

THE METAL AGES AND MEDIEVAL PERIOD

DOI: 10.17746/1563-0110.2018.46.3.041-048

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On the Construction Features of Wheeled Vehicles in Iran and Mesopotamia (Third to First Millennium BC)

Reinforcing metal elements in early Eurasian wheels are described. A typology of wheel constructions is proposed, and stages of their evolution and diffusion in socially and ethnically diverse societies are reconstructed. In Sumer and southwestern Iran, early (3d millennium BC) evidence of the use of wheeled transport includes remains of wagons in burials, and representations on vessels and cylinder seals, as well as clay and metal models. The early reinforcing details were bronze nails pinned along the treads of solid-disk wheels. Thick leather straps on treads served for binding wheels, prevented wear, and made riding more comfortable. Chariots marked the high social status of their owners, and were used for military, hunting, and ritual purposes. Around 2000 BC, metal tread-bands with additional plates were introduced in Susiana and Central Asia. In the Early Iron Age, after a 1000-year long break, studded treads reappeared, but on spoked wheels. This construction occurs across a huge territory from the Balkans and Aegean to Bactria. A review of materials from the Bronze Age kurgan burials in the Eastern European steppes reveals no evidence of the use of metal details in the Pit-Grave, Novotitorovka, Catacomb, or Sintashta cultures, indirectly suggesting a multiplicity of wheel-manufacturing traditions.

Keywords: *Bronze Age, Iron Age, Iran, Mesopotamia, wheeled vehicles, metal reinforcing details, technological traditions.*

Introduction

There has been much discussion of the development of wheeled transport in the scientific literature (Nagel, 1966; Kovalevskaya, 1977; Littauer, Crouwel, 1979; Nefedkin, 2001; and others). The military aspect of the history of chariot use by Indo-European peoples is studied in the monograph by D. Anthony (2010). Fundamental issues of the origin and distribution of wheeled transport are discussed. For instance, the association of the wheeled vehicles with the dispersion of Indo-European peoples from their nomadic ancestral homeland became the central theme in a number of studies by E.E. Kuzmina (1994, 2008) and in the collective monograph “The Mystery of the Ethnic History of the Earliest Eurasian Steppe

Nomads” (Tainstvo..., 2014). The collection of papers “Origin and Spread of Chariots” (Proiskhozhdeniye..., 2008) discusses the time and place of horse domestication and the appearance of two-wheeled vehicles as an important element of the warfare, social-political history, and ideology of ancient Eurasian societies.

The present article was prompted by a representation of a vehicle drawn by a pair of oxen among the petroglyphs of the Chatur Bkhu Nash grotto in Northern India (Novozhenov, 2012: 113, fig. 57; p. 374, 379): in particular, of a detail in the form of short radial lines extending away from the outer outline of the wheel (Fig. 1, 3). Obviously, an ancient artist had tried to render some characteristic constructive detail. In search of matches, we considered archaeological materials of the Bronze and Iron Ages

from various regions. Finds from Iran and Mesopotamia and the South Russian steppes are considered primarily, but comparative materials from later periods and more remote areas are also involved. We are interested in the construction of wheels using metal details. On the basis of these data, we have attempted to outline the stages of evolution and distribution of technological traditions in socially and ethnically diverse societies.

Materials

There is a variety of ancient evidence of the use of wheeled vehicles, including those with metal reinforcing details, in the territory of Sumer and culturally related Susiana. The available Near Eastern materials pertain to the period from the turn of the 4th to 3rd millennia BC up to the 2nd millennium BC inclusive.

