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Horse and Chariot. Critical Reflections on one Theory

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Abstract

The problem of horse domestication allows us to suppose different scenarios that could be realized in the 4th–3rd millennia BC in various regions where the wild horse lived (Europe, Eurasian steppes and the Near East). However, the main advantage of a horse is its ability to quickly pull a light cart. Therefore, reliable and abundant evidence on the domestic horse appears only with the development of wheeled transport and with the invention of chariots. This was a very complex process of gradual evolution of wheeled transport, the use of different types of equids and the evolution of corresponding types of harness. This process can be traced back to the Near East during the 3rd millennium BC, where domestication of the horse started from the use of wild horses for crossing with donkeys. We also see there the development of wheeled transport and harnesses. In the Eurasian steppes, we do not see the evolution of any component of this complex. The chariot complex appeared there together with the Sintashta Culture in a fully developed form. The widespread ideas about the earlier dates of the Eurasian chariots in relation to the Near Eastern ones are erroneous since they are based on the use of radiocarbon dates for the first and 'Middle' chronology for the second. In fact, the dates of the Near Eastern chariots are earlier.

Keywords

Domestication, horse, chariot, harness, chronology, Indo-Europeans

Zusammenfassung – *Pferd und Streitwagen. Kritische Überlegungen zu einer Theorie*

Die Frage der Domestikation des Pferdes lässt verschiedene Szenarien vermuten, die im 4.–3. Jahrtausend v. Chr. in verschiedenen Regionen, in denen das Wildpferd lebte (Europa, eurasische Steppe und Naher Osten), möglich waren. Der Hauptvorteil eines Pferdes ist seine Fähigkeit, einen leichten Wagen schnell zu ziehen. Eine größere Zahl an zuverlässigen Belegen für das Hauspferd gibt es daher erst mit der Entwicklung von Transportmitteln auf Rädern und der Erfindung des Streitwagens. Es handelte sich um einen sehr komplexen Prozess der allmählichen Entwicklung des Wagens, der Verwendung verschiedener Arten von Equiden und der Etablierung entsprechender Geschirrtypen. Dieser Prozess lässt sich im Nahen Osten im 3. Jahrtausend v. Chr. beobachten, wo die Domestikation des Pferdes mit der Verwendung von Wildpferden zur Kreuzung mit Eseln begann. In dieser Region ist auch die Entwicklung von Transportmitteln auf Rädern sowie von Geschirren zu beobachten. In der eurasischen Steppe ist hingegen keine Entwicklung einer dieser Komponenten zu erkennen. Der Streitwagenkomplex erschien dort zusammen mit der Sintašta-Kultur in voll entwickelter Form. Die weit verbreitete Annahme einer früheren Datierung der eurasischen Streitwägen im Verhältnis zu den nahöstlichen ist unzutreffend, da sie auf der Verwendung von Radiokarbondaten für erstere und der „mittleren Chronologie" für zweitere beruht. De facto sind die Daten der nahöstlichen Streitwägen früher anzusetzen.

Schlüsselbegriffe

Domestikation, Pferd, Streitwagen, Pferdegeschirr, Chronologie, Indoeuropäer

1. Introduction

In archaeology, the idea has become established that horse breeding and chariots originated in the Ponto-Caspian steppes. In general terms, this theory looks consistent. Steppe Eurasia was the area of the wild horse, and people domesticated it in the Eneolithic. With the beginning of the EBA,[1] wheeled transport was introduced, initially with bovine traction, then a gradual improvement of the wheel design took place, and two-wheeled carts appeared in the MBA (Catacomb Culture), the prototypes of chariots. On the basis of all these achievements, at the beginning of the LBA (Sintashta Culture), spoked wheels and a light chariot appeared (Fig. 1), and the Indo-Iranians rushed in all directions. This model is based on the understanding that such a complex technology (and social phenomenon) as the chariot could not have appeared without long evolutionary development.

This theory is closely related to the Indo-European problem, and is used to substantiate the localization of the Indo-European homeland in the Ponto-Caspian steppes.[2] However, it involves many problems, inaccuracies, and

1 Abbreviations used in the article: EBA – Early Bronze Age, MBA – Middle Bronze Age, LBA – Late Bronze Age, ED – Early Dynastic, BMAC – Bactria-Margiana Archaeological Complex.

2 Anthony 2007. – Kuz'mina 2007.

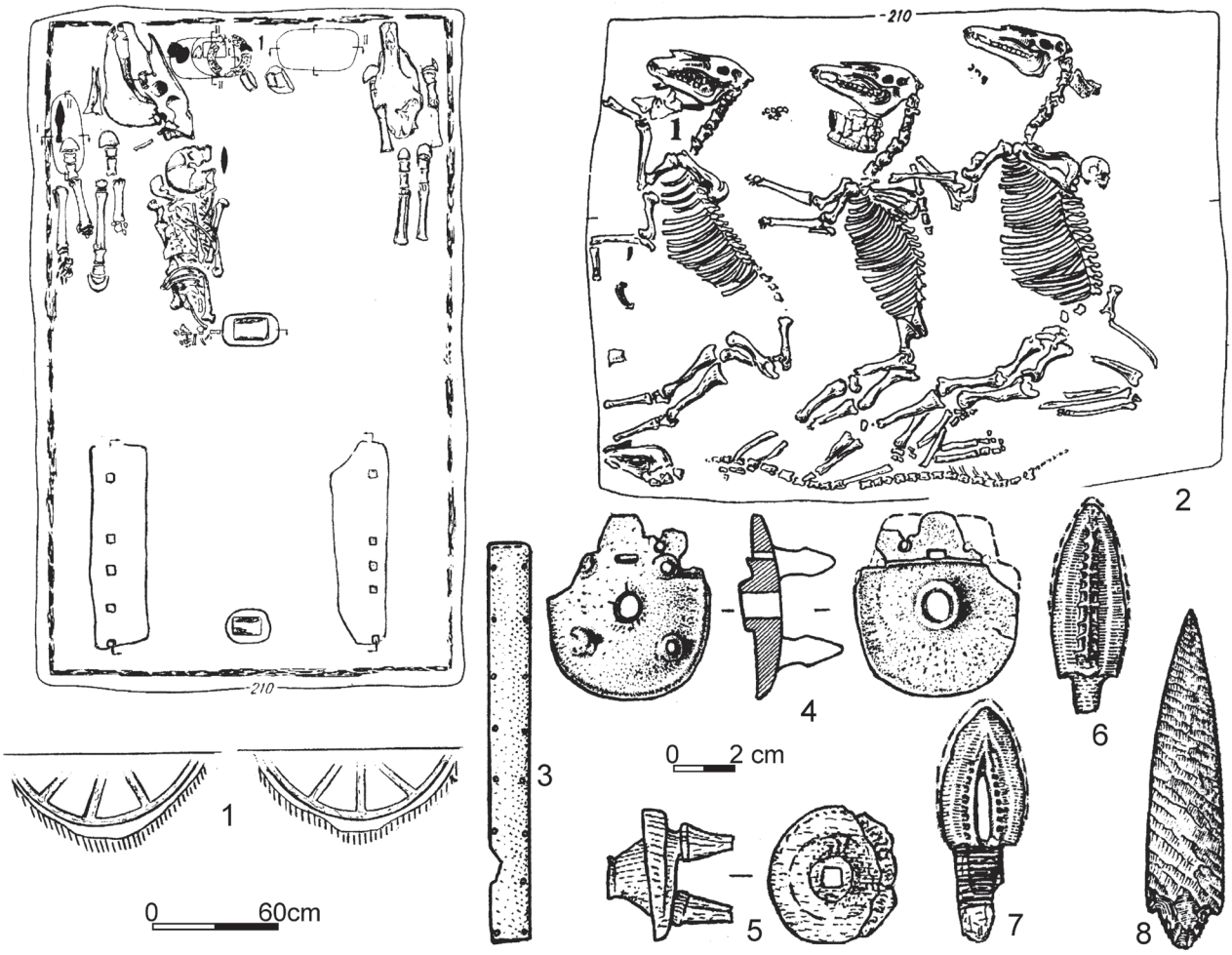

Fig. 1. Chariot complex of the Sintashta culture (1–2, 4, 6–8. Sintashta. – 3. Kamenniy Ambar. – 5. Bolshekaraganskiy). – 1. Grave 30 with remains of spoked wheels and horse bones. – 2. Grave 2 with horse skeletons. – 3. Bone protection plate. – 4–5. Cheekpieces. – 6–8. Metal and stone arrowheads (after Gening, Zdanovich, Gening 1992, Figs. 45, 75, 111, 185. – Epimakhov 2005, Fig. 13. – Botalov, Grigoriev, Zdanovich 1996, Fig. 17).

distortions of facts. In addition, there are many facts relating to the early presence of horses and chariots in the Near East. I have already discussed the problem of the chronological correlation of evidence on chariots in the steppe and in the Near East in a Russian-language article,[3] and the results of this discussion are also given below. But, as is very often the case with generally accepted theories, their shortcomings are rarely reflected, and the arguments in their favour require no proof. The aim of this article is to show that the chariot is a rather complex system, consisting of many technical and social components, that development of this system required a gradual evolution of all its interrelated elements, and that this evolution had to be necessary in order to meet social needs.

