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Reconstruction of the Bronze Age Chariot of Kazakh Steppe

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Abstract: *The article is devoted to the study of the possibilities of using reconstructions of the chariots of the Bronze Age in museums' displays and exhibitions. The cultural and historical significance of these exhibits was demonstrated by comparing the artefacts of the Ural-Kazakh and Chinese complexes of chariots. Some general evidence in both complexes, such as the rite of burial, chariot constructions, weapons, the tradition of making vessels from bronze, and victims of people, was analyzed. A series of radiocarbon calibrated dating confirms the chronological priority of the steppe chariots. This fact allows to clarify the technical parameters of the Bronze Age chariots and make their reconstruction reliable. The idea of migrating the early Andronovo clans to northern China along the Altai Mountains and the Tarim desert and suggesting studying the steppe and early Chinese chariot monuments as evidence of a single Asian chariot complex was supported.*

Key words: Bronze Age, Kazakh Steppe, Chariot Reconstruction, Chariot's Petroglyphs, Ural-Kazakhstan Chariot Complex, Ancient Chinese Chariots, Asian Chariot Complex

Introduction

The discovery of Arkaim and Sintashta in the 70s of the last century significantly stimulated archaeologists' interest in chariot problems. Some results and the current state of the problem have already been described in a number of works,[1] where issues of horse domestication are examined in detail; linguistics; anthropology; ethnic history; paleodemography; reconstruction of the headband of chariot horses, harness parts (evolution of cheek-pices) and analysis of monuments with chariot attributes by

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[1] Kuznetsov, 2006; Kuzmina, 2007; Novozhenov, 2012; 2020; Teufer, 2012; Kupriyanova *et al*., 2017; Cheremisin, Komissarov & Soloviev, 2019; Kozintsev, 2019; Chugunov, Rawson, & Grebnev, 2020; Jacobson-Tepfer, 2020; Lindner, 2020.

highlighting chariot culture blocks in steppe Eurasia or chariot complexes, which seems to be the most successful measure.

This article is devoted to the analysis of the possibilities of using reconstructions (models) of chariots in the expositions of specialized museums. It seems that in modern expositions it is advisable to exhibit virtual (3D models in a multimedia context) or material mock-ups (natural models) of reconstructed exhibits associated with ancient communications as a vivid example of technological achieve-ments of ancient societies. These include the reconstruction of a real chariot from the Bronze Age, both in the form of a 3D model and in the form of a natural model. The current model of the chariot can be exhibited in the museum exposition as an independent object, showing the construction details of the archaic chariot as such as a separate and independent carriage design, and as a solid object – with a harnessed pair of horses and a chariot in full vestment, harness, with weapons and the charioteer's armor[2].

At the beginning of 2nd millennium BC in the steppe's societies of Eurasia, all the necessary prerequisites for the use of light, fast and maneuverable horse-drawn carriages – chariots – has developed. They were developed, with an undoubted military and ritual function, also as a means of managing huge herds of domestic animals, first of all, very mobile and little-managed herds of horses, and for hunting, which served as an important source of replenishment of the resources of these societies. The function of reconnaissance – the search for new fertile pastures and the survey of new steppe territories, was also relevant. In addition, the pair harness itself was already the most effective step and an effective means of taming the horse. The earliest horse domestication center in the European part of the continent is represented by osteological materials of the Sredny Stog II (Dereivka, Repin Khutor). The existence of a large center of horse domestication was supposed theoretically in the Asian part of steppe Eurasia[3] and was brilliantly confirmed by findings from the Botai settlement in Northern Kazakhstan.[4] From the genetic's point of view the Botai horses was the Przewalski's horses.[5] The development of equestrianism was restrained by the stable herd instinct of horses, overcoming of which required a very long selection. In addition, the horse's hooves would wear out under the weight of the rider much faster, and no devices for their preservation in archaeological materials have yet been recorded. Tamed horses served as an important means of exchanging steppe pastoralists with settled agricultural societies. Moreover, the steppes population in the 3rd-2nd millennium BC had a monopoly on the selection, breeding and supply of trained horses in Cenrtral Asia.

[2] Tserklevych *et al*., 2021.
[3] Gaiduchenko, 2014; Outram, 2014.
[4] Zaibert, 2009.
[5] Gaunitz *et al*., 2018.

Significant successes in the study of chariot complexes were made by Ural researchers.[6] In the concept of chariot complex the researchers include: the actual remains of chariots and their parts in the graves; the remains of the reins – finds of cheek-pices; a chariot weapon system, as well as written and graphic sources – drawings on vessels and corresponding chariot's petroglyphs.[7] In the Asian part of steppe Eurasia, a large series of burial grounds and a group of burial mounds with the remains of wooden chariots are now studied. Monuments of the Ural-Kazakhstan chariot complex are known now in the South Trans-Urals (Sintashta, Nikolaevka II), in the North (Kenes, Ulubay, Berlik II, Novonikolskoe), Western (Tanabergen 2) and Central Kazakhstan (Satan, Aschisu, Nurtay, Ayapbergen, Bozingen, Shantimes).[8] All currently known finds of chariots come from Sintashta, Petrovo and Alakul monuments of the South Trans-Urals in Russian Federation, Western, Northern and Central Kazakhstan. Published information on more than 20 chariots. Main monuments with chariots founded in Central part of China as well.[9]