We will give a brief overview of early wheeled vehicles, remains of which have been discovered in Susa and Kish burials (the middle of the 3rd millennium BC). These have wheels with metal fasteners in the form of rows of nails pinned along the treads. In burial B 280 of the cemetery on the Donjon hill in Susa (Mecquenem, 1943: 122–124, pl. 10) charred remains of a four-wheeled vehicle were found. The wheels are of different sizes: one pair is 83 cm in diameter, and the other pair is 64.4 cm (Fig. 1, 5, 6). Since the vehicle was placed in the burial in a disassembled condition, it is unclear whether the wheels belonged to the same carriage, or to two different ones. Metal nails 4.5–5.0 cm long affixed thick leather straps on the treads. 91 and 86 nails were discovered on the big wheels, and 64 nails on each of the small ones. Chariot-remains were found on another Susa hill, in the Ville Royale, area 1, burial 555. The wheel, deformed into the shape of an oval 77 × 68 cm, also has metal nails along the edge (Tallon, 1987: Vol. 1, p. 303, fig. 44). Chronologically, these finds correspond to the burials containing vehicles in the Royal cemetery of Ur of the Early Dynastic epoch (hereinafter—ED) III (*Ibid.*: Vol. 1, p. 301); however, no metal reinforcement of wheels has been recorded there (Woolley, 1934: 64, 108–109, pl. 30). Two-wheeled and four-wheeled vehicles were found in three burials of cemetery Y (ED) in Kish; therewith in burial 529, both types were discovered. On the wheels of the vehicle from burial 354 (Langdon, Watelin, 1934: 13, fig. 3, 30–34), leather strap protectors attached by 55 nails were observed (Fig. 1, 8).

There are known images of wheeled carriages on various objects, the earliest of which pertain to ED (early-middle 3rd millennium BC). These are drawings on vessels of scarlet ware type from Khafaje (eastern Iraq) and Susa (southwestern Iran) (Delougaz, 1952: 70, pl. 62; Carter, 1985: 45). This type of painting reliably dates the materials to ED I (2900–2750 BC) and the beginning of

ED II (2750–2600 BC) (Van De Mieroop, 2016: 41, 42). The vessel from Khafaje shows a representation of an onager-drawn heavy vehicle with four solid-disk wheels (Fig. 1, 1, 2). The most interesting detail is a fringe-like toothed framing along the circumferences of the wheels, which probably depicts a reinforcing construction made of straps, attached to the tread by metal nails. Judging by the presence of a quiver with arrows, the vehicle was used for military or hunting purposes. The construction of the wheels can also be judged by the images on the famous “standard” from the Royal cemetery of Ur dated to the middle of the 3rd millennium BC. These have the appearance of solid disks and are made of three solid planks, including the middle plank with a hub at the center, and two outermost ones in the form of segments; the parts are secured together by short cross-members (Hansen, 2003). A scarlet ware vessel from Susa (burial 322 of the cemetery on the Donjon hill (Carter, 1985: 45) has a representation of a vehicle drawn by an ox. Short radial dashes (probably projecting nails of the band) (Fig. 1, 4) are shown along the wheel’s periphery (Mühl, 2014). In general, the composition is very similar to the image of vehicle in the Chatur Bkhu Nash grotto.

Images of wheels with additional details can also be seen on cylinder seals and their sealings. The sealing on a vessel from Uruk (the first half of the 3rd millennium BC) represents a solemn procession (Boehmer, 1985: 104, fig. 6.7, No. 58). The leader carries a round object (a tambourine?), and an axe is depicted in the rider’s hand. A toothed framing, the same as that on the vessels from Khafaje and Susa, is shown along the periphery of the wheels (Fig. 1, 7).

One more group of images involves models of ED chariots. In a number of cases, these have wheels with profiled treads, which render in clay projecting nail heads. Thus, two models from Nippur have wheels with toothed edges (Legrain, 1930: Pl. 45, 46) (Fig. 1, 11, 12). Another clay model originating from urban layers of Kish has the same wheels. The composite model consists of a two-wheeled carriage, a figurine of a standing driver (Fig. 1, 10), and several equids (Langdon, Watelin, 1934: Pl. 14, 1). A well-preserved copper model of a quadriga was found in the Shar temple at Tell Agrab (Delougaz, Lloyd, 1942: 257, fig. 200). The wheels are solid, three-part, with toothed edges, which render the nails of bands (Fig. 1, 13). The vehicle is light, open, without a body. It could move quickly through the use of four animals. Possibly it is a war chariot, or a carriage for ritual competitive games.

Images of chariots are present in stone carvings. A fragment of a chlorite vase from the Sin temple in Khafaje contains representation of a two-wheeled light vehicle with its driver holding in his hand a long object (an axe handle? a club?) (Frankfort, 1935: 48, fig. 55) (Fig. 1, 9).