2. The Problem of Horse Domestication

For a long time, there were ideas that the horse was domesticated in the Eneolithic in the south of eastern Europe (Dereivka) and in Kazakhstan (Botai). The morphology of the horse does not allow us to reliably judge its domestication; indirect data (bit wear on teeth, figurines, bones in burials) allow different interpretations to be proposed. However, studies of osteological collections from these settlements have shown that the population structure corresponds to the hunted wild herds.[4] Genetic studies have

3 Grigoriev 2020a.

4 Levine 2005, 11, 14. – Kosintsev 2008, 116–119.

shown that modern horses are not related to the Przewalski's horse,[5] and the latter is an offspring of the Botai horse.[6] Accordingly, the Botai horse did not participate in the domestication process. In addition, the Przewalski's horse is almost impossible to tame. Therefore, although we may admit the domestication of some individuals, this species would not have yielded a stable result. Besides, hunters do not usually tame animals, although they may keep some wild animals that will be eaten during a bad hunting season.

Strictly speaking, there are also no reliable data on the domestic horse in the EBA and MBA of eastern Europe. Recent genetic studies have shown that in the Eurasian steppes colour variation of horses occurred only after 3000 calBC, which is a sign of domestication. And in central Europe, this process started in the period between 3370 and 3100 calBC.[7] Therefore, we may admit the appearance of domestic horses in the EBA, but the purpose of this domestication remains unclear. Horse behaviour, even its gait, is DNA-dependent. Therefore, formation of the necessary psychological, behavioural and physiological types requires a long breeding process.[8] Moreover, the people who are engaged in this must have a specific goal that they aim to achieve over several generations of horses. That is, the hunters of Botai should have had the idea of domestication, for example for riding, and saving the herd even in case of hunting failure. This is also true for cattle-breeding collectives with sheep and cows in the herd, solving all problems with wool, meat and milk. Therefore, the idea that the horse was domesticated, but until the end of the 3rd millennium BC was kept only for meat,[9] is questionable. The horse is a very difficult animal to domesticate, breed and maintain. An example is unsuccessful attempts to tame the Przewalski's horse. This could have happened either in the case of accidental genetic changes or targeted selection, but in any case, to obtain a domestic horse, it is necessary to breed some horses in captivity for a long time.[10] Nobody would have done it over a long period without a clearly defined purpose. Horse breeding could turn into an activity of socio-economic importance only if it had a reason. The horse's only advantage over the bull was its ability to quickly move a person on horseback or in a cart. However, it is impossible to harness a horse into carts otherwise pulled by bulls. Therefore, we have unconditional evidence of a domestic horse only when light carriages and the corresponding harness appeared.

Thus, in the Eurasian steppes, neither unequivocal evidence of horse domestication nor the necessary conditions and reasons for this exist. Marsha Levine believes that, judging from the palaeogenetic data and taking into account the complexity of this process, the horse could have been domesticated in a single area, but then, with the spread of horse breeding to other areas, local wild horses were included in the population of domestic horses.[11] Genetic studies of horse bones do not allow conclusions about the place of its domestication to be drawn. They identified extensive matrilineal and lower patrilineal diversity, which is explained by the ways of breeding these animals.[12] Moreover, the most significant changes in the genetic pools that led to the current state began in c. 900 calBC.[13] The horses of eastern Europe and western Siberia have made the largest contribution to the modern horse population, but this is the result of later changes. Previously, it was supposed that ancestors of the first domestic horses of Eurasia were probably the horses of the Bronze Age of southeastern and eastern Europe and the Caucasus,[14] which allows this version of Levine to be regarded as quite possible. But in the latest work on this topic, it is shown that the modern population of domestic horses is based on horses of the 4th–3rd millennia calBC from the Volga-Don steppes, but the active spread of this genetic profile outside this area occurred after 2000 calBC. It is assumed that the Eneolithic horse of Botai and horses of the Yamnaya Culture were domestic, but the former were genetically different from domestic horses, and the latter had no genetic similarity to horses in the Corded Ware Culture sites. Therefore, the Yamnaya people migrated to Europe without horses.[15] This probably indicates the absence of domestic horses in the Early Bronze Age of eastern Europe. Therefore, the first reliable domestic horses appeared simultaneously with the chariots of the Sintashta Culture. During the migration of the Sintashta people and the spread of horse-breeding traditions among the people of steppe Eurasia, they could include local wild horses in their herds, regardless of the area of primary domestication.

Paradoxically, the only region where there is evidence of domestication and its need is the Near East, with its complex economy, highly developed society, wide communications

5 Jansen et al. 2002. – Lindgren et al. 2004, 336.
6 Gaunitz et al. 2018.
7 Benecke 2018, 6.
8 Levine 2005, 11. – Benecke 2018, 67, 68.
9 Drews 2017, 33, 36, 37, 39.
10 Levine 2005, 16, 17, 19.
11 Levine 2005, 19.
12 Lindgren et al. 2004.
13 Fages et al. 2019.
14 Benecke 2018, 69.
15 Librado et al. 2021.

network and the use of equids to pull relatively light carriages.

In Transcaucasia, horse bones were found at the settlements of Arukhlo I and Zopi of the Shulaveri-Shomutepe Culture (6th–5th millennia calBC), and at the later settlements of Alikemektepesi (4th millennium calBC) and Horom (3371–3136 calBC), horse bones accounted for 6.5–7.5 % of the osteological material.[16] Possible evidence of partial domestication is bit wear on a horse's tooth from the Late Neolithic layer in Mokhrablur in Armenia.[17] There are ideas that horses in Transcaucasia were imported from the Ponto-Caspian steppe and soon penetrated further south,[18] but the Shulaveri-Shomtepe Culture preceded the hypothetical horse breeding in the steppe.

In central and eastern Anatolia, the wild horse persevered after the Pleistocene, and its remains have been found at many settlements of the 7th–4th millennia calBC. But in the Late Chalcolithic layer of the Çadır Höyük settlement (second half of the 4th millennium calBC), 20 % of the animals have foot bone pathologies which may indicate their use as pack animals.[19] However, most archaeozoologists consider horses of the late 4th – early 3rd millennia calBC (Tepeçik, Tülintepe, Norşun Tepe) as wild, and horses of the 3rd millennium calBC (Demircihüyük, Yarikkaya, Hayaz Höyük) as domestic.[20] Recent genetic studies have shown that the population of domestic horses in Anatolia was not based on local individuals. The main haplotype becomes Q, which was previously present in the south Caucasus. However, after 2200 calBC (i.e. earlier than Sintashta horses on the steppe) in both of these regions, a series of other haplotypes appeared, from which it is concluded that only from this time is it possible to speak about domestication, and these new horse species came from steppe Eurasia, where this process took place.[21] Strictly speaking, this only shows that domestication did not take place in Asia Minor, but the south Caucasus remains a perfectly acceptable candidate. And we can assume the presence of an influx of horses from some other region, since the steppe origin of these horses has not been reliably shown.

Unfortunately, in the latest work on horse palaeogenetics, materials from eastern Anatolia and the south Caucasus have not been included, and it has been shown that the Anatolian Neolithic horse was not the ancestor of the modern domestic horse, but horses from Acemhöyük dated to 2200–2040 and 1970–1870 calBC had the same genetic profile and are comparable to Don-Volga horses. It is assumed that at this time these horses appeared there, as well as in the Carpathian Basin (Holubice and Gordinesti II), from steppe Eurasia even before the invention of chariots.[22] Thus, this happened 200 years before the reliably fixed domestic horses of the Sintashta Culture. In fact, chariots in the Near East and in the Carpathians predate the Sintashta Culture and fall into this chronological horizon; besides, in the Carpathians, the Near Eastern type of chariots appeared.[23] Therefore, we can state that the evidence on the domestic horse everywhere chronologically coincides with the evidence on the use of chariots. The genetic similarity of these horses may be explained by the earlier genetic similarity between horses in Transcaucasia and eastern Europe.

