation of a Xiongnu royal complex in the Tsaraam valley, part 2: The inventory of Barrow no. 7 and the chronology of the site. *The Silk Road* 5(1): 44–56.

https://www.academia.edu/3269337/Investigation_of_a_Xiongnu_Royal_Tomb_Complex_in_the_Tsaraam_Valley.

Mnatsakanian, A.O. 1960. Drevnie povozki iz kurganov bronzovogo veka na poberezhie ozera Sevan (Ancient vehicles from the Bronze Age barrows on the banks of Lake Sevan). *Sovetskaia arkheologija* 2: 139–152.

Moore, M.B. 1986. Exekias and the harnessing of a chariot team. *Antike Kunst* 29: 107–114.

Needham, J. 1965. *Science and Civilisation in Ancient China IV.2. Mechanical Engineering*. Cambridge.

Needham, J., and Lu Gwei-Djen. 1960. Efficient equine harness: The Chinese inventions. *Physis. Rivista di storia della scienza* 2: 121–162.

Novozhenov, V.A. 2012. *Chudo kommunikatsii i drevneishii kolesnyi transport Evrasii* (Communications and earliest wheeled transport of Eurasia). Edited by E.E. Kuzmina. Moscow.

https://www.academia.edu/5159110/Communications_and_the_Earliest_Wheeled_Transport_of_Eurasia.

Nowgorodowa, E. 1980. *Alte Kunst der Mongolei*. Leipzig.

Pan Biao 潘彪. 2014. Fulu san nanjingliny daxue mucai gongye xueyuan mucai jianing baogao 附录三 南京林业大学木材工业学院木材鉴定报告 (Appendix 3. Wood identification report from Nanjing Forestry University, School of Wood Industry). In Sun Yujun 2014. Nanjing.

<https://www.frelax.com/scdb/mulu/9/HAYH585069c1.html>

Piggott, S. 1974. Chariots in the Caucasus and China. *Antiquity* 48(189): 16–24.

<https://doi.org/10.1017/S0003598X00054120>.

- Piggott, S. 1978. The Chinese chariot: An outsider's view. In P. Denwood, ed., *The Arts of the Eurasian Steppelands*, 32–51. Percival David Foundation of Chinese Art Colloquies on Art and Archaeology in Asia no. 7. London.
- Piggott, S. 1983. *The Earliest Wheeled Transport: From the Atlantic Coast to the Caspian Sea*. London.
- Piggott, S. 1992. *Wagon, Chariot and Carriage: Symbol and Status in the History of Transport*. London.
- Pogrebova, M. 2003. The emergence of chariots and riding in the south Caucasus. *Oxford Journal of Archaeology* 22: 397–409.
- Polosmak, N.V., E.S. Bogdanov, D. Tsevendorj and N. Erdene-Ochir. 2008. The Han chariot from Noin Ula Mound 20 (Mongolia). *Archaeology, Ethnology and Anthropology of Eurasia* 36(4): 63–69.
- Portal, J., ed. 2007. *The First Emperor: China's Terracotta Army*. Catalogue of exhibition, British Museum, 13 August 2007 - 6 April 2019. London.
- Puett, M. China in early Eurasian history: A brief review of recent scholarship on the issue. In V. Mair, ed., *Bronze Age and Early Iron Age Peoples of Eastern Central Asia*, vol. 2: 699–715. Washington, D.C.
- www.academia.edu/4242385/_China_in_Early_Eurasian_History_A_Brief_Review_of_Recent_Scholarship_on_the_Issue.
- Qin Shihuang Bingmayong Bowuguan 秦始皇兵馬俑博物館 (Qin Shihuang Terracotta Warrior and Horse Museum). 1998. *Qin Shihuang ling tongchema xiufu baogao* 秦始皇陵銅車馬修復報告 (The bronze chariots and horses unearthed from the Qin Shihuang Mausoleum – a restoration report). Beijing.
- Qin Shihuang Bingmayong Bowuguan 秦始皇兵馬俑博物館 (Qin Shihuang Terracotta Warrior and Horse Museum) and Shaanxi Sheng Kaogu Yanjiusuo 陝西省考古研究所 (Shaanxi Provincial Institute of Archaeology), eds. 1998. *Qin Shihuang ling tongchema fajue baogao* 秦始皇兵馬陵銅車馬發覺報告 (The bronze chariots and horses unearthed from the Qin Shi Huang Mausoleum: An excavation report). Beijing.
- Raulwing, P., K.M. Linduff and J.H. Crouwel, eds. 2019. *Equids and Wheeled Vehicles in the Ancient World: Essays in Memory of Mary A. Littauer*. BAR International Series S2923. Oxford.
- Raulwing, P., S. Burmeister, G. Brownrigg and K.M. Linduff, eds. 2023. *Chariots in Antiquity. Essays in Honour of Joost H. Crouwel*. BAR International Series S3159. Oxford.