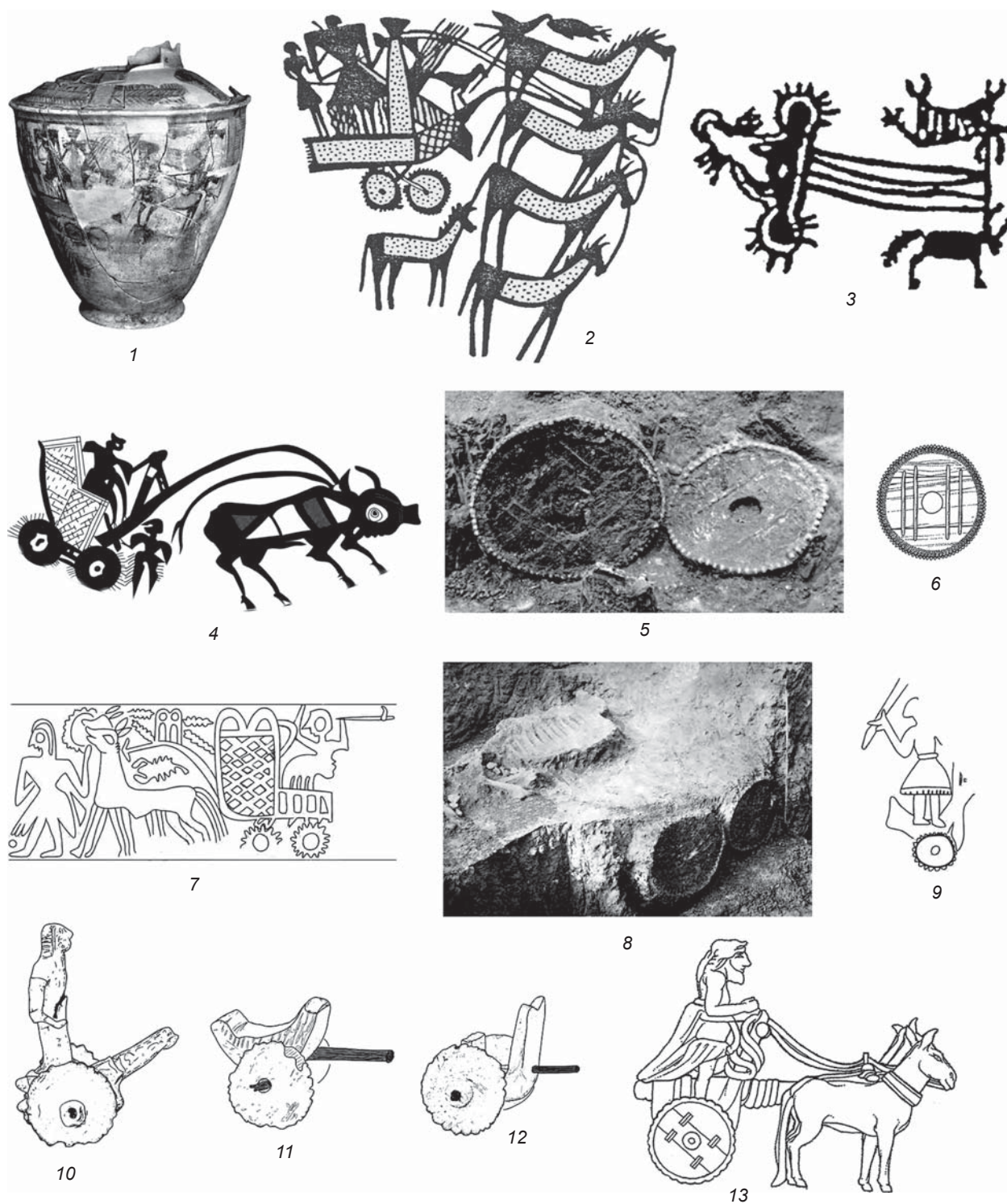


Fig. 1. Near-Eastern wheeled vehicles of the 3rd millennium BC with wheel fasteners in the form of a row of nails, found in the funerary complexes and pictorial sources.