In northwestern Iran, the horse disappeared during the transition to the Holocene. Its remains are present at Neolithic, Chalcolithic, and EBA sites, but there are no data on its domestication.[24] In eastern Iran and central Asia, horse remains are present only in the layers of Namazga VI and BMAC, from the late 3rd – early 2nd millennium calBC.[25]

Unlike Anatolia, in Syria and the Levant, the Pleistocene horse disappeared, and horse remains reappeared in the settlements of the 4th millennium calBC. The area of these finds extends in the south to the Negev Desert. One tooth from the Gilat settlement has bit wear. Other types of equids at this time were the donkey domesticated in Egypt[26] and the wild onager. Since the EBA (after 3800 calBC) there are remains of mule bones, which suggests that donkeys were crossed with horses, but this does not indicate that the horses were domestic.[27] Horse remains in Syria have been found more stably since the mid-3rd millennium BC, and this is accompanied by the appearance of corresponding figurines.[28]

It is rather difficult to distinguish different types of equids in terracotta figurines, but by the shape of their tails, mane, neck, forehead and ears, some figurines were identified as horses.[29] The study of a huge number of figurines from the EB III and Akkadian periods of the Tell Arbid settlement in the Khabur Basin made it possible to reveal the features that distinguish a horse from a donkey and onager,

16 Rybakov et al. 1982, 134, 135. – Shev 2016, 128.
17 Anthony, Brown, George 2006, 148.
18 Shev 2016, 127, 128.
19 Shev 2016, 129.
20 Grigson 2012, 186.
21 Guimaraes et al. 2020.
22 Librado et al. 2021, 3, 5, Suppl. Materials.
23 See below and Grigoriev 2021a.
24 Mashkour 2004, 133–136.
25 Shchetenko 2008, 220, 221, 225. – Shev 2016, 127.
26 Beja-Pereira et al. 2004. – Grigson 2012, 188.
27 Grigson 2012, 186, 191–195.
28 Vila 2006, 101, 102, 115–118.
29 Littauer, Crouwel 1979, 26, 57.

and some of these figurines have depicted bridles, headstalls (with cheekstraps and a noseband) and trappers. It is significant that since this time (mid-3rd millennium BC) in the Near East, the horse appeared in the texts, and the significance of the onager decreased.[30] The first information about the use of horses for riding is dated to the same time. This is a series of images of horsemen on baked clay tablets from the ED III, Isin-Larsa, and Old Babylonian periods. The animals on these images are usually identified as onagers, but horses are present too. Moreover, one of the horse images probably belongs to the ED III period. In any case, this suggests that horses were included in human life. In all images where this can be discerned, control was achieved using a rein attached to the nose ring.[31]

In the Mesopotamian written sources, terms for the horse appeared in the 3rd millennium BC. The original logogram ANŠE was used for equids in general, but specifically for donkeys, and from the late 3rd millennium BC exclusively for donkeys, which appeared in Mesopotamia at the beginning of the ED period. The term for horse changed during Mesopotamian history: in Sumerian and Old Akkadian, it is present in the form of the logograms ANŠE.ŠUL.GI and ANŠE.ZI.ZI. The first variant appeared in ED I/II and disappeared at the end of ED IIIb, being replaced by the logogram ANŠE.LIBIR in Old Akkadian and Old Babylonian, and from the Isin-Larsa period by ANŠE.KUR.RA. The logogram ANŠE.ZI.ZI belongs to the period of the Third Dynasty of Ur.[32] This indicates the familiarity of the Mesopotamian population with the horse in the 3rd millennium BC, although Mesopotamia was not the area of wild horses.

These facts suggest that the populations of the Pleistocene horse, preserved in Anatolia and the Transcaucasia, spread to northwestern Iran, and somewhat later, after 4000 calBC, to Syria and the Levant. After that time, episodic evidence appeared in all these regions indicating possible domestication, but the quality of this evidence is not much more reliable than the facts of Botai's horse domestication. It is important for us in this context to understand how the horse was domesticated in the Near East. Since the first term, ANŠE.ZI.ZI, means 'quick donkey' and the second, ANŠE.KUR.RA, 'donkey from the mountains', Robert Drews believes that horses in Mesopotamia were imported from areas south of the Caucasus. At this time images of horsemen are known in Mesopotamia, but they sit in the same way as on donkeys: they are shifted back. This is because prior to the development around 1000 BC of appropriate harnesses, using horses for riding was inconvenient and dangerous. Horses began to be used only in chariots. And nowhere, until the end of the 3rd millennium BC, is there information about any other use, except for meat.[33] And if above I expressed doubt that the steppe pastoral societies could breed horses for this purpose, then the import of horses into Mesopotamia from the Caucasus in order to eat them made no economic sense, and above we discussed the difficulties of horse domestication. There would need to be serious economic reasons to overcome them. The trigger for this was related to three factors: the rapid development of Mesopotamia, the development of metallurgy, and the domestication of the donkey in Egypt. The successes of the agricultural economy of Mesopotamia as early as the 4th millennium calBC led to a growing demand for resources which were missing there, primarily metals,[34] which could be exchanged for the two main Mesopotamian products: grain and textiles. This stimulated the Uruk expansion to the north. The volume of metal consumption increased fivefold in the ED period.[35] Partly, this trade was realized by waterways, but the main routes were overland, moreover, through the Taurus and Zagros mountain systems. Caravans of hundreds of animals crossed vast areas, paying tolls everywhere. In addition, there were costs involved in ensuring the security of the caravan. As a result, the price of grain in Iran doubled compared to the price of production. This trade was the most important factor in Near East politics, but despite state control, it was based on private initiative and competition, and traders constantly had to strive to reduce transportation costs.[36]

An important factor in the problem of horse domestication in the Near East is the presence of other equids: the wild onager and the domestic donkey, which was widely used as a pack animal. At the same time, the onager was never domesticated,[37] but from the mid-3rd millennium BC the practice of its crossing with the donkey took place, as a result of which more efficient but sterile hybrids appeared. From the mid-3rd millennium BC there is epigraphic evidence from Ebla and Tell Beydar about the crossing of donkeys with onagers, and from Tell Brak there are remains of this hybrid (c. 2200 BC). The presence of mules can also be

30 Makowski 2014.

31 Moorey 1970, 36–49.

32 Zarins 1978, 4, 5, 7–10. – Littauer, Crouwel 1979, 26, 27, 42, 43, 58.

33 Drews 2017, 33, 37, 40–42, 49.

34 The complex structure of this trade, which was based on the supply of copper and tin, is well described, see Muhly 1973.

35 Avilova 2008.

36 Edens, Kohl 1993, 26, 27, 30. – Dercksen 2005, 17, 19, 20.

37 Zarins 1978, 17.

explained by crossing with a wild horse,[38] but this practice implies keeping wild onagers and wild or domestic horses in captivity, which opened up wide opportunities for breeding work. We can get more detailed information about this process from written sources, and this problem is studied in detail by Juris Zarins.[39] In the documents of the ED and Old Akkadian periods, mules (ANŠE.BAR.AN) are mentioned, which means the crossing of donkeys with horses. There are two possible species, depending on the type of crossing: the hinny (offspring of a donkey and a stallion) and the mule (offspring of a donkey and a mare). Mostly mules appear in the documents, and hinnies (KŪDANU, GIR.NUN) are rare, since it is more difficult to produce and maintain them.[40] Both species are sterile, so horses must be kept in order to reproduce them. There is a document from the Old Akkadian period describing six persons associated with 200 equids (i.e., a relatively large production aimed at provision of the transport needs of the colossal Mesopotamian trade), and among these equids, adult mares (ANŠE.LIBIR.SAL.GAL) are described, giving offspring in the form of mules (ANŠE.BAR.AN) and foals (ANŠE.LIBIR). In texts of the ED period, the mares ANŠE.ŠUL.GI produced foals ŠUL.GI and BAR.AN, i.e., horses and mules. The economic motives for this crossing are also obvious: the mule is incomparably more powerful and hardy than the donkey, it is more convenient to keep, it has better health and lives longer. Therefore, in the 3rd millennium BC, a donkey cost 4–5 shekels of silver, and a mule (BAR.AN) cost half a mina, which is six times more expensive. There is another rare type of hybrid, NISKUM, which could mean onager or a hybrid of donkey and onager, but its meaning is not clear. Onagers were sometimes included in the herd, but they were never domesticated.[41] These documents give us clear information about the horse-domestication process. To obtain a mule, a working equid optimal both as a pack animal and for pulling carts, it was necessary to keep mares, which were originally taken from herds of wild horses. However, the life of horses is not very long, 25–30 years, and the reproductive period is even shorter. Therefore, this herd had to be renewed. But catching wild mares and transporting them for many hundreds of kilometres was rather complicated and expensive. It was easier to keep one or two stallions in the herd, which explains these two types of mare offspring, which are mentioned in the documents. Thus, the situation of the extensive matrilineal and limited patrilineal diversity established by geneticists arose. Keeping a large number of stallions was not economically viable. At the same time, selection of horses was carried out, since selection of mules was impossible. Therefore, in this region there were two necessary conditions for the domestication of the horse: 1) the horse was kept in captivity for a long time for crossing; 2) there was a clear understanding of for what purpose and in what direction it was necessary to carry out the controlled breeding. In the specific conditions of the Near East, this was not only economically justified, but extremely profitable from the first year, since the target products were mules.

In these conditions, it was possible to tame horses, so we see not only mentions of them, but also images with a rider. But in all these images, the rider's position is rather uncertain. There is a famous letter from Bahdi-Lim to his master, the king of Mari, advising him to ride on a mule or in a chariot, as befits a king, but not on a horse.[42] It is possible that this royal protocol was initially determined by security considerations, since before the appearance of the appropriate harness and cavalry, it was difficult to control the horse. As a result, the horse appears sporadically in various Near Eastern sources, but its role was auxiliary in the production of mules. It was economically impractical to use a horse as a pack animal: a mule is more powerful than a horse when comparing their weight, its life span is much longer, susceptibility to diseases is less, care is easier and cheaper, its working age starts earlier (at 4 years compared to 5–7 years for a horse), and finally, the mule is much more hardy. All these advantages increase sharply in mountainous terrain, and the trade routes through the Zagros and Taurus were the main ones in this trade. The logogram ANŠE.ŠUL.GI, which was used in the ED period and in the Third Dynasty of Ur to designate horses, is found in association with a yoke,[43] which demonstrates the occasional use of horses in harness. But before the appearance of light vehicles, this practice could not be widespread. This explains the modest presence of horses in written and other sources, most of which are represented by the documents of traders who did not use them.[44]

Therefore, it is possible that episodic attempts at domestication took place in different areas of the wild horse's habitat; they had different goals and different consequences.