- Rawson, J. 2017. China and the steppe: reception and resistance. *Antiquity* 91: 375–388.
- Rawson, J., K. Chugunov, Y. Grebnev and Limin Huan. 2020. Chariotry and prone burials: Reassessing Late Shang China's relationship with its northern neighbours. *Journal of World Prehistory* 33: 135–168. [Doi.org/10.1007/s10963-020-09142-4](https://doi.org/10.1007/s10963-020-09142-4).
- Rawson, J., Limin Huan and W.T.T. Taylor. 2021. Seeking Horses: Allies, Clients and Exchanges in the Zhou Period (1045–221 BC). *Journal of World Prehistory* 34: 489–530. <https://doi.org/10.1007/s10963-021-09161-9>.
- Rudenko, S.I. 1970. *Frozen Tombs of Siberia: The Pazyryk Burials of Iron-Age Horsemen*. London.
- Rudolph, R.C., and Wen Yu. 1951. *Han Tomb Art of West China. A Collection of First and Second Century Reliefs*. Berkeley and Los Angeles.
- Schovsbo, Per Ole, Vogn og vej (Carriage and road) 1999. *Skalk* 6: 10–13. https://karetmager.dk/wp-content/uploads/2018/11/vogn_og_vej.pdf.
- Shang Chengzuo, ed. 1957. *Changsha chutu qiqi tulu* 长沙出土漆器吐露 (Catalogue of Chu lacquers unearthed from Changsha). Beijing. First published Shanghai 1955.
- Shaughnessy, E.L. 1988. Historical perspectives on the introduction of the chariot into China. *Harvard Journal of Asiatic Studies* 48: 189–239.
- Shaughnessy, E.L. 1989. Western Cultural Innovations in China, 1200 bc. *Sino-Platonic Papers* 11: 1–8. http://www.sino-platonic.org/complete/spp011_shang_china.
- Shen Youmin 申郵民. 1997. Zhao Wulingwang de Hufu qishe 趙武靈王的“胡服騎射”. In Men Kui 門巋, Zhang Yanjin 張燕瑾, eds., *Zhonghua guocui da cidian* 中華國粹大辭典, 129. Hong Kong.
- Shi Dangshe 史黨社. 2017. Qin mache de wenhua shi yiyi—cong Qin ling chutu tong chema tanqi 秦馬車的文化史意義—從秦陵出土銅車馬談起 (The cultural and historical significance of Qin horse-drawn chariots: From the bronze horse-drawn chariot excavated from the Qin mausoleum). *Qin Shihuang ling bowuguan* 秦始皇陵博物院 (Qinshihuang Museum), 338–356.
- Sichuan Zheng Kaogusuo Yanjiuso 四川省文物考古研究所 (Sichuan Provincial Institute of Cultural Relics and Archaeology). 2019. Sichuan ziyang shi yan jiang qu lan jia po han mu fajue jianbao 四川資陽市雁江區蘭家坡漢墓發掘簡報 (A brief report on the excavation of the Han tomb

- of Lanjiapo, Yanjiang District, Ziyang City). *Sichuan Wenwu* (Sichuan Cultural Relics) (1) (2019): 5–31. www.han-art.net/view.asp?id=189.
- Spruytte, J. 1978. L'attelage sportif. Le quadriges de course. *Plaisirs équestres* 102 (Novembre-Décembre): 418–424.
- Spruytte, J. 1978–1979. Le véhicule à un essieu, à brancards ou à deux timons, dans l'antiquité. *Almogaren* (Jahrbuch des Institutum Canarium und der Gesellschaft für interdisziplinäre Sahara-Forschung (GISAF), Hallein (Austria), 9–10 (1978–1979): 53–75.
- Spruytte, J. 1983. *Early Harness Systems: Experimental Studies*. London. Translation by M.A. Littauer of *Études expérimentales sur l'attelage* (Paris, 1977).
- Stead, I.M. 2014. *Iron Age Cemeteries in East Yorkshire*. English Heritage Archaeological Monographs. York: Archaeology Data Service. <https://doi.org/10.5284/1028203>.
- Stephen, B. 1992. Formal variation in Shang dynasty vehicles. In *Proceedings. International Colloquium on Chinese Art History, 1991, Antiquities, Part I*: 107–135. Taipei.
- Sun Ji 孙机. 2001. *Zhongguo gudai cheliang yu fushi lunwen* 中国古代车辆与服饰论文 (Essays on ancient Chinese vehicles and garments), rev. ed. Beijing.
- Sun Yujun 孙玉军. Huai'an bowuguan 淮安市博物馆 (Huai'an Museum). 2014. *Huai'an Yuhegun zhanguo mu mudiao guche yu xiufu baogao* 淮安運河村戰國墓木雕鼓車保護與修復報告 (Report on the preservation and reconstruction of the wooden drum carriage found in the Warring States tomb at Yunhe Village near Huai'an). Beijing.
- Swart, P., and B.D. Till. 1984. Bronze carriages from the tomb of China's first emperor. *Archaeology* 37: 6, 18–25.
- Taylor, W.T.T. 2017. *The Origins of Horse Herding and Transport in the Eurasian Steppe* (doctoral dissertation, University of New Mexico). https://www.academia.edu/32259255/Origins_of_Horse_Herding_and_Transport_in_the_Eastern_Steppe.
- Thote, A. 2008. Artists and craftsmen in the late bronze age of China (eighth to third centuries BC): Art in transition. *Proceedings of the British Academy* 154: 201–241. DOI: 10.5871/bacad/9780197264355.003.0008.