1, 2 – image on a scarlet ware vessel from Khafaje, ED I–II; 3 – drawing on petroglyphs of the Chatur Bkhu Nash grotto in Northern India; 4 – image on a scarlet ware vessel from Susa, the cemetery on the Donjon hill, burial 322; 5, 6 – wheels from burial B 280 of the cemetery on the Donjon hill in Susa; 7 – sealing on a vessel from Uruk; 8 – vehicle from burial 354 of the cemetery Y in Kish; 9 – image on a carved chlorite vase from Khafaje; 10 – terracotta model from Kish; 11, 12 – terracotta models from Nippur; 13 – copper model from Tell Agrab.

A review of Near Eastern materials of the 3rd millennium BC suggests some technical characteristics of vehicles with metal fasteners on wheels in the form of rows of nails. These are heavy body frame and massive solid wheels, fitted onto an immovable axis. The resistance to rotation and friction factor of the wheels were great, requiring frequent lubrication. Vehicles skidded when moving through the mud, but during dry seasons, they could have moved rather quickly across the plains of Mesopotamia. Nails pinned along the treads often fastened leather straps that served for binding three massive planks of composite wheels and preventing wheel wear. Chariots were complex and expensive structures, which, together with the necessity of managing draught animals, meant that they could belong only to people of high social status.

Assemblages from the Ur, Kish, and Susa cemeteries show an important role for heavy wagons with solid-disk wheels in a funeral ritual. They could have been used to deliver loads to the place of burial (Anthony, 2010: 403). Vehicles are mentioned in Sumerian texts (gišGIGIR). In a number of cases, these are chariots intended for cult goals, which belonged to a deity or a king. For instance, a text dated to the end of the 3rd millennium BC “The Death of Ur-Nammu and His Descent to the Underworld” describes the arrival of the king in Kur (kingdom of the dead) in a chariot; draught animals (equids – ANŠE) are also placed in the grave. The king offers the chariot with an ox-team as a sacrifice to the deity (Littauer, Crouwel, 1979: 45).

There was much concern with reducing the mass and increasing the speed and maneuverability of the vehicles. A solution was found for changing the construction: carriages became two-wheeled and turned into war chariots. This class of vehicles is represented by models from Nippur, Kish, Tell Agrab, and by a carved image from Khafaje.

Now for some observations on the types of vehicles with metal details, known from archaeological materials. At the end of the 4th millennium BC, Susa was the center of the early state formation Susiana, located in the territory of modern Khuzestan. The region was included in “greater Sumer” and was under the control of Sumerian city-states (Potts, 2015: 81, 82). In the period of late Uruk, Susiana left the Sumerian civilization. The Susa III stage (the Proto-Elamite period) corresponds to the beginning of the ED in Southern Mesopotamia (3100–2700 BC). At this time, the cultural traditions of the Iranian Plateau prevailed in the region. The appearance of its own Proto-Elamite writing system is one of the identifying characteristics of the culture. The tablets have not been deciphered, but their language is different from the Sumerian (Potts, 2012: 601). The subsequent development of Susiana is related to Elam, and ca 2300 BC the region was integrated into the empire of

Sargon of Akkad. A lot of vehicles dating to the end of the 3rd to the 2nd millennia BC are known in the Near East, but these do not have wheel fasteners in the form of nails (Littauer, Crouwel, 1979: 48–98). During this time, a new type of wheel-reinforcing element was introduced, in the form of metal tread-bands with additional side plates overlapping the wheel surfaces (Ibid.: 39). These are represented in burials of the early 2nd millennium BC in Susa. The treads consist of several arched sections with three pairs of side plates each (Fig. 2, 1, 2). They were found in burial A 89 on the Donjon hill (stored in the Tehran museum) (Tallon, 1987: Vol. 1, p. 302, fig. 46) and in the burial within area 1 in the Ville Royale (stored in the Louvre) (Ibid.: 337, No. 1304).

Full analogs of the new-type tread-bands are the finds from the Gonur-Depe cemetery in Turkmenistan, dated to the late third or early second millennium BC. In burials 3900 and 3200, well-preserved vehicles were discovered, with the wheels reinforced by metal tread-bands with side plates (Sarianidi, Dubova, 2010) (Fig. 2, 3–5). This fact reflects close relations between the two regions at the turn of the 3rd and 2nd millennia BC, and points to similar processes in the formation of local elites.

There is a fairly large number of materials concerning wheeled vehicles from the Late Bronze Age (the 16th–12th centuries BC) in the Near East and Egypt. The domestication of horse, which quickly became the main draught animal, took place in the 2nd millennium BC; during the same period, light war chariots of a new construction, on spoked wheels, appeared, which was a revolution in warfare (Nefedkin, 2001: 58–60).