38 Vila 2006, 116. – Grigson 2012, 188, 189, 196.

39 Zarins 1978, 9, 11, 13–15, 17. – Zarins, Hauser 2014, 171–174.

40 This is caused by genetic reasons. A donkey has 62 chromosomes, and a horse has 64. The crossing is more successful if the male has fewer chromosomes than the female.

41 Perhaps the crossing of donkeys and wild onagers continued in some places, but by the end of the 3rd millennium BC this practice disappeared completely, see Lafont 2000, 211.

42 Moorey 1970, 48.

43 Zarins 1978, 6.

44 Michel 2004, 195.

But the most likely area for horse breeding for their use in vehicles (or in the terminology of Pavel Kosintsev, 'chariot' horses)[45] is the Near East. This coincides and was connected with another technological innovation: with the development of vehicles.

2.1. Wheeled Transport

The early data on wheeled transport vary in different cultural contexts: models of wagons, images, remains of wheels and carts in burials. We may assume that in some areas there was no tradition of placing wagons in burials or making models of them. The dates of these complexes are difficult to compare, since the dates obtained many years ago by the old radiocarbon method and modern AMS dates are often discussed together. Finally, in the case of very rare early finds, we may assume the discovery of new evidence in the future, which in some regions will change the situation. Therefore, we are still very far from certainty on this issue. Previously, it was believed that the earliest evidence of wheeled transport was five clay tablets from Uruk and one from Tell Uqair in Lower Mesopotamia, which have pictograms of a sledge and a sledge with four wheels. Their interpretation, chronology, reading and language are the subject of long debate. In particular, for the pictogram without wheels, the interpretation GURUŠ (sledge) is proposed, and the pictogram with two round impressions under the runners was transliterated as GURUŠa+2N14. And, although other scholars interpret the last sign as numerical, it differs from other numerical signs in terms of the depth of the impressions. Therefore, it is assumed that we are dealing with wheeled carts, the language was Sumerian, and they belong to the Uruk IVa phase, but could be dated to the Uruk IVb or even Uruk IVc phase. Their date may be earlier than the interval 3517–3358 calBC, but due to the small number of dates for this period, they may be reliably dated within the 4th millennium calBC.[46] However, these difficulties in interpretation and chronology force us to treat this evidence with caution.

The chronology of the oldest wheeled transport in central Europe and the south of eastern Europe is similar. The ideas about the invention of wheeled carts in central Europe are based on the discovery of clay models thereof in the Baden Culture (3500–3000 calBC)[47] and a drawing on the vessel from Bronocice. This vessel belongs to phase III of the settlement with the date of 3637–3373 calBC.[48] There are also wheel tracks in the Flintbek megalithic burial (3600–3400 calBC), and for the period 3200–3200 calBC in the Horgen, Goldberg III, Boleráz, and Corded Ware Cultures, there are twelve monolithic or two- and three-partite wooden wheels fixed to an axle.[49] The first vehicles in the steppe appeared in the Maikop Culture, formed as a result of migration from the south in the 4th millennium calBC.[50] In eastern Europe, about 220 burials with vehicles of the Yamnaya and Novotitarovo Cultures of the late 4th – first quarter of the 3rd millennium calBC were found, as well as 120 vehicles of the Catacomb period. These are vehicles with three-partite disc wheels and a box in the form of a frame made of massive longitudinal bars and light crossbars. In the Catacomb period, crosspieces of beams appear, connecting the corners of the box diagonally. These vehicles are comparable to those in Mesopotamia,[51] which made it possible to assume the spread of these innovations to the north from the Near East.[52]

Mary A. Littauer and Joost H. Crouwel demonstrated a long history of wheeled transport in the Near East. The earliest transport depicted on the clay tablets from Uruk was a sledge drawn by bulls. The straight pole was attached to the yoke, and this system grew out of the plough harness. The first vehicles were developed from this construction and had four massive wheels. Later wheels are made of three planks, and then, to make them lighter, the wheels appear with a felloe with four intersecting bars (the so-called cross-bar wheels appeared after 2000 BC, but one image is known in the previous period). The appearance of this type of wheel is preceded by the use of wooden tyres for disc wheels, which began in the third quarter of the 3rd millennium BC. This evolution culminates in the creation of four-spoked wheels, and then only the number of spokes grows. In parallel, a bent pole appeared, which is technologically closely related to the appearance of wheels with a felloe.[53] An important innovation was the change in the wheel fixation system. On the 'Standard' of Ur, the wheel is fixed firmly on the axle, and the axle rotates. With this method of fastening, the wheels rotate more slowly, and one wheel slips when turning. Therefore, subsequently, the axle began to be fixed firmly to the cart, and the wheels rotate on it.[54] In addition to the chronology and logic of technological evolution, the motives for the development and implementation of wheeled

45 Kosintsev 2008.

46 Burmeister, Krispijn, Raulwing 2019, 49, 53, 54, 61, 62, 67.

47 Boroffka 2004, 348. – Boroffka 2008. – Bondár 2012, 29, 43, 49, 50. – Horváth 2015, 4.

48 Czebreszuk, Kośko, Szmyt 2008, 50.

49 Bondár 2012, 23, 26. – Horváth 2015, 5.

50 Izbitser 2013, 12–14.

51 Avilova, Gey 2018, 46.

52 Novozhenov 2012, 148, 149, 153, 154, 156.

53 Littauer, Crouwel 1979, 14–22, 28, 37–40, 48, 68–71.

54 Brownrigg, Dietz 2004, 483.

vehicles are an important issue. In the Near East, with its agricultural economy, complex and diverse socio-economic zoning and developed trade networks, this was a vital need, since not all goods could be transported using donkeys. Agricultural products required large volumes to be transported. Therefore, bull-drawn wagons were essential for the functioning of this system.

Because of the rarity of early finds and the proximity of their dates, it is difficult to determine the centre of invention of wheeled transport. In the steppe, it appeared from the Near East together with the Maikop Culture. But in Europe, with its early agricultural tradition, independent development could have taken place. Remains of a wooden sledge in Hornstaad-Hörnle (c. 3900 calBC) or an A-shaped travois (Rúdcsúszka), as well as vessels in the form of an ox-drawn sledge at sites of Cucuteni A–B / Tripolye BI–CI (in my opinion, the earlier dish from Târgu Frumos is not so convincing) may be regarded as an intermediate stage. In terms of time, this is close to the appearance of evidence on arable farming and the beginning of the castration of bulls to obtain a more powerful working animal. The need was the same as in the Near East: the transportation of grain.[55] There is also evidence of an earlier appearance of arable farming in Europe, from the mid-5th millennium calBC,[56] which brings us back to the possibility of the independent appearance of wheeled transport. At the same time, all researchers consider this process within the framework of the concept of the 'secondary products revolution' proposed by Andrew Sherratt,[57] which means the relatively simultaneous spread of some innovations, among which the most important for our topic are arable farming, wheeled transport and the breeding of woolly sheep, which led to the spread of weaving. It is no coincidence that spindle-whorls are strongly associated with the appearance of the wheel, and they are often regarded as wheel models. In Europe, these innovations are dated to c. mid-4th millennium calBC.[58] This is understandable: the idea of using the spinning effect in a wheel could had been taken from weaving. In this case, the Near East may have a certain priority,[59] but the question of one or two centres of origin for wheeled transport has not been finally resolved.[60] It is only obvious that this could have happened in an agricultural region.

There was no such need in steppe Eurasia. Products of the main economic sector, animal husbandry, moved from the place of production to the place of consumption on their own. If we admit the existence of sustainable distant pasture, the problem of transporting small belongings would be solved with packs loaded on bulls. Therefore, there was no economic need for such a development. However, when an innovation is introduced and spread by borrowing or with migratory collectives, it becomes a cultural norm.