- von Dewall, M. 1964. *Pferd und Wagen im frühen China*. Saarbrücker Beiträge zur Altertumskunde 1. Bonn.
- von Dewall, M. 1986. Der Wagen in der Frühzeit Chinas. In W. Treue, ed., *Achse, Rad und Wagen. Fünftausend Jahre Kultur- und Technikgeschichte*, 168–186. Göttingen.
- von Dewall, M. 1989. Modellwagen und Wagenmodelle in frühen chinesischen Grabfunden. In E. Von Schuler, ed., *XXIII Deutscher Orientalistentag (vom 16. bis 20. September 1985 in Würzburg). Ausgewählte Vorträge*. Zeitschrift der Deutschen Morgenländischen Gesellschaft, Supplement VII: 648–661. Stuttgart.
- Wagner, M., with G. Leube. 2004. Wagenbestattungen im bronzezeitlichen China. In M. Fansa and S. Burmeister, eds., *Rad und Wagen. Der Ursprung einer Innovation. Wagen im Vorderen Orient und Europa*. Beiheft der Archäologische Mitteilungen aus Nordwest Deutschland no. 40 (Mainz am Rhein): 107–122.
- Wang Haicheng 王海成. 2002. 中國馬車的起源 (The origin of Chinese horse-drawn chariots) *Ouzhou yanjiu* 欧洲研究 (European Studies) 3: 4–75.
<https://washington.academia.edu/HaichengWang>.
- Wang Peng 王鹏. 2019. Zhouyuan yi zhi qing tong lun ya ma che yu dong xi wen hua jiao liu 周原遗址青铜轮牙马车与东西文化交流 (The chariots with bronze felloes unearthed at the Zhouyuan site and the cultural communication between the East and West). *Kaogu* 2: 74–88.
https://www.sohu.com/a/307351087_199807
- Wang Xiang. 2013. The Horse in Pre-Imperial China. PhD dissertation, University of Pennsylvania. Publicly Accessible Penn Dissertations, Paper 720.
<https://repository.upenn.edu/edissertations/720/>.
- Wang Zhenduo 王振铎. 1997. 东汉车志修复研究 *Dong Han chezhi fuyuan yanjiu* (Reconstruction and study of the Eastern Han vehicle), edited and supplemented by Li Qiang 李强. Beijing.
- Wang Zijin 王子今. 2015a. *Qin Han jiaotong shi xinshi* 秦漢交通史新識 (New understanding of the history of communications in the Qin and Han). Beijing.
- Wang Zijin 王子今. 2015b. *Zhanguo Qin Han jiaotong geju yu quyu xingzheng* 戰國秦漢交通格局與區域行政 (Transportation patterns and regional administration in the Warring States Period, Qin and Han Dynasties). Beijing.