In the early chariot complexes, the crew of the war chariots had a protective carapace, a shield, a helmet, a bow, a club-baton, a spear, a dagger knife, an ax, a distant battle throwing weapon – a complex bow and arrows with large flint tips in the quiver. An imitation of a chariot burial in the Aschisu (Kazakh steppe) demonstrates excellent weapons – bronze spears of the Seima-Turbino type, a knife – a dagger, a bronze hook and flint arrowheads. Of the objects of the chariot complex, a bone ornamented cheek-pices (psalii) stands out and a bone ornamented clutch with a bronze tip of goad. Among the rare and unique finds is the pointed rib copper vessel found in this burial ground on an annular tray. The radiocarbon dating of these finds along the bones of buried horses was determined within the late 3rd-early 2nd millennium BC.[10]

Similar goads and parts of chariot's complex were found in the Sintashta monuments Bolshekaragansky and Kamennyi Ambar – 5, Krivoie Ozero[11] in the Southern Urals, in Tanabergen 2 (Western Kazakhstan),[12] Bozengen and Maitan (Central Kazakhstan).[13] Bronze hooks of a similar type are also known in Sintashta settlements and burials and earlier ones in grave 32 with a wagon, in the Catacomb's Ipatovsky mound, dating from radiocarbon in the second half of the 3rd millennium BC.[14] In the early chariot complexes, the crew of the war chariots had a protective carapace,

[6] Chechushkov, 2013; Chechushkov, Epimakhov & Bersenev, 2018; Grigoriev, 2020.
[7] Molotkina & Khmelnytska, 2023.
[8] Novozhenov, 2012; Kukushkin & Dmitriev, 2019.
[9] Wu, 2013.
[10] Hanks, Epimakhov & Renfrew, 2007.
[11] Vinogradov, 2003.
[12] Tkachev, 2017.
[13] Tkachev, 2013; 2019.
[14] Belinskij & Kalmykov, 2004.

a shield, a helmet, a bow, a club-baton, a spear, a dagger knife, an ax, and distance-throwing weapons – a complex bow and arrows with large flint tips in the quiver and goad or whip as well.

Materials and methods

To reconstruct the steppe chariot, statistical combinatorial methods were used for analytically setting the parameters of burials with the remnants of the chariot harness and equipment and obvious grooves at the bottom of the grave pits, into which the wheels of the carts were inserted, allowing the technical parameters of the chariots to be restored. Computer modeling and comparison with real structures from synchronous Chinese monuments made it possible to verify the resulting designs of the steppe carts and the general parameters of the chariots, as well as their typology. Analysis of numerous fine monuments (a series of more than 600 images), primarily petroglyphs, images on vessels, in small plastic, their statistical analysis made it possible to identify several types of carts, including chariots, distinguishable by details and features of the designs depicted. The radiocarbon dating method for the studied burials with the found elements of the chariot complex made it possible to determine the dating of the considered burials and distinguished types of structures.[15] Findings in the construction and dating of the steppe chariots are made possible by finds in che-ma-kyns – graves with chariots of the Shang-Yin and early and late Zhou periods [Fig. 1].

Since the chariots are fragmented in the steppe graves, their reconstruction is of greatest interest.[16] The first reconstructions based on the materials of the cemeteries Sintashta and Krivoye Ozero were justly criticized.[17] A more objective reconstruction [Fig. 2] was undertaken on the basis of a mathematical analysis of the entire series of burials and computer modeling.[18] In 2018, the full-size chariot based on this model was reconstructed at the Arkaim Museum-Reserve.

Our reconstruction of the Early Andronovo chariot was undertaken on the basis of a general computer model, based on the analysis of material remnants of the chariots in the Sintashta-Petrovo and early Alakul burials of the Ural-Kazakhstan region.[19] The main parameters of the reconstruction proposed below were determined by the size of the burial pits, wheel grooves and the remains of wooden parts in them, as well as the remains of the body structure recorded in one case. As the sources for this reconstruction, the data of written and pictorial monuments were widely used

[15] Wagner, 2004.
[16] Anthony & Vinogradov, 1995: 36-41; Anthony, 2010.
[17] Littauer & Crouwel, 1996.
[18] Chechushkov, 2013.
[19] Novozhenov, 2012; 2020.

– numerous chariot petroglyphs of Central Asia and Chinese finds of real chariots in the graves of the Shang and Western Zhou periods and were undertaken with the previous experience of reconstructions made by other researchers.[20] The chariot was reconstructed in the Research Restoration Laboratory Island of Krym in 2014-2019.[21] A scale model of the chariot was made, on which the fastenings of the main components and structural parts [Fig. 3]. Two the full-sized chariots are worked out in detail and currently exhibited at the National Museum of Kazakhstan in Astana and in open-air exposition of UNESCO Center for Rapprochement of Cultures in Almaty.

Results and discussion

In China, the tradition of making wheeled vehicles in synchronous and earlier monuments is not fixed: there was no evolution at the level of innovation or the invention of four-wheeled vehicles at a later time, with the exception of the appearance of representative carriages with umbrellas, as well as an increase in the body of the chariot and its transformation into a cargo or cargo-passenger two-wheeled covered cart by the end of the 1st millennium BC. The most complete and detailed summary and analysis of all burials with chariots from China, published by Hiao-yun Wu. In this work, she analyzes more than 230 samples of real chariots from burials from the Shang Yin era to the chariots of Emperor Qing Shihuang, as well as the features of the funeral rite and the topography of the burial grounds in which they are found.