2.2. Development of Two-wheeled Carts and Chariots

There is a strong belief that chariots were invented in the Urals in the Sintashta Culture. This is reinforced by the general belief that chariots appeared later in the Near East. At the same time, Littauer and Crouwel demonstrated the origins of chariots in the Near East as a result of local development,[61] but under the influence of the general conviction to the contrary, even they agreed with their earlier independent origins in steppe Eurasia.[62] The presence of cheekpieces in the Carpathian Basin, synchronous with the Sintashta ones, made it possible to assume three centres of origin for the chariot.[63]

Therefore, our task is to consider the facts about the early chariots in both regions. It is quite obvious that stages of development and specific socio-economic conditions were necessary for the emergence of this complex phenomenon. Therefore, in the eastern European steppes, the prototypes of chariots should have appeared in the Catacomb period preceding the Sintashta Culture. The presence of battle chariots in the Catacomb Culture was suggested by Serhii Pustovalov.[64] However, analysis of these materials showed that their reconstructions do not correspond to them; these were two-wheeled carts, whose use for combat was impossible, even the best-preserved cart from Grave 32 of the Bolshoi Ipatovskiy kurgan near Stavropol (Fig. 2/1), which is dated to the beginning of the Sintashta era.[65] Moreover, these carts were pulled by bulls. Bulls harnessed to the cart by means of a yoke are clearly depicted on one of the petroglyphs of Kamennaya Mogila, Zaporozhye (Fig. 2/2). Together with a cart in the Kryvyi Rih burial, the remains of a yoke were

55 Horváth 2015, 3, 4, 7, 8. – Ţurcanu, Bejenaru 2015, 200–202, 205, 206–210. – Bondár 2018, 283.
56 Comşa 1991, 85. – Sherratt 1997, 230.
57 Sherratt 1981.
58 Bondár 2012, 16. – Horváth 2015, 9. – Ţurcanu, Bejenaru 2015, 211. – Boroffka 2018, 10.
59 Horváth 2015, 17, 18.
60 Bondár 2018, 281.
61 Littauer, Crouwel 1979, 68–71.
62 Littauer, Crouwel 2001, 334.
63 Burmeister, Raulwing 2012, 100–102, 104.
64 Pustovalov 2000.
65 Izbitser 2009, 125–129. – Izbitser 2010, 187–193. – Kaiser 2011, 137, 143–151.

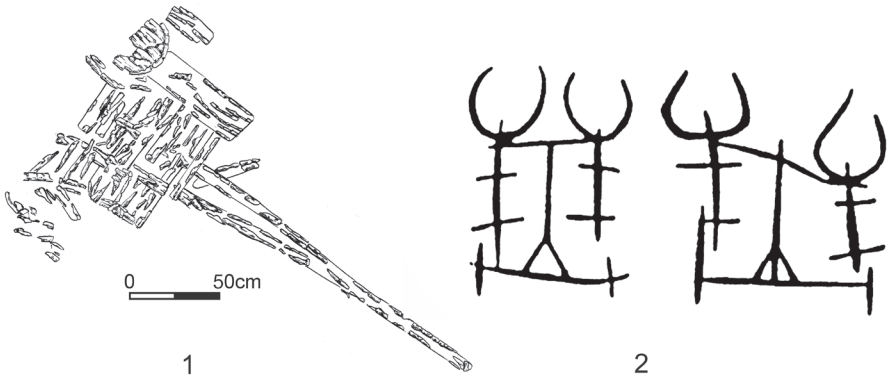

Fig. 2. Two-wheeled carts of the MBA in eastern Europe. – 1. Remains of a two-wheeled cart from the catacomb (burial 32) of the Bolshoi Ipatovskiy kurgan, Stavropol region (after Korenevskij, Belinskij, Kalmykov 2007, Fig. 10). – 2. Two-wheeled carts with a bovine team on a slab from Kamennaya Mogila, Zaporozhye (after Pustovalov 2008, Fig. 3/1).

found, and in the burial near Izhevka, bovine bones. In the Catacomb period, we have no evidence of the use of horses in harness in any other area of the world either.[66] Horse bones are sometimes found in burials with vehicles of the EBA and MBA, but more likely these are food remains.[67] For the first time, a harnessed horse team appeared in steppe Eurasia in the Sintashta period together with chariots, but the previous evolution was absent.[68] There is also no evidence of the use of wheeled vehicles for military purposes.[69]

In the Near East, the situation is different. There, by the end of the 3rd millennium BC, carts with two massive wheels drawn by equids had been in use for several centuries. At this time and at the beginning of the 2nd millennium BC, a series of wheel modifications and control methods were developed, leading to the appearance of chariots at least in the 18th and 17th centuries BC,[70] although earlier evidence exists. This is not exclusively related to two-wheeled carts. The cylinder seals from Karum Kanesh II depicted two- and four-wheeled carts with spokes (Fig. 3/2).[71] But most importantly, here we are able to trace a logical evolution driven by social needs. In addition to the images on cylinder seals, this evolution is supported by numerous clay models from Syria and Mesopotamia.[72]

In the Near East, the four-wheeled carts drawn by equids were used in military affairs very early. The earliest image is a four-wheeled cart drawn by four equids on the 'Standard' of Ur (Fig. 3/1).[73] A defeated enemy lies under the cart, but the texts do not say anything about the use of such carts in battles.[74]

The transition from four-wheeled carts to two-wheeled ones took place already in the ED period (28th–24th centuries BC), and it was caused by their greater manoeuvrability. Already in the second quarter of the 3rd millennium BC, two types of two-wheelers appear: the straddle cart and the platform cart. There is no data on their use in combat, although there are images with weapons. Chariots evolved from the latter type, as can be seen from the emergence of new design solutions aimed at improving manoeuvrability, speed and lighter construction: the appearance of spoked wheels, wicker boxes, changing the curvature of the pole, and lengthening the axle to expand the wheelbase (Fig. 3/2–8).[75] Thus, we see here not just the evolution and the emergence of elements characteristic of chariots, but the interconnected evolution of the entire system. As in the case of horse domestication and the appearance of wheeled transport, an important issue is the socio-economic reason for this innovation. Obviously, carts of this type were less adapted for economic purposes than four-wheeled carts. Based on written sources, it is possible to see the fields of their use: transportation in war, travel, hunting, parade equipage,

66 Izbitser 2010, 192. – Drews 2017, 37, 38. – Kaiser 2018, 151–158, 161.
67 Rogudeev 2008, 86.
68 Kaiser 2011, 157. – Kaiser 2018, 159, 160.
69 Rogudeev 2008, 75, 87.
70 Littauer, Crouwel 2001, 332, 333.
71 Moorey 1986, 201, 202.
72 Bollweg 1999.
73 Littauer, Crouwel 1980, 344.
74 See additions by W. Färber in Littauer, Crouwel 1980, 336.
75 Littauer, Crouwel 1979, 34–40, 52, 53, 55.

Fig. 3. Battle carts of the Near East. – 1. 'Standard' of Ur (2600 BC). – 2. Karum Kanesh II (1970–1840 BC). – 3–8. Modern impressions of cylinder seals from Syria (Ashmolean Museum of Art and Archaeology): 3. 1850–1650 BC; 4, 6–8. 1750–1600 BC; 5. 1850–1650 BC (1–3, 5 after Littauer, Crouwel 1979, Figs. 3, 29, 33, 34; 4, 6–8 after Moorey 1986, Figs. 4, 5 and Pls. 2, 3, 5; modified by O. Orlova).

processions, or transport of gods.[76] Moreover, it is quite logical that two-wheeled carts with spokes, which were used for hunting, evolved into chariots.[77] Accordingly, this type of transport could appear only in societies where an elite had already emerged who could afford it, which is quite consistent with the Near Eastern situation in this period.

The inseparable connection between battle carts and equids is extremely important. The use of donkeys for these purposes is not enough, and we see teams of four animals. A more suitable animal is a hybrid of donkey and onager or donkey and horse, and the horse is an ideal solution. It is no coincidence that the appearance of combat vehicles by the mid-3rd millennium BC coincides with the emergence of hybrids.

The first images of spoked wheels in the south are dated to an earlier time than in the steppe. This is a seal from Tepe Hissar in Iran (Fig. 4/11) (second half of the 3rd millennium calBC),[78] an image on a vessel from eastern Iran (Fig. 4/12) dated to the late 3rd millennium BC, a bronze model of a four-wheeled cart from layer III in Acemhöyük in Anatolia (19th–18th centuries BC) and images of a four-wheeled cart and a chariot (both have wheels with four spokes) in Kültepe (Karum Kanesh II) in the layer dated in the system of 'Middle' chronology c. 2000–1850 BC (Fig. 3/2). Syrian seals from 1750–1600 BC already show chariots with eight spokes, although chariots with four spokes were also used at this time (Fig. 3/3–8).[79] Thus, in the Middle East, we see the evolution from cross-bar wheels to wheels with four spokes and a further increase in the number of spokes from four to six, eight and nine. But this is also associated with the ability to make bent wooden parts. In the Near East, this skill appeared already c. 2400 BC.[80] In Sintashta, this evolution is absent, and wheels with nine to twelve spokes appeared suddenly (Fig. 1/1).

It is impossible to understand from the texts when the chariots appeared. The logogram ^{GIŠ}GIGIR, which was applied to chariots in the Near Eastern texts of the 2nd millennium BC, appeared for the first time in the 3rd millennium BC, and the Hittites used it in descriptions of military actions.[81] This term appeared in Sumerian together with another term ^{GIŠ}MAR, to denote two-wheeled carts. But if there is no evidence on military use for the second term, ^{GIŠ}GIGIR is used in the context of preparation for battle or returning from battle. Ur-Lumma (c. 2400 BC) used 60 carts of this type drawn by donkeys in his war against Lagash, but a specific use remains unclear. In Akkadian sources, there are also references in a military context, and it is possible that it could be used for transporting warriors.[82] Therefore, it is obvious that the evolution of chariots developed on the basis of these two-wheeled vehicles, but initially not as a means of war.