According to S. Piggott, this was not a result of internal evolution from an onager-drawn heavy vehicle with solid-disk wheels, but was borrowed *in toto* from groups of illiterate nomadic non-urban population that inhabited the distribution area of wild horses, to the north of highly developed civilizations of the Near East.

These societies, some of which pertained to the Indo-European language family, used light horse-drawn vehicles with spoked wheels (Piggott, 1978: 42). The quick mass spread of war chariots makes it possible to relate them to the appearance of newly-arrived ethnic groups (Hurrians, Kassites) and to the existence of the state of Mitanni, and to consider them in terms of the broad Indo-European issue (Moorey, 1986).

The construction of wheels fastened by straps and nails is not present in materials of the 2nd millennium BC. It may appear that it had outlived its usefulness because of its imperfection, and had disappeared in a new ethnic environment. However, this is not the case. In the Early Iron Age, such fasteners reappeared (Mühl, 2014) but on spoked wheels of new design. Finds of this type are known from the Balkans and the Aegean to Bactria. We shall mention a sealing from Anatolia (Gordion, ca 800 BC) showing a hunting scene (Fig. 2, 9). A golden

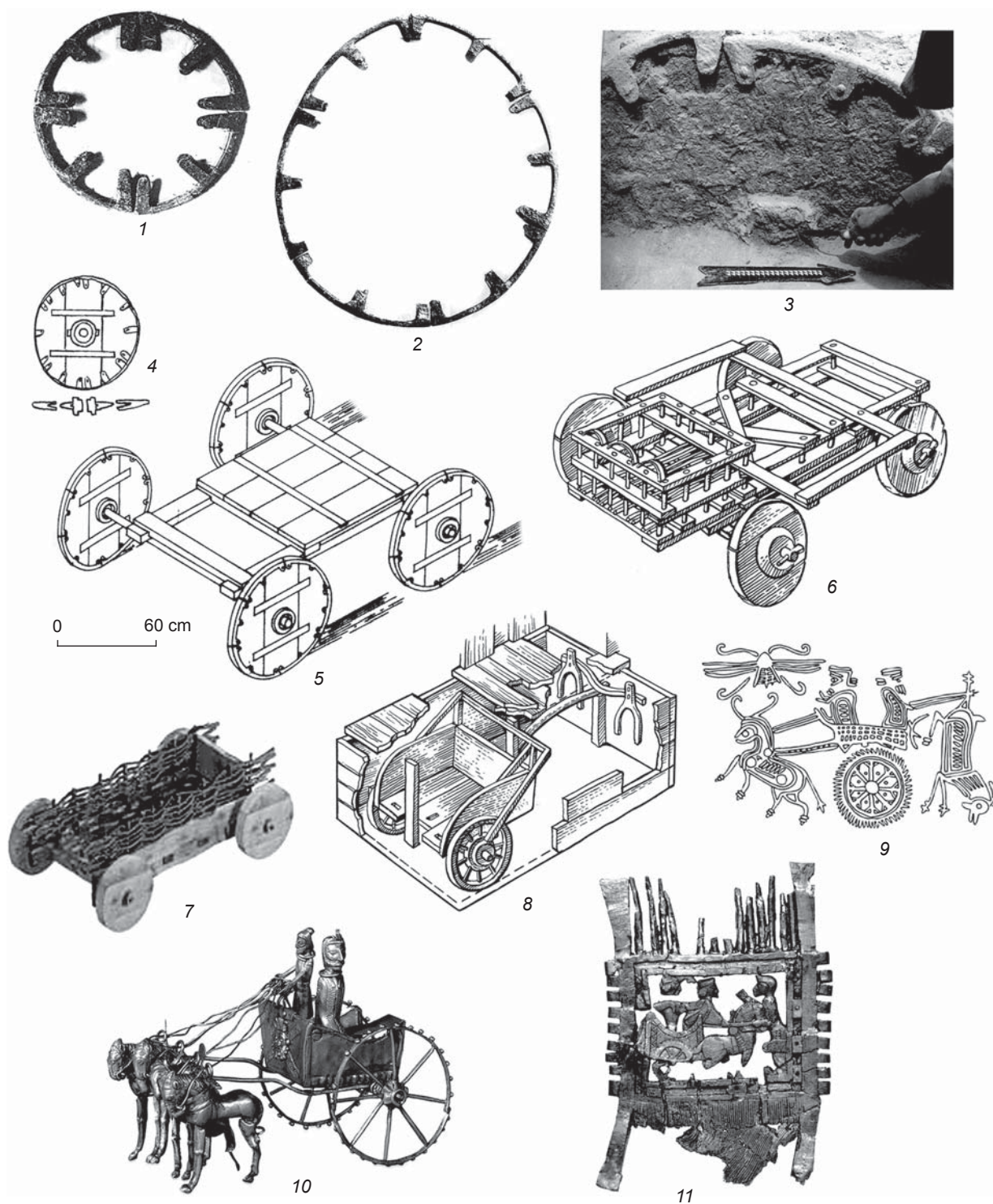


Fig. 2. Fasteners of wheels in the form of metal tread-bands from burials of the 2nd millennium BC in the Near East and Central Asia (1–5), vehicles without metal fasteners from the Bronze Age sites of Eastern Europe (6–8), and images of vehicles with wheel-fasteners in the form of a row of nails of the 1st millennium BC (9–11).

1 – Susa, the cemetery on the Donjon hill, burial A 89; 2 – Susa, Ville Royale, the burial in area 1; 3 – Gonur-Depe cemetery, burial 3900; 4, 5 – Gonur-Depe cemetery, burial 3200, reconstruction; 6 – Ostanniy kurgan cemetery in the Kuban region; 7 – Ulan IV kurgan cemetery in the lower Don region; 8 – Sintashta kurgan cemetery in the Southern Urals, burial chamber 30; 9 – sealing from Gordion; 10 – golden figurine from the Oxus treasure; 11 – wooden comb from Taksai-1 kurgan cemetery.