The Shang-Yin's che-ma-kyns were found in the area of Anyang, in the areas of Dasykuntsun, Xiaomingtun, as well as in the monuments of Gojiazhuang, Xiaotung, Qiaobei, Baidzhafeng, Meiyuanjuan, Lujiazhuang, Qianzhanda and others. Zhou chariots of the early period come from the relics of the northern and less often central provinces of China, from such monuments as Baitsyaopo, Zhangziaopo, Lulihe, Zhaogu, Shantaiguan, Shantsunlin, Fenshunlin, Yuandong, Tsaytsyagan, Nanshangen, Bayotzy, Xikun, ect.[22] About 30 monuments of this period are known. In total, in the territory of modern China, more than 60 monuments of early periods with chariots are known. In all the variety of che-ma-kyns types, two traditions can be clearly traced: the installation of real chariots in the grave and the imitation of its installation. If the Shang-Yin time is characterized by single graves with one chariot (or its imitation), a pair of horses, one or two buried chariots, then in the early Zhou and later times the number of various options and their combinations increases significantly.

Researchers of Chinese chariots suggest their borrowing from the steppe regions of Eurasia, which is unequivocally evidenced by the similarity of technical parameters,

[20] Littauer & Crowell, 1996; Izbitser, 2010.
[21] Altynbekov & Novozhenov, 2014: 256-273; Novozhenov, 2014.
[22] Wu, 2013.

funeral rites and written sources – inscriptions on fortune-telling bones and ancient Chinese chronicles.[23] Some Chinese myths related to ideas about the chariot were also borrowed from the steppe environment.[24] This conclusion is also confirmed today by a series of published calibrated radiocarbon dating for these monuments, which consists of 39 dates for Sintashta monuments; 17 – for Petrovo and 33 – for Ala-kul. Their calibration according to the dendrochronological scale was made in the program Oxal 3.1.[25] In absolute terms, the boundaries of this series are as follows: Sintashta dates – 2040-1690 BC (68.2 %); 2900-1500 BC (95.4 %); after checking these dates on 15 reference dates of the Arizona and Oxford laboratories – 1970-1770 BC (68.2 %) and 2030-1750 BC (95.4 %), which corresponds to the end of the 21-18 centuries BC; Petrovo's dates – 2500-2250 BC (13.6 %); 1950-1500 BC (54.6 %). For the monuments of the Trans-Urals, the position of the layers of Petrovo time over Sintashta and the Alakul series from 2500-2000 BC were stratigraphically recorded (39.7 %) and 1750-1500 BC (28.5 %), after calibration – 2700-2000 years BC (39.7 %) and 1900-1400 BC (28.5 %), which can be synchronized with the Srubnaya and Alakul-Fedorovo antiquities – 1750-1530 BC. Thus, the entire chariot complex of the Ural -Kazakh steppes dates back to: the border of 3-2 millennium BC – end of the 16th century BC.

In the light of the dating, the urgent task is to synchronize the steppe and ancient Chinese chariot monuments. Traditionally, in Chinese historiography, a perio-dization system has been formed based on the annals of the court chronographs, which in detail and conscientiously recorded all the significant acts of their masters. The interested only in the earliest dynasties: Xia (2205-1767 BC); Yin dynasty, and then the Shang (1767-1112 BC); Western Zhou (1111-771 BC); Eastern Zhou (770-256 BC) includes two periods of Chunshu – literally: spring-autumn (770-476 BC) and Zhangguo: literally – Warring States (475-221 BC); Qing Dynasty (221-206 BC).[26]

Next, grouped the calibrated dating of the northern archaeological cultures related to the chariot complex, in order to compare them with the dynastic:

1. Early Monuments: CisUrals – 2400-1950 (2650-1750) BC, Ural – 1900-1750 (1980-1630) BC, Middle Volga – 2470-2190 (2600-2000) BC – may synchronize only with the antiquities of the Xia dynasty, the finds of che-ma-kyns during this period are not known.
2. Elunino (Gorny Altai) – 2200-1600 (2600-1300) BC, as well as the Seima-Turbino, a transcontinental phenomenon – 2120-1630 (2150-1600) BC synchronized with the Xia dynasty, the early period of the Yin and Shang dynasties, as well as Okunevo – 2200-1750

[23] Kozhin, 2015; Cheremisin, Komissarov & Soloviev, 2019; Wang, 2019.
[24] Novozhenov, 2020.
[25] Epimakhov, 2008.
[26] Merz & Svyatko, 2016; Chugunov, Rawson, & Grebnev, 2020; Wang, 2019.

(2600-1700) BC. It is well synchronized with the Abashevo, Sintashta, Petrovo, Potapovo and Pokrovsky antiquities, and the related, but later Andronovo community.

3. Andronovo – 1610-1410 (1740-1400) BC synchronized only with the antiquities of the Shang dynasty, the developed period.
4. Karasuk – 1440-1130 (1700-1050) BC well synchronized with the developed and late Zhou.