There is evidence of a connection between chariots and horses. Texts from Mari from the 18th century BC mention that the royal family was involved in the breeding and training of horses.[83] This indicates the function of horses associated with high social status, which is possible in the case of chariots. But in Mari, judging by the texts, both mules and horses were used to pull the ^{GIŠ}GIGIR two-wheeled carts. In Mesopotamia, it is obvious that horses were harnessed in chariots in the 2nd millennium BC, but there is no philological evidence of this until the Middle Babylonian period.[84]

In the south of central Asia, chariots appeared together with the coming of BMAC people from western Asia in the late 3rd to the early 2nd millennium calBC. Indirect evidence is the discovery on Gonur Tepe of five signal horns with a wide socket made of bronze, silver and faience. In the Near East in the 2nd millennium BC, their counterparts were used exclusively for training horses. A similar silver horn was found in Hissar IIIC, a complex belonging to the BMAC.[85] At the same time, c. 2000 calBC, a model of a spoked wheel is known on Dashli I in Bactria (Fig. 4/7). This was preceded by the appearance of two-wheelers. Their clay models are found in Namazga III (late 4th – early 3rd millennia BC) and in all later periods.[86]

Spoked wheels in this region are well represented in the form of clay models (Fig. 4/7–10), the earliest in Namazga V, and possibly in Altyn Depe and Namazga IV, i.e. at least from the second half of the 3rd millennium calBC. However, in eastern Iran, there is evidence of the early appearance of light chariots. First of all, is the already mentioned seal from Tepe Hissar IIIB, which depicts a chariot with spokes drawn

76 See W. Färber in Littauer, Crouwel 1980, 336.

77 Bollweg 1999, 45, 46.

78 Littauer and Crouwel were not convinced that this was a spoked wheel since not all planks are directed strictly from the centre, see Littauer, Crouwel 1979, 40. In my opinion, this is a wheel with spokes, but a plank is added to one of the spokes, as an additional strut of the felloe, which is also found in some western Asian images (Fig. 3/3). But it is possible that this is just an inaccurate image.

79 Littauer, Crouwel 1979, 49–51. – Moorey 1986, 198, 201, 202 and Pls. 2, 5. – Teufer 2012, 296, 299.

80 Drews 2017, 45.

81 Littauer, Crouwel 1979, 64. – W. Färber in Littauer, Crouwel 1980, 336, 337.

82 See W. Färber in Littauer, Crouwel 1980, 340.

83 Moorey 1986, 198.

84 W. Färber in Littauer, Crouwel 1980, 340, 341.

85 Shchetenko 2008, 224.

86 Teufer 2012, 288, 289, 295.

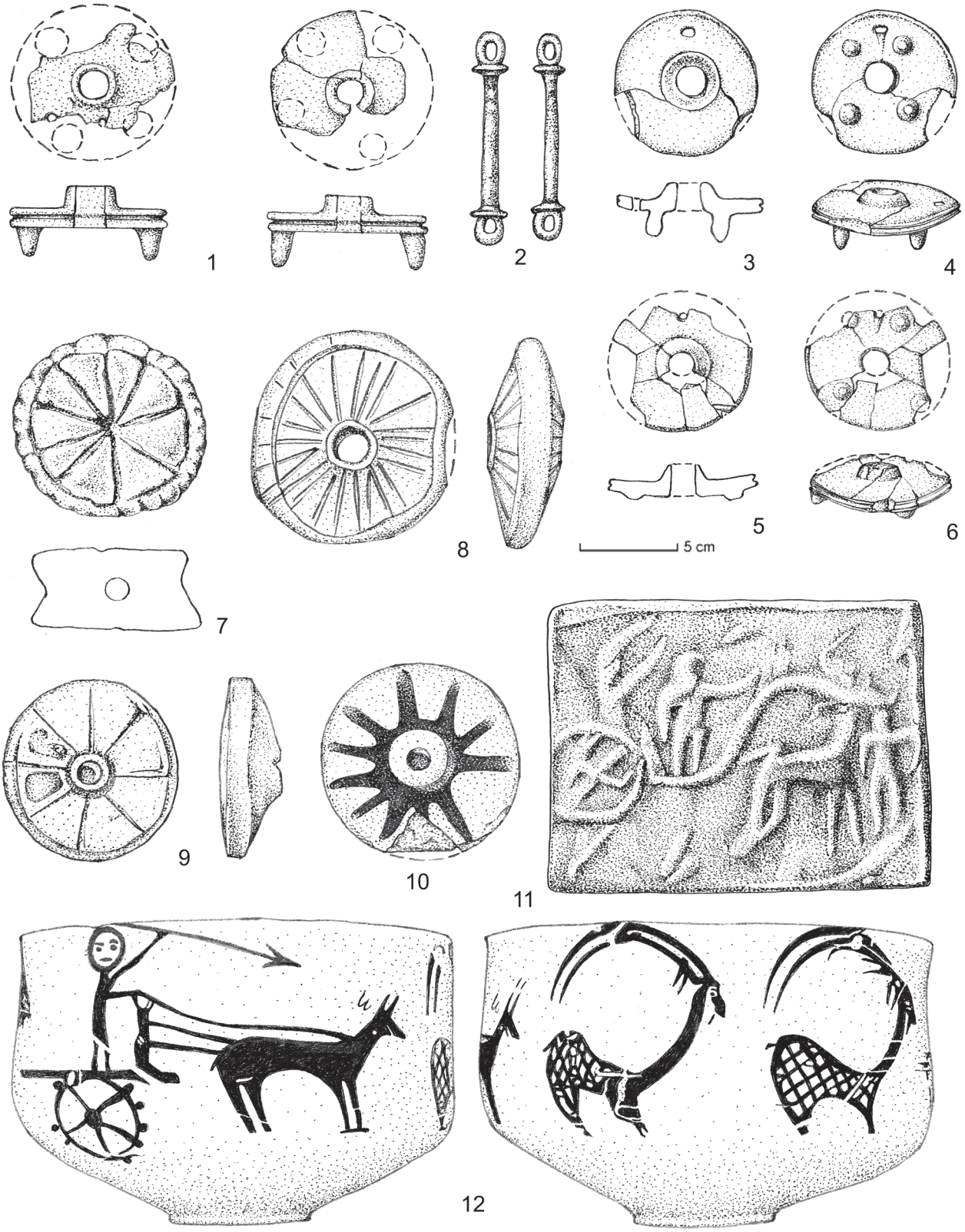

Fig. 4. The chariot complex of Iran and Turan. – 1–2. Bone cheekpieces and metal bits from Zardča Chalifa. – 3–6. Bone cheekpieces from Sazagan. – 7. Stone model of a wheel from Dashli. – 8. Clay model from Dzharkutan. – 9. Clay model from Tepe Yahya. – 10. Clay model from Rakhigarchi (northwest India). – 11. Impression of a cylinder seal, Hissar IIIB (northeastern Iran). – 12. Image on a vessel (eastern Iran) (1–10 after Teufer 2012, Figs. 3, 4, 17, 18; 11–12 after Littauer, Crouwel 1979, Fig. 21; modified by O. Orlova); the scale shown refers to numbers 1–8.

by a large equid with a charioteer standing on it (Fig. 4/11).[87] The fact that it is a horse is indicated by a vessel from eastern Iran with a scene of hunting gazelles with a spear on a chariot with spoked wheels drawn by an equid (Fig. 4/12). This vessel is comparable to the pottery from Tepe Yahya of periods IVB5 and IVB4, late 3rd millennium BC. Analogies of these ceramics are found in eastern Iran in the area between Tepe Yahya and Shahdad in the second half of the 3rd millennium BC.[88] The identification of this animal with a horse is possible for the reason that gazelle hunting with a spear in a chariot drawn by a donkey is impossible.

It is difficult to say when the seal from Hissar is dated, but the modern AMS dates of Hissar III do not go beyond the 18th century calBC, and the later part of this interval is represented by the Hissar IIIC layer.[89] Accordingly, the date of layer IIIB is within the 3rd millennium calBC. Hissar IIIC is a part of the BMAC, and it can be synchronized with the Sintashta Culture based on finds of cheekpieces, which we will discuss below. Period IVB on Tepe Yahya may start around 2800 calBC, although radiocarbon dates are more likely within the second half of the 3rd millennium calBC, and it is highly doubtful that this period continues into the 2nd millennium calBC. It is partially synchronized with the ED period of Mesopotamia, but mainly with the Akkadian period (2334–2154 BC in the 'Middle' chronology), and possibly the post-Akkadian period.[90] This noticeably predates the Sintashta Culture and the seals from Kanesh.

Thus, the earliest evidence of chariots in eastern Iran is found in the second half of the 3rd millennium calBC (probably about the last third of the 3rd millennium BC in the 'Middle' chronology). In the Near East there is evidence of chariots with four spokes in the very early 2nd millennium BC and with eight spokes in the 18th–17th centuries BC in the 'Middle' chronology system. At the turn of 3rd/2nd millennia calBC, chariots appeared in Bactria and Margiana, but in the radiocarbon chronology. We will touch upon this difference below.