figurine from the Oxus treasure, an Achaemenian jewelry masterpiece, depicts in detail a four-horsed war chariot. Large wheels with eight spokes have metal tread-bands, big nail heads project on the treads (Littauer, Crouwel, 1979: Fig. 82) (Fig. 2, 10). S. Mühl provides data on war chariots from the first millennium BC with such fasteners; in particular, a catalog of images on the reliefs of the Nineveh palace-complexes (2014: 167, 168).

Of great interest are new finds from Western Kazakhstan. A charred wooden comb with an openwork carved image of a chariot was found in the burial mound Taksai-1, in a burial of a noble woman (6th to 5th centuries BC). Spoked wheels have cogs along the circumference—reinforcing details in the form of nails (Altynbekov, Novozhenov, 2014: Fig. 1) (Fig. 2, 11).

Discussion

Let us return to the Bronze Age. Was the use of metal reinforcing details in wheels a pervasive practice at that time? Let us consider materials from Eastern Europe. Around 3000 BC, wheeled vehicles gained widespread use in the South Russian steppes. Such finds are known from the Cis-Urals in the east to the lower reaches of the Danube in the west. Their greatest concentration is observed in the steppe Kuban region, and a somewhat lower one in the Lower Dnieper and Dniester regions. Modern methods of mound excavation have enabled recording of numerous cases of the placement of vehicles in the burial chambers (Rogudeev, 2008: 75–85).

Vehicles from approximately 220 burials belonging to various territorial versions of the Pit-Grave and Novotitorovka cultures, pertaining to the turn of the early and middle periods of the Bronze Age (the end of the 4th to the first quarter of the 3rd millennium BC), are carts with solid three-part wheels. For instance, burials from the Ostanniy kurgan cemetery in the Eastern Azov region had immovable axes and solid-disk wheels, each made of three thick planks with a massive hob, which resembles Near-Eastern finds. The construction of the body was much more complicated: it was based on a frame made of massive longitudinals and lighter cross-members. Using numerous vertical posts, flooring boards were secured onto it, sometimes in tiers, which ensured both the lightness and the strength of the structure (Fig. 2, 6). The dimensions of the body are 2.20×1.15 m, the diameter of wheels is about 70 cm (Gey, 2000: 180–184).