Thus, carriers of archaeological cultures of the 2nd group could take part in the formation of the Chinese chariot complex, and carriers of cultures of the 3rd and 4th groups could influence its development in the middle and late periods of the Shang-Yin dynasty. The synchronization of these cultures and the mapping of monuments of the 2nd group probably shows the direction and stages of the movement of their carriers in space and in time towards Ordos, through the only geographically convenient way – along the steppe pastures, along the Altai Mountains. In the steppe and Chinese chariot complexes, significant coincidences of fragments of the funeral rite are found: special grooves for the wheels; cult burials of dogs; cult of fish; individual horse sacrifices; manufacturing of cult bronze vessels; a pair of horses is stacked with parts of chariot equipment – cheek-pices; barrows with chariots have a special location, only men are buried in them, which indicates the presence of a special strata in the society – charioteers.[27]

The following features are also noted: the decoration of the sides and significant parts of the cart's body and the presence of special grooves for wheels that were not used at the bottom of the grave – the chariot was placed nearby and its wheels were not inserted into these grooves. Thus, there is an analogy recorded in the steppe tradition of imitation of the burial of a chariot. There is a similarity of the main technical parameters of the Yin and Zhou chariots with the steppe ones, while the former had superior to the latter in terms of wheel size and wheelbase width, which allows to clarify the parameters of our reconstruction of the steppe chariot. Manufacturing technology, materials and tools. The main execution technique was the traditional method of working with wood in the steppe – bending of straight poles under heating (moistening with hot water and heating), followed by fixing the necessary bends until the tree completely dries and reinforcing the main compo-nents of the structure using rawhide belts or arcan (rop from horse's mane and tails)[28]. This is how rounded carriage details were made from the Pazyryk barrow, in such a way shynyrak (circle top of Yurt) and ukies (bended poles of Yurt's roof structure) were traditionally produced in the steppe – the main element in the construction of the Kazakh Yurt.

According to archaeological data, the earliest carts in the steppes of Eurasia were made from various hardwoods – elm, oak, willow, birch. For this reconstruction,

[27] Chechushkov, Epimakhov & Bersenev, 2018.
[28] Homon *et al*., 2023.

mainly willow poles were selected, whose natural properties, direct fiber structure, flexibility, sufficient elasticity and hardness optimally solve the design problems of the reconstructed cart. Willow grows everywhere in all archaeological landscapes of the monuments of the Bronze Age of the region, in the valleys of small steppe rivers[29]. Natural features, namely, the growth of straight, even, without knots, branches – the most optimal raw material for the production of wooden bent parts of this design. For the manufacture of axles, bearings and wheel hubs, solid breeds of trees are used – solid trunks of birch, oak and elm. Another type of material is rawhide of cattle. Leather belts were probably the main fixing element of the whole structure. With their help, the structural parts were interconnected and thus fixed, strips of leather were used to weave the floor of the platform of the chariot for greater amortization.

Clearing the chariot wheel in Satan's burial ground documents the presence of an external leather (red-brown) tire on the wheel rim fixed on it with small bone cloves on the inside of the rim. At the same time, as a result of the practical operation of the cart with such leather tires, in conditions of high humidity and when wet, rawhide naturally stretches, loses its original shape and functionality. The only way to defeat this problem is a very high degree and quality of dressing of the skin itself and the use of protective vegetable lubricants such as animal fat or tar. Such greases, in combination with leather washer seals, were also used to better glide the rotating parts of the chariot. For gluing wooden parts, natural resin (pine resin) is used. Fixation and fastening of structural units carried out with rawhide belts, previously moistened, using the "cross to cross" method, followed by drying. The ancient carpentry tool is also found in the chariot complexes of the Ural-Kazakhstan steppes and consists of: bronze and stone tools – a chisel, ax, mint, knife, scrapers and other tools. The presence of specialized tools indicates a high level of development of woodworking and the possibility of manufacturing with them all the described structural parts.

The main technical parameters – chariot dimensions: total length – 275 cm; wheelbase width – 120 cm; wheel diameter – 95 cm. The design consists of: two identical wheels with 8 spokes and a hub, with a total diameter of 95 cm; axis with a total length of 155 cm; central draught-pole, 235 cm long; body frame D – shaped, size 95 x 70 cm; yoke, 120-130 cm long; and yoke-saddles (optional). Wheel construction consists of a rim with grooves for eight spokes, a diameter of 95 cm and a hub. The rim is made of a straight willow pole with a diameter of 4-5 cm, length 190 cm, the ends of which are sharpened at an angle (for overlapping each other during bending) and which has round grooves in the amount of 8 pieces, located at equal distance from each other, depth up to 2 cm and into which knitting needles are inserted – poles with a diameter of up to 2 cm. The other end of the spoke is inserted into 8 grooves made in the central hub on the outside, with a landing nest 2 cm deep.

[29] Lukashchuk, Onufriv & Tupis, 2023.