The emergence of any technology is a result of a response to some challenge; it reflects a social need. In the period 2900–2350 BC, the basis of the Sumerian army was heavy infantry, a phalanx. From the depiction on the 'Standard' of Ur (Fig. 3/1), it is assumed that the battle cars were designed to crush this phalanx, although their effectiveness was very limited.[91] There are javelins in the images of the carts, therefore, in principle, they could be used as a mobile arsenal on the battlefield, but there are no signs of their use in combat. The manoeuvrability of these carts was low, as well as the control of animals, and their use for attacking enemy lines is questionable. This transport made a big turn of 18 m, and of 33 m at a gallop; it is possible that a person was needed to control animals, who walked nearby, so it was, rather, a prestigious mode of transport.[92] On the other hand, the text from Fara of the ED IIIa period mentions people who go to battle or leave it, therefore these carts were used only by the leaders of troops.[93] In the Sumerian, Akkadian and Old Babylonian periods military operations were mainly limited to the siege of cities, where infantry and archers were required, as well as a large number of military workers who erected siege structures and ramparts. There were almost no open field battles.[94]

The early Mesopotamian battle carts were used by warriors armed with spears and javelins. The earliest (first half of the 18th century BC) written data on horse-driven light chariots are the tablets from Mari and the Anitta text. The last document mentions 40 chariots, but there is no evidence about combat use. The first Hittite battle descriptions belong to the reign of Hattusili I (c. 1650–1620 BC). During the siege of the city of Uršum, it was surrounded by a cordon of chariots and troops of infantry; open battle was avoided. Numerous elite chariot squads, effective in open battle, could only be possible in mighty states, and such units appeared only in the Near Eastern LBA.[95] Early depictions of chariots show a single charioteer, which made it impossible to drive and fight at the same time. The use of chariots in battles in the 20th and 17th centuries BC was very difficult because of their design features. In all images from this time, the wheel axle is located in the middle of the box. This is convenient in carriages for transporting cargo, but with fast turns, driving on rough terrain and people standing in a chariot, stability is lost and the load on animals increases.

In Egyptian and Asian images of the second half of the 2nd millennium BC, the wheel axle is shifted back, and there are descriptions of their active use in combat and texts describing a huge number of chariots. It is only as a result of these later innovations that the chariot develops to combine manoeuvrability and firepower. The earlier ones were used in war, hunting, and also as ceremonial and status vehicles. It

87 Teufer 2012, 292, 295.

88 Teufer 2012, 296, 299.

89 Gürsan-Salzmann 2016.

90 Lamberg-Karlovsky 2001, 271, 274, 276. – Potts 2001, 196, 203, 215, 221.

91 Gilibert 2006, 93–96. – Drews 2017, 62.

92 Brownrigg, Dietz 2004, 482, 483. – Brownrigg 2006, 166.

93 Littauer, Crouwel 1979, 32–35, 44.

94 Drews 2017, 64–68, 73, 96.

95 Littauer, Crouwel 1979, 65. – Moorey 1986, 196, 203–208. – Drews 2017, 71, 115–119.

is no coincidence that there is a strict association of chariots and horses with the palace and the king. They were not of great importance in military affairs.[96]

An important weapon for the charioteers was a composite bow. In steppe Eurasia, the earliest details of such bows and the corresponding arrows with a massive stone or metal arrowhead (Fig. 1/6–8) first appear in the burials of the Sintashta Culture and disappear after its end.[97] Thus, their appearance coincides with the appearance of chariots. In contrast, in the Near East, the composite bow was known long before the MBA. In southern Iraq and neighbouring regions of Iran, images of it are present on cylinder seals of the late 4th millennium BC and up to the Akkadian period (2350–2150 BC). There is a stele from Mari of the ED III period (2600–2350 BC) with such a bow, and texts from Mari from the 18th century BC describe this bow as a common weapon. Texts from Alalakh of the 17th century BC describe charioteers armed with bows.[98]

Accordingly, the conditions for the invention of chariots were the presence of an elite, the siege of cities, numerous armies divided into detachments that had to be controlled by couriers, and a developed bow. All these conditions were present in the Near East, but they were absent in steppe Eurasia in the pre-Sintashta age. But even in Anatolia, all evidence of the limited use of chariots is dated to the Hittite era. In the Karum Kanesh II period, in which a seal depicting a proto-chariot was found, there were relatively small city-states, and numerous infantries participated in the wars. There is mention of the use of draft animals, but there is nothing about their use in battles. Long-term hostilities began only at the end of the next Ib period, when large territorial states formed.[99] Before that, it was senseless to keep large groups of charioteers. At the same time, chariots and horses were expensive, but they also required the maintenance of veterinarians, grooms, high training of drivers and archers. And there was no military class. Even in Mesopotamia during the Hammurabi reign, the military class was absent and the warriors were not the elite.[100]

This situation is even more applicable to Sintashta. As a rule, the phenomenon of the steppe chariot is discussed in terms of the emergence of an elite, sometimes even of an aristocracy, which could even be international.[101] But analysis of finds in chariot burials of the Sintashta, Abashevo and early Srubnaja cultures does not allow us to say that these buried persons specialized exclusively in the military sphere and the chariot was an important element of their activity.[102] Probably, there was some kind of leadership in this egalitarian society, especially in the case of hostilities, and it is possible that the leaders were buried with chariots, but they were not common and important for battles. It is significant that after the disappearance of large Sintashta settlements, the traces of chariots also disappeared from burials and cheek-pieces became very rare. But in Kazakhstan there is a series of petroglyphs with chariots. They depict chariots, as a rule, separately, but there are hunting scenes, scenes with domestic animals, one procession scene and only one supposed battle scene where the charioteers shoot arrows forward. However, this may also reflect hunting. Therefore, chariots were used, but mainly for travel, hunting, herd control and ceremonies.[103]

Based on the above, the most likely region where chariots were invented is the Middle East, an area between Syro-Anatolia and eastern Iran. Probably, western Asia was a donor of this innovation for other regions. There is a widespread belief that chariots came to Greece from steppe Eurasia.[104] However, the Eurasian chariots have at least nine spokes, while the Mycenaean ones have four spokes,[105] like the later chariots on the petroglyphs of Scandinavia. Four spokes are present in four-wheeled models of carts in the cultures of the Carpathian MBA, synchronous to Sintashta in the Urals; models and images of chariots with four spokes are also known there (a chariot on a vessel of the Susiu de Sus Culture from Veľké Raškovce; wheel models of the Madjarovce and Otomani-Füzesabony cultures; a model of a four-wheeled carriage in the Pocsaj settlement of the Gyulavarsánd Culture; two models of chariots from Dupljaja, a site of the Žuto Brdo-Dubovac group).[106] We have discussed above that on the Syrian seals of 1750–1600 BC, chariot wheels have four and eight spokes. Therefore, the penetration of the Near Eastern chariots into Greece, central and

96 Littauer, Crouwel 1979, 53, 62, 63, 65, 72, 77, 78, 90, 91, 93, 94. – Drews 2017, 46–48.

97 Bersenev, Epimakhov, Zdanovich 2011.

98 Moorey 1986, 209–210. – There is another opinion, that due to the complexity of their manufacture, such bows were expensive and not so widespread. Only charioteers and some elite foot archers used them. Most of the archers had a simple bow, see Drews 2017, 73.

99 Barjamovic 2011, 30, 33.

100 Drews 2017, 109, 110.

101 Bochkarev, Kuznetsov 2019, 53.

102 Berseneva 2013. – Podobed, Usachuk, Tsimidanov 2016.

103 Novozhenov 2020, 312, 324, 325, 357–361. – I am grateful to V. Novozhenov for his consultations on the functions of chariots during this period.

104 Littauer, Crouwel 2001, 334.

105 Karo 1930, Abb. 12.

106 Vasić2004. – Boroffka 2004, 350. – Bondár 2012, 62, 63, 86. – Novozhenov 2012, 84, 201, 294 and Fig. 166. – Bátora 2018, 151–153 and Fig. 113, 114.

northern Europe is more probable,[107] but this happened through the Carpathians, at a time close to the formation of the Sintashta Culture or somewhat earlier. This process was not associated with steppe Eurasia, since it is difficult to imagine such a degradation of technology in a more developed society.