Vehicles of the Catacomb culture of the Middle Bronze Age (the second to third quarters of the 3rd millennium BC; currently, about 120 burials are known) have a similar construction. The basic innovation is the use of a large cross-piece of bars connecting the

body corners diagonally. The vehicles also have solid-disk wheels composed of three parts (Ulan IV kurgan cemetery in the lower Don region) (Shishlina, Kovalev, Ibragimova, 2013) (Fig. 2, 7).

Notably, with a considerable series of vehicles from the burials of steppe cultures, the use of metal reinforcing or connecting details was never observed, either for complete vehicles or for bodies or separate wheels, irrespective of the state of preservation or the type of construction. All connections were made using wooden nails, pins, and posts inserted in drilled- or hollowed-out holes or bores. While the assumption about using an incomplete construction or even its dummy with respect to certain simplified versions of the body is permissible, it is virtually impossible in case of wheels, since many of these show wear traces near the hub.

The issue about using special tread-bands for damping the motion or additional fastening of the wheel's disk parts still remains unclear. In well-preserved wheels, the thickness in the central portion reaches 6–7 cm, sometimes 10–12 cm, and decreases towards the edges to 2–4 cm, which seems to be illogical as regards ensuring the roadworthiness of the carriage. Only individual and, frankly speaking, ambiguous observations count in favor of the existence of laid-on tread-bands. Noteworthy are the cases of finding black or white borders along the edges of wheels lying flat in the Novotitorovka burials of the Kuban region (Ostanniy, 1/150; Plastunovskiy I, 2/13); distinct thickening, up to 12 cm, along the treads of wheels from the cenotaph excavated near the Plastunovskaya Cossack village in 1977 (Nekhaev, 1977); and a clay wheel model with a thickening along the edge from the catacomb burial of the Darya cemetery, in the lower Manych basin (Larenok, 1997: Pl. 97).

Discovery of the Sintashta kurgan cemetery of the 2nd millennium BC in the Southern Urals became a notable event in the history of the study of the Late Bronze Age (Gening, Zdanovich, Gening, 1992: 215, fig. 116). Technically sophisticated war chariots have been found in the burial chambers (Fig. 2, 8). They each have a plank body and two wheels with eight or nine spokes. A yoke designed for two horses (their skeletons have been found in the burials) was fastened to a curved draft tongue. Reconstruction of connection between the axis and the draft tongue using holding bars disposed outside along the body is questionable. Nothing similar has been found in any other burial grounds. Small size, lightness, and mobility made these chariots excellent transport vehicles for military or hunting purposes, which allowed the Aryan tribes rapidly to overcome the immense distances within Eurasian steppes and forest-steppes. As in the Near East, chariots marked the high social status of buried warriors. However, no evidence of studded treads has been found here either.

Conclusions

Two main types of wheeled-vehicle construction can be distinguished in the Eurasia of the Bronze Age in terms of the availability and special features of metal reinforcing details. The early type of fastening the solid-disk wheels using strap protectors and nails is recorded in Sumer and southwestern Iran at the beginning of the 3d millennium BC in the form of remains of chariots in burials, images on vessels and cylinder seals, and clay and metal models. The next stage of development of the Mesopotamian-South Iranian technical concepts is represented by the flat metal tread-bands known at the turn of the 2nd and 3rd millennia BC in Susiana and Central Asia. The chronology and geography of the finds suggest that the metal reinforcing details of vehicles were an achievement of the advanced agricultural civilizations of the Near East, and were widespread among the early state formations. The relative accessibility of copper/bronze raw materials played a large part in this.

In the Early Iron Age, after a 1000-year-long break, studded treads reappeared, but on a new-type of spoked wheel. Such finds are known in a huge territory from the Balkans and the Aegean to Bactria and the steppes of Kazakhstan, which is a rare example of revival of previously invented construction in another ethnic and cultural environment.

Both early heavy vehicles with solid-disk wheels and light chariots of the 1st millennium BC were owned by people of high social status, and were used for military, hunting, and ritual purposes.

The review of a considerable body of materials from the Bronze Age mound burials in the Eastern European steppes confirms that metal construction details were not used in the vehicles of nomadic stock-raising cultures such as Pit-Grave, Novotitorovka, Catacomb, and Sintashta. This is indirect evidence of the multiplicity of wheel-manufacturing traditions.

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Received April 23, 2018.