The whole-wood, cylindrical, round, hub has a diameter of 25 cm, a central through hole for the axis, with a diameter of 5 cm, its width is also 25 cm. It is made of a whole trunk of birch, beech or oak. The wheel is assembled into a single unit by bending the rim with knitting needles around the hub under heating and is fixed by the outer diameter of the one-piece rim of a well-made, thick rawhide leather, 10 cm wide. Initially, the tire skin of the wheel is moistened for more convenient tension on the rim. Natural drying of the skin produces the effect of tightening the entire wheel and fixing the entire structure with resin. On the inner side of the rim, in the spaces between the spokes, the free edges of the skin are beaten with conical bone cloves up to 1 cm long. After final assembly, the leather tire of the wheel is covered with a water-repellent composition. Suppose mounting the tire on the wheel rim using resin, by lubricating the surface of the rim with resin for better fixation of the tire when the entire structure dries out and to enhance water-repellent properties.

Axis is made of a solid and even birch (oak) log, with a diameter of up to 9 cm and a total length of 155 cm. Each edge of the log is cut 30 cm from the edge to a dia-meter of 4.9 cm, leaving a rectangular ledge on the inside edges for fixing on the axis of the inner edge of the wheel. In the central part of the axis, a landing groove for the drawbar (draught-pole) is made, with a diameter of 7 cm and a depth of 4 cm. At both outer ends of the axis, 5 cm from the edges, there is a through hole (1 cm in diameter) for the check – wooden conic (birch, oak) a rod that fixes the outer edge of the wheel on the axle. The size of this conical shaft is 10 cm long, with a diameter of 0.8 to 1.5 cm. For smoother sliding of the wheels on this design, a leather washer-gland with an outer diameter of 7 cm is cut from the outer and inner sides of the wheel – 10 cm, internal – 5 cm and which are worn on the axle at both ends of the wheel and lubricated with grease, as well as the ends of the axle on which the wheels rotate. Central draught-pole made of a solid pole (willow, birch, oak), with a diameter of 7 cm and a length of 235-240 cm. One end is inserted into the landing groove on the axis and glued with resin, fixed tightly on the axis with a raw cross-to-cross belt, to the second – the yoke is attached. Has a double bend. The first bend corresponds to the attachment point of the outer front edge of the chariot platform to the drawbar and is no more than 30 degrees (approximately). The second bend smoothly goes to the end of the drawbar and the yoke, forming a slightly curved arc. The tilt angle of the draught-pole is formed so that the height of the edge of the drawbar attached by yoke to the necks of the draft horses is 130-135 cm from the ground, while the platform of the chariot on wheels is strictly horizontally in relation to the surface.

Platform body has a D-shaped plan shape of the frame, 90-95 cm wide and 70 cm long along the drawbar (central draught-pole), and is made of two willow poles with a diameter of 5-6 cm. One is made in the form of a curved arc, the other in the form a straight rod, 80-85 cm long. Both parts are connected into one, by bonding the ends with rawhide straps in the same “paw” plane – selecting symmetrical grooves

and tying these nodes with rawhide cross-to-cross straps. The platform is fastened in a similar way (using small recesses under the pole of the platform on the draught-pole and axis and tied with cross-to-cross straps) at three points – to the draught-pole in front and in two places to the rear axle of the cart. The rear edge of the platform can protrude beyond the axis of up to 20 cm. The area of the platform formed by the frame is covered by weaving from rawhide strips of skin fixed to the poles of the frame by bone carnations. It is possible to manufacture the surface of the site from woven willow rods, a thickness of 0.5-1 cm.

Yoke is a straight pole with a diameter of 5-7 cm and a length of 120-130 cm, perpendicularly tied to the upper end of the drawbar with raw cross-cross straps and installed in a special groove at the end of the drawbar. It can be equipped with two yokes – slingshots for fixing the yoke from the top of the harness horse's neck. It is made of a double willow branch, having the shape of an inverted letter "Y". It is attached to the yoke by branching down with the help of grooves and rawhide straps tied cross to cross. All construction details are made separately and assembled together with glue-resin and rawhide belts. The final fit of the yoke and its fastenings to the horse takes place under the physiological characteristics of specific harness horses. The headband of chariot's horses has already been reconstructed based on the analysis of a large series of cheek-pices from synchronous graves and has been successfully tested in numerous field experiments in modern conditions on real horses.[30] These experiments convincingly proved the functionality and efficiency of such a harness and confirmed the correctness of this reconstruction.

Managing a pair of chariot horses required special additional equipment, in comparison with a conventional riding horse. In addition, in the era of Early Bronze, the horse was still not domestized enough, not fully tamed, which also required a more stringent control system. Therefore, a snaffle-type system was used with studded bone (horn) cheek-pices painful for a horse, in combination with organic bits of a hair lasso and bronze bits with bone handles. The harness was made up of a headband combined with a nasal belt; it was actually bitten with cheek-pices fixed on the cheeks of the horse, and reins were tied to the ends of the rod. Maneuvering was carried out by pulling the halter on the right side and pressing the spikes of the cheek-pices on the sensitive areas of the horse's head. The simultaneous tension of all the reins led to a stop of the chariot, and the acceleration of the cart could be achieved by injections with a goad in the horse's croup. Initially, the chariots were developed as an individual, personal vehicle and were driven by one driver, so he was forced to simultaneously manage the chariot and use his own set of weapons. In this case, the reins were tied around the belt, one of the legs was fixed in a special loop on the platform floor, and the wagon was controlled by the turns of the driver's body. In this position, it was

[30] Chechushkov, Epimakhov & Bersenev, 2018.

possible to use a spear on the go, shoot from a bow, use a close combat weapon – a baton or a dagger.