- Watt, J.C.Y. *et al.* 2004. *China: Dawn of a Golden Age, 200–750 AD*. Exhibition catalogue, New York, Metropolitan Museum of Art, October 12, 2004 – January 23, 2005). New York, New Haven and London. *China_Dawn_of_a_Golden_Age_200_750_AD.pdf*.
- Whitfield, Susan. 2021. Selenium and horses in Ancient China: A missing link. *Silk Road Digressions*, April 16, 2021. <https://silkroaddigressions.com/2021/04/16/selenium-and-horses-in-china-a-missing-link/>.
- Wu Hsiao-yun. 2009. *Shang Zhou shiqi chema muzang yanjiu* 商周马车墓葬研究 (Study on Chariot Burials in Early China, 1200–210 BCE). Aurora Center for the Study of Ancient Civilizations, Beijing University Publication Series 20.
- Wu Hsiao-yun. 2013. *Chariots in Early China: Origins, Cultural Interpretations, and Identity*. BAR International Series S2457 (Oxford).
- Wu Hsiao-yun. 2023. When chariots were first known in China: Early cheekpiece development in the late Shang dynasty around 1250 BCE. In Raulwing *et al.*, eds., 199–214.
- Wu Hung. 1994. Beyond the great boundary: Funerary narrative in early Chinese art. In J. Hay, ed., *Boundaries in China*, 81–104. London.
- Wu Hung. 1995. *Monumentality in Early Chinese Art and Architecture*. Stanford.
- Wu Hung. 1998. Where are they going? Where did they come from? – Hearse and “soul-carriage” in Han dynasty tomb art. *Oriental Art* 26(6): 22–31.
- Wu Xiaolong. 2013. Cultural hybridity and social status: Elite tombs on China’s northern frontier. *Antiquity* 87: 121–136.
- Xin Lixiang. 1999. 漢代畫像中的車馬出行图考 Handai huaxiang zhong de chema chuxingtu kao (Chariots and horses in the travel pictures of the Han dynasty). *Dongnan wenhua* 199(1): 47–63.
- Yang Fuquan. 2004. The “Ancient Tea and Horse Caravan Road”: The Silk Road of Southwest China. *The Silk Road* 2 (1): 29–32. <http://www.silkroadfoundation.org/newsletter/2004vol2num1/tea.htm>.
- Yates, R.D.S. 2002. The horse in early Chinese military history. *Military Organisation and War: Papers from the Third International Conference on Sinology, History Section*, 1–78. Taipei.
- Yates, R.D.S. 2007. The rise of Qin and the military conquests of the Warrior States. In Portal, ed., 2007: 30–57.

- Yates, R.D.S. 2023. Early Chinese chariots, carriages, and carts in war and peace: Evidence from new textual and archaeological sources. In: Raulwing *et al.*, eds.: 215–227.
- Ye Shuxian. 2022. Youxiong: The mythical etymology of the Yellow Emperor. In *A Mythological Approach to Exploring the Origins of Chinese Civilization*, 249–276. Research Series on the Chinese Dream and China's Development Path. Singapore. https://doi.org/10.1007/978-981-19-3096-6_11.
- Yu Liangming 余良明. 2015. *Zhongguo gudai che wenhua* 中國古代車文化. (Culture of ancient Chinese chariots). Fuzhou.
- Yuan Jing and R.K. Flad. 2003. Two issues concerning ancient domesticated horses in China. *Bulletin of the Museum of Far Eastern Antiquities* 75: 111–127.
- Yuan Jing and R.K. Flad. 2006. Research on early horse domestication in China. In M. Mashkour, ed., *Equids in Time and Space: Papers in Honour of Véra Eisenmann*, 124–131. Oxford.
- Yuan Zhongyi 袁仲义. 1990. *Qinshihuang Ling Bingmayong Yanjiu* (秦始皇陵兵马俑研究) (Research on the terracotta warriors and horses of the emperor Qin Shihuang's tomb complex). Beijing.
- Yuan Zhongyi 袁仲义. 2002. *Qinshihuang ling kaogu faxian yu yanjiu* 秦始皇陵考古发现与研究 (Archaeological discovery and research of Qin Shihuang Mausoleum). Xi'an.
- Zhang Chengrui, Yongan Wang, Junmin Zhang, W.T.T. Taylor, Feng Sun, Zexian Huang, Ruijing Qiu, Furen Hou, R. K. Flad and Yue Li. 2023. Elite chariots and early horse transport at the Bronze Age burial site of Shijia. *Antiquity* 97: 636–653. doi: 10.15184/aqy.2023.54.
- Zhang Feilong 张飞龙. 2009. *Zhongguo gudai qiqi wenshi fazhan yanjiu* 中国古代漆器纹饰的发展研究 (A study of the development of ornamentation in ancient Chinese lacquer). *Zhongguo shengqi* 中国生漆 28(1): 10–48, 363–653. Doi: 10.15184/aqy.2023.54.
- Zhao Huacheng 赵化成. 1979. Hanhua suojian handai cheming kaobian 汉化检验韩代化学考变 (An examination of the nomenclature of chariots in Han pictorial art). *Wenwu* 3: 76–82.
- Zhao Wucheng 赵武成. 2018. Gansu Majiayuan zhanguo mu mache de fuyuan 马家园战国战车战车复原 (Reconstruction of chariots from the Warring States period tombs at Majiayuan, Gansu Province). Supplement II. *Wenwu* 6: 44–57.

Zhao Wucheng. 2019. The restoration of the chariots of the Warring-States Period in Majiayuan, Gansu (continued): The designing and making skills of chariots and modifying and designing ideas of oxcarts. *Chinese Archaeology* 19(1): 169–181. (Translated and updated from Zhao Wucheng 2018). <https://doi.org/10.1515/char-2019-0013>.

All issues of *Sino-Platonic Papers* are accessible to readers at no charge via our website.

To see the complete catalog of *Sino-Platonic Papers*, visit

www.sino-platonic.org