Later, the chariots increased in size, a special handrail appeared, and the size of the body of the cart allowed transporting two and three people, including the charioteer. Then such a combination of functions was no longer relevant, as each of the crew members concentrated on their tasks: someone controlled the chariot, someone shot on the move from a bow, someone covered the entire crew with a protective shield. From the middle of the 2nd millennium BC the most widespread was the crew, consisting of two people – a charioteer and a chariot – warrior. The Hittite chariots, and later Assyrian, very large-sized carts, had a crew of three people, providing control of the chariot (charioteer), attack (chariot warrior) and the defense of the crew (shield carrier). Charioteer clothing, weapons complex. The appearance of the charioteer is reconstructed on the basis of small plastic items definitely associated with the charioteers of an earlier period, graphic and written sources and is based on existing reconstructions of Andronovo clothes.[31] The features of the charioteer's image include large eyes and a deliberately shown large nose, a round hat, like a skullcap, from which long hair flows down to the shoulders and back. Often the charioteers are shown with crosses on their torso – two belts intersecting on the chest and back in the manner of a sword belt. Obviously, the charioteer had a belt to which the items he needed were fastened – a bow, a mace, a dagger, an ax, a bow with arrows (behind his back) and even a spear inserted behind his back in the belt crosshairs.

Archaeological evidence indicates the presence of a protective carapace on the chest and back of a charioteer, consisting of rectangular bone plates measuring 30-40 x 5 cm, arranged vertically and fixed to clothing using special small holes at the edges. This carapace protected from flying arrows and even blows with a spear or club. Harness belts and a belt were probably located on top of this protective bone shell. Later, the function of the protective shell was performed by a small rectangular shield woven from rods and covered with thick bovine skin, known from the images in petroglyphs. Similar lacquered shields made of wood are found in Chinese graves with Shang chariots. In all the early Chinese dynasties, written sources recordthe bloo-dy custom of human sacrifices and the forced burial of subordinates, concubines, who did not give birth to children, prisoners and slaves. Many circumstances of the funeral rite of the steppe graves with chariots unequivocally testify to the existence of such a custom.[32]

Throughout the territory of Ordos, numerous daggers and knives of the Seima-Turbino and Karasuk type with bell-shaped or zoomorphic tops, biloba axes, spears are found. These objects, typical of the chariot weapon system, have pronounced northern,

[31] Usmanova, 2010.
[32] Kupriyanova *et al*., 2017.

steppe features, which indicates the existence of a developed channel of communication and the receipt of a large number of weapons from the northern regions, the variety of such contacts was expressed including the involvement of the Chinese rulers as allies or mercenaries of individual steppe clans. These steppe groups (Riwem/Rong) could include the gui-fang, tu-fan, and guang-fang tribes known by inscriptions on fortune-telling bones and bronze vessels, with which the Shang and early Zhou rulers repeatedly waged wars. Northern China during this period was a kind of contact zone where mutual penetration and mixing of various cultural elements took place. Steppe societies that had settled by that time already in the vast steppe space of Eurasia in the form of large patriarchal families – self-sufficient production groups of close relatives or groups of such, or more simply – shepherd's clans, developed exclusively for their livestock. Many of them succeeded in inventing new mechanisms and devices that could facilitate their daily lives. The closest and loved ones that daily surrounded their facilities have undergone modernization and innovation. The horse, as the most reliable friend, gradually began to lose its gregarious and wild features, a new stage of its domestication began, a mobile and clumsy housing on wheels – a van, began to modernize and change its functions. All this became the prerequisites that led to the invention of a light, comfortable for horses and humans, more mobile carts – chariots.

A vivid proof of the advancement of the steppe Early Andronovo societies eastward is a significant series of mummies, a Caucasian appearance, recorded in the Tarim desert, the Taklamakan lowlands, in the Xinjiang Uygur Autonomous Region of China and now presented in the special hall of the Urumqi History Museum. Monuments of this type are located on the same routes along which the Great Silk Road later passed. Excavations of numerous burial grounds of this series provide unique information about this migration: a complex of ceramics, features of burial structures and a rite that made it possible to date these monuments from the 18-17th centuries BC.[33,] The women's clothing preserved in these graves is very reminiscent of the reconstructions carried out by E.R. Usmanova[34] on Alakul and Andronovo women's suits and jewelry: the desert's climatic conditions preserved many artifacts inaccessible in the steppe archaeology, such as clothes, beautiful red dresses for women, mineral wool and animal skin dyed, numerous wooden items and objects. It is unlikely that one should expect the complete similarity of things invented among herders and later presented in the cultures of Erlitou or the Shang-Yin dynasty. The peculiarity of the interconnections of these two worlds is their mutual influence on each other, in borrowing at the level of ideas, principles, technology, which then develop on the basis of their own tradition.

[33] Xiaoshan & Bo, 2008; Boyko & Kuleshov, 2023.
[34] Usmanova, 2010.

The relationship between the steppe tribes and the early Chinese states is traditionally regarded as a confrontation between two worlds – the barbarian world of the steppes and developed Chinese civilization. Recent studies allow us to reconsider such a traditional idea and highlight some elements of the material and spiritual culture of pastoralists, which were borrowed by Chinese civilization and developed in it in accordance with their own traditions and ideas. Such borrowings fully include the chariot, its driving skills, some images and mythologemes of the steppe fine tradition, bronze casting technology, domesticated horses and many mythological representations, beliefs and cults. Based on the foregoing, it is advisable to consider the Ural-Kazakhstan and ancient Chinese chariot complexes as a single Asian chariot complex, and consider the differences as a chronological [Fig. 4].

Such a model probably formed the basis for the formation of two centers of European and Asian chariot complexes at the very beginning of the 2nd millennium BC on both sides of the Ural Mountains, precisely dividing the steppes belt of Eurasia into its European and Asian parts. This boundary of nature may have predetermined the vector of the subsequent movement of these clans – some to the west, and others to the east [Fig. 5].

On a historical scale, it was a fast process. Already in the 18th century BC these clans, advancing along the routes already known to them, and more precisely – along the pastures mastered by their ancestors, reached the contact zones – entered into interaction with agricultural civilizations. In the west, these are Mycenaean and Achaean Greece, the tribes of primitive Europe, in the east – the early Chinese dynasties, in the south – Harappa, Assyria, Babylon, and by the middle of the millennium – Egypt. In this story, it is also important that, thanks to the updated dating of the ancient Chinese and Ural-Kazakhstan chariot complex in particular, it is possible to look a little differently at pictorial sources – numerous Central Asian chariot petroglyphs, plates with chariots from graves, the finds of which territorially fix the directions of movements Early Andronov and post-Andronov clans on the map of the Asian part of Eurasia [Fig. 6].

Therefore, not from the fighting or colonial-expansionist tradition dictated by Middle Eastern tyrants, but from the real needs of their nomadic hard life, a chariot probably was born in the steppe. The process of driving a chariot is a rather dangerous activity, requiring considerable skills in horseback riding, agility, and physical abilities. Undoubtedly, the most trained members of societies, occupying the appropriate social position and receiving privileges for this, became chariot's drivers. Of course, as soon as this "miracle" of the steppe technology appeared, in which all the labor and production resources of all, without exception, relatives came together, only the most important – the leader or the elder of this clan could own it. It is these physically developed, agile and fearless "masters" of the clans who became the first charioteers. And of course, they very quickly realized that they possess secret weapons with which

they can kill, rob and subdue, in a word – develop very successfully and actively the external communication channels of their initially very small societies.

Conclusions

Thus, although the exact place of the invention of the chariots remains debatable, it is clear that they played a significant role in the daily life and communications of the Bronze Age population of the steppe's belt of the Eurasian continent. This is clearly evidenced by the sources used in our study, originating from dated archaeological complexes with chariot paraphernalia (more than 60 monuments), with the remains of chariot designs (elements of body, central dtaught-pole), wheels with spokes (nave, axe), tools of carpenters and weapons of charioteers. A significant body of artifacts make up the details of the chariot horse's harness (cheek-pices, goads, whips), allowing to reconstruct the ways of harnessing of draught horses. Significantly complement our knowledge about steppe chariots the synchronized visual monuments, which clarify the lost in time organic details of chariots, not preserved in the burials.

At present, more than 600 chariot's petroglyphs – images of chariots on the rocks – have been taken into account, which in addition to the marked advantages in the detail of this historical object also point to the routes of migration and contacts of the population during the Bronze Age on the vast steppe expanses of Central Asia (combined with specific archaeological materials). The vast plains, covered with cereal and hoove vegetation, were quite comfortable natural infrastructure, which did not require the construction of a special road network and naturally allowed such long migrations. The contacts of the population recorded in this way allow to attract for the reconstruction of steppe chariots a significant series of chariots, excavated by Chinese archaeologists and dated as Shang and West Zhou periods. All this hull of sources allows to reliably reconstruct the structure of the steppe chariots of the Bronze Age and to raise the question of the formation at the turn of 3rd-2nd millennium – 15 century BC on the steppe expanses of Central Asia the Asian chariot complex, well represented in the archaeological and visual monuments of this period.

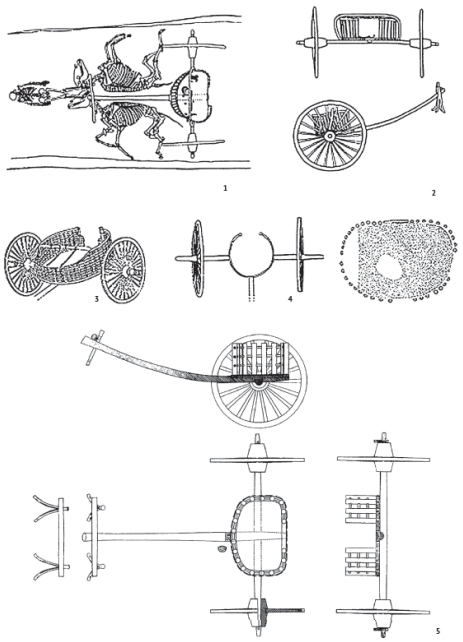

Fig. 1. Ancient Chinese chariots with a small platform
[1 – Qiaobei (Shang-Yin);
2 – Guo-jiazhuang, burial M 1003, remains of the body (Shang-Yin);
3 – the grave of Zhao Qing (Zhangou), burial M251, No. 1 (Later Chunsu);
4 – Matszyayuan, burial No. 4 (Later Zhanguo);
5 –Xiaotung, burial 40],
(developed by the author)

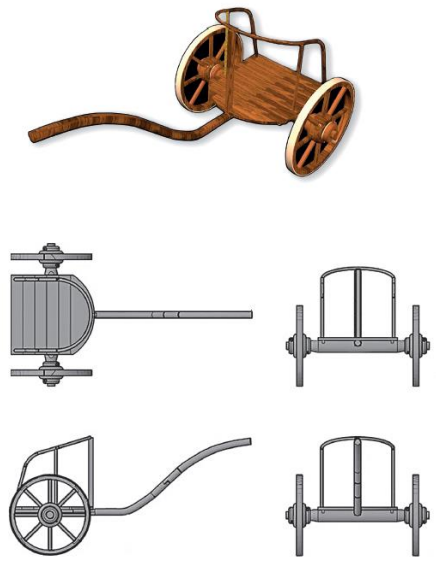

Fig. 2. The computer model of the chariot (developed by the author)

Fig. 3. Reconstructions of the chariot [1 – The model in a scale of 1:10; 2 – A full-size chariot exhibited at the National Museum of Kazakhstan in the city of Astana; 3, 4, 5 – A full-size chariot with horses exhibited at open-air exibition of UNESCO Center for Rapprochement of Cultures in Almaty, Kazakhstan] (developed by the author)

Fig. 4. Asian chariot complex and other centers of the use of chariots in the Ancient World in 2nd-1st millemium BCE [Earliest chariot's centers: 1 – Ural-Kazakh, 2 – Chineese, 3 – Indian (Indus valley), 4 – Hittite-Mittani (Assiria-Babilon), 5 – Egiptian, 6 – Sakharian, 7 – Greece, 8 – Rome, 9 – Spain, 10 – Scandinavia, 11 – Volga-Don] (developed by the author)

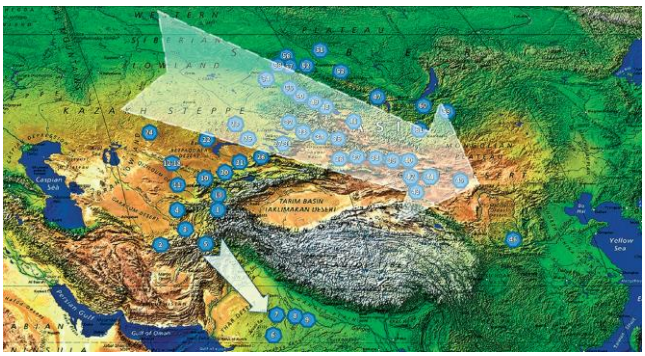

Fig. 5. Map of largest pictorial monuments with chariot petroglyphs marking possible directions of communications in the Asian part of Eurasia in the Bronze Age [1 – Akdzhilga, 2 – Tekke -Tash, 3 – Okhna, 4 – Karakiyasai, 5 – Tkhor, 6 – Chibbarnala, 7 – Djarampuri, 8 – Chatur Bkhu Nash, 9 – Eda Kalkave, 10 – Zhaltyryk-Tash, 11 – Ters, 12-18 – Koibagar, Arpauzen, Koshkar-Ata, Sauyskandyk, Rang Ozen, 19 – Saimaly-Tash, 20 – Tamgaly, 21 – Chumysh, 22 – Dzhambul, 23 – Kesteletas, 24 – Baikonur, 25 – Saiak, 26 – Yeshkiolmes, 27 – Akbaur, 29 – Moinak, 30 – Tul'kune, 31 – Saur Tarbagatai, 32-35 – Kalbak-Tash, Elangash, Zhalgyz Tepe, Adyrkhan, 36 – Yamany Us, 37 – Tsagaan Gol, 38 – Bichigty Am, 39 – Khobd Somon, 40 – Beger Somon, 41 – Chuulut, 42 – Darvi Somon, 43 – Manlai Somon, 44 – Khavtsgait, 45 – Urad (Lanshan'), 46 – Yangsu (Ganguan), 47 – Syyn Churek, 48 – Muguur Sargol, 49 – Chinge, 50 – Ortaa Sargol, 51 – Ust' Tuba, 52 – Oglakhty, 53 – Sukhanikha II, 54 – Oshkol, 56 – Sedlovina, 57 – Shishka, 58 – Polosataia] (developed by the author)

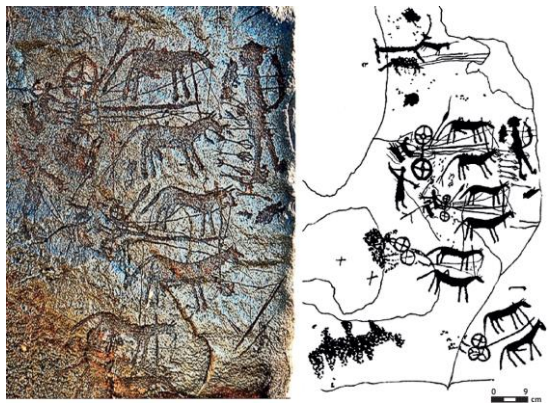

Fig. 6. Petroglyphs Yeshkiolmes (Valley of the river Koksu), (developed by the author)

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