The appearance of chariots in China at the beginning of the late Shang period is apparently connected with the same region. Stuart Piggott was the first to draw attention to the similarity of the Shang chariots to the chariot from Lchashen in Armenia, and now this idea has been developed in works by Chinese authors.[108] The main difference in these chariots is the large number of spokes. It is significant that, at the same time, chariots with a large number of spokes appeared in the Karasuk Culture of southern Siberia. On the Karasuk petroglyphs, they have 7, 14 and 17 spokes.[109] In the same period, on the northern periphery of the Shang civilization, the so-called Northern Complex formed, which reflects the Shang interactions with the Karasuk Culture.[110] The similarity of the Shang chariots with the chariot from Lchashen in Armenia may be explained by the fact that the Karasuk Culture was formed as a result of the influence of alien tribes on the local Andronovo substrate. There are many inclusions in the culture with parallels in the Transcaucasia and Iran.[111]

3. Harness

Driving a chariot is unthinkable without the appropriate harness, which consists of several elements. The pole of the chariot is attached to a yoke saddle connected to a girth, a belt running from the saddle at the junction of the animal's withers to the belly. Control is exercised by means of reins attached to the headstall (belts worn on the horse's head, consisting of cheekstraps and a noseband). For more effective control, a bit is attached to the headstall, often with cheekpieces, which press on the corners of the mouth, and through which the headstall parts are passed (Fig. 5).[112]

Experiments with a chariot and harness model have shown that the main effect in control is achieved by pressing the bit on the toothless edges of the lower jaw. The cheekpieces, on the other hand, are a secondary part that have an additional effect when turning, and braking is carried out due to the pressure of the bit and, to a lesser extent, of the noseband.[113] Accordingly, the mandatory elements in the bridle are the headstall and the bit, and it is with them that the development and use of the horse harness should begin. But it should also be noted that it is difficult to get the horse to obey commands by the pressure of the harness, and training the horse is critical. The harness was needed, first of all, to give signals to the horse.[114] Thus, the problem of the appearance of cheekpieces is not related to the problem of the origins of chariots; it reflects only a later stage of their development. None of the bridle elements described above

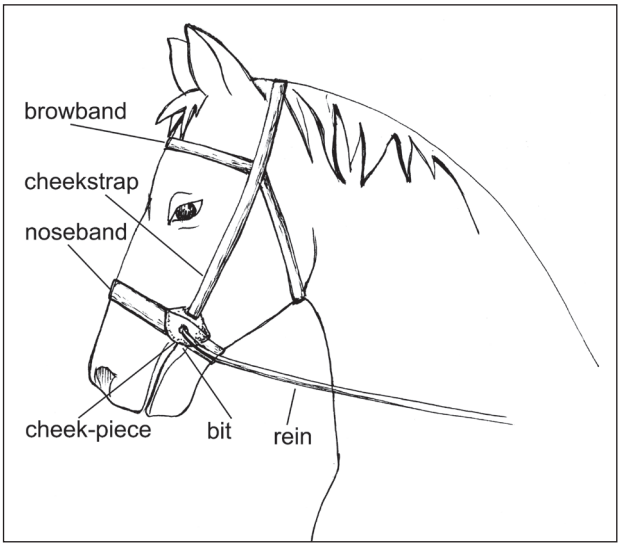

Fig. 5. Horse harness (© S. Grigoriev, O. Orlova).

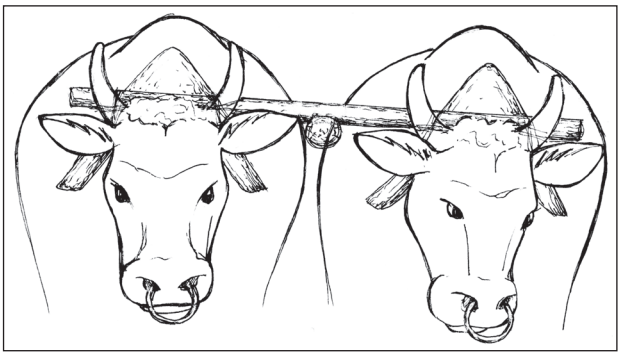

Fig. 6. Bovine harness (© S. Grigoriev, O. Orlova).

107 Boroffka 1998, 116. – Drews 2017, 141, 146, 161, 166, 219, 220, 229.

108 Wu 2013, 4, 6, 35.

109 Novozhenov 2020, 437–439.

110 Di Cosmo 1999.

111 Grigoriev 2002, 287–294.

112 Brownrigg, Dietz 2004, 487. – Epimakhov, Chechushkov 2004. – Novozhenov 2012, 358–361.

113 Brownrigg, Dietz 2004, 487. – Epimakhov, Chechushkov 2008, 208.

114 Brownrigg 2006, 165.

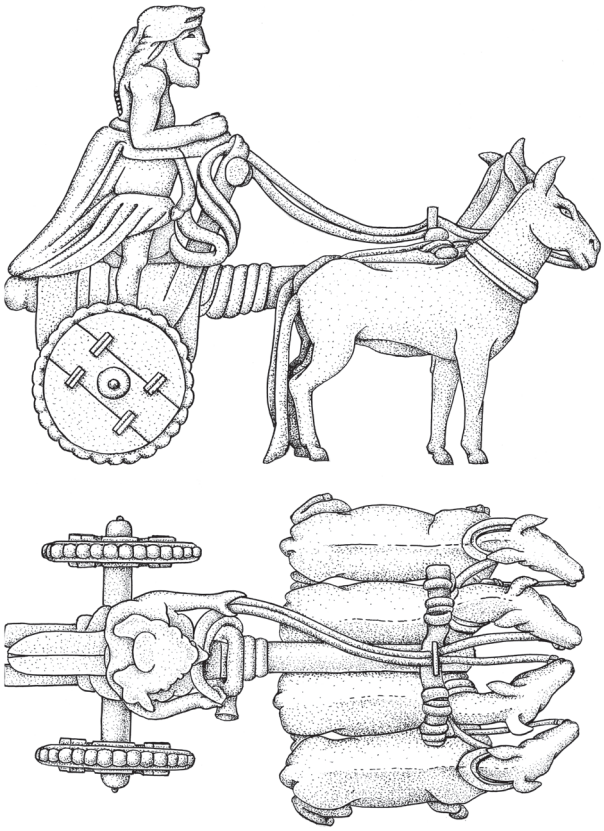

Fig. 7. Carriage model from Tell Agrab (after Littauer, Crouwel 1979, Fig. 7, modified by O. Orlova).

were previously known in the Volga-Ural steppes. They appeared all together, at the same time as the Sintashta chariots. By contrast, Drews believes that cheekpieces, which made it possible to control the horse better, and made it possible to create a light cart with spokes, were first invented in the steppe.[115] But the mechanism of such an innovation is unclear.

The situation is completely different in the Near East, where the horse harness gradually evolved from the harness of bulls and equids. Initially the bulls were harnessed with ropes attached to a bar tied to the horns, then a yoke with a pole appeared (Fig. 6). This variant is already recorded in the vehicle on the image of the ED IIIa period (c. 2600–2500 BC). Probably, additional control was exercised using a nose ring. This system could only arise in agricultural societies, since it goes back to the plough harness, but it is not suitable for equids with their long necks. Therefore, in the early equid harness, as in the model from Tell Agrab, the yoke is displaced to the base of the neck in the area of the withers and attached to the pole and neck belts (Fig. 7). The latter are also present on the 'Standard' of Ur (Fig. 3/1). But for equids, such a harness is inconvenient, so they began to attach the pole not to the neck belt, but to the yoke in the area of the withers.[116] Control was exercised by lines attached to the nose ring, as in the bovine harness, but very quickly they began to combine it with the headstall. The original reason for this was perhaps that it prevented the draft animals from bickering. But then someone removed the nose ring and attached the reins to the noseband in order to achieve the effect of gradual braking and partial control of the direction. To enhance the effect, a bit was passed through the mouth. The appearance of cheekpieces only increased this effect. From that time onwards, the reins were attached only to the headstall, and the yoke was replaced by a saddle.[117] Thus, this development of the harness was realized in the 3rd millennium BC, and it was associated with the widespread use of equids and with the evolution of wheeled transport.[118] Probably, different types of bridle coexisted for some time. In any case, despite the schematism of the image, it seems that on the seal from Karum Kanesh II, the equids are harnessed using a nose ring (Fig. 3/2). Akkadian had two words for bridle: *appatu* (nose) and *ašâtu* (jaw).[119] Perhaps this was caused by a specific function of the team, as the nose ring assumes control exercised by a pedestrian walking next to the cart.

Syrian terracotta equid figurines of the ED III period (26th–24th centuries BC) from the settlement of Tell Arbid provide rich material for the reconstruction of the harness (Fig. 8/1–5). On these figurines, a headstall with cheekstraps and a noseband is clearly visible, but there are also more complex forms of the headstall. In this type of harness, bits are used; images exist in the Akkadian period (Tell Brak), and bit wear on donkey teeth is known. In the second half of the 3rd millennium BC, equid figurines with holes on the muzzle at the location of the bit exist, which may also be evidence of its use. Finally, already in this period there are figurines that make it possible to reconstruct the use of trappers, which in the Near East were used exclusively in horse harnesses.[120]

115 Drews 2017, 44.

116 Brownrigg, Dietz 2004, 484.

117 This was a natural evolution. Unlike bulls, equids have low withers and a high neck. Therefore, the yoke was shifted to the withers so that it would not slide off the neck. Initially, some kind of soft material was probably put under the yoke so as not to injure the animal, see Littauer, Crouwel 1979, 85.

118 Littauer, Crouwel 1979, 14, 28–31, 61, 72. – Littauer, Crouwel 2001, 335.

119 Brownrigg, Dietz 2004, 483. – Brownrigg 2006, 170.

120 Makowski 2014, 262, 264, 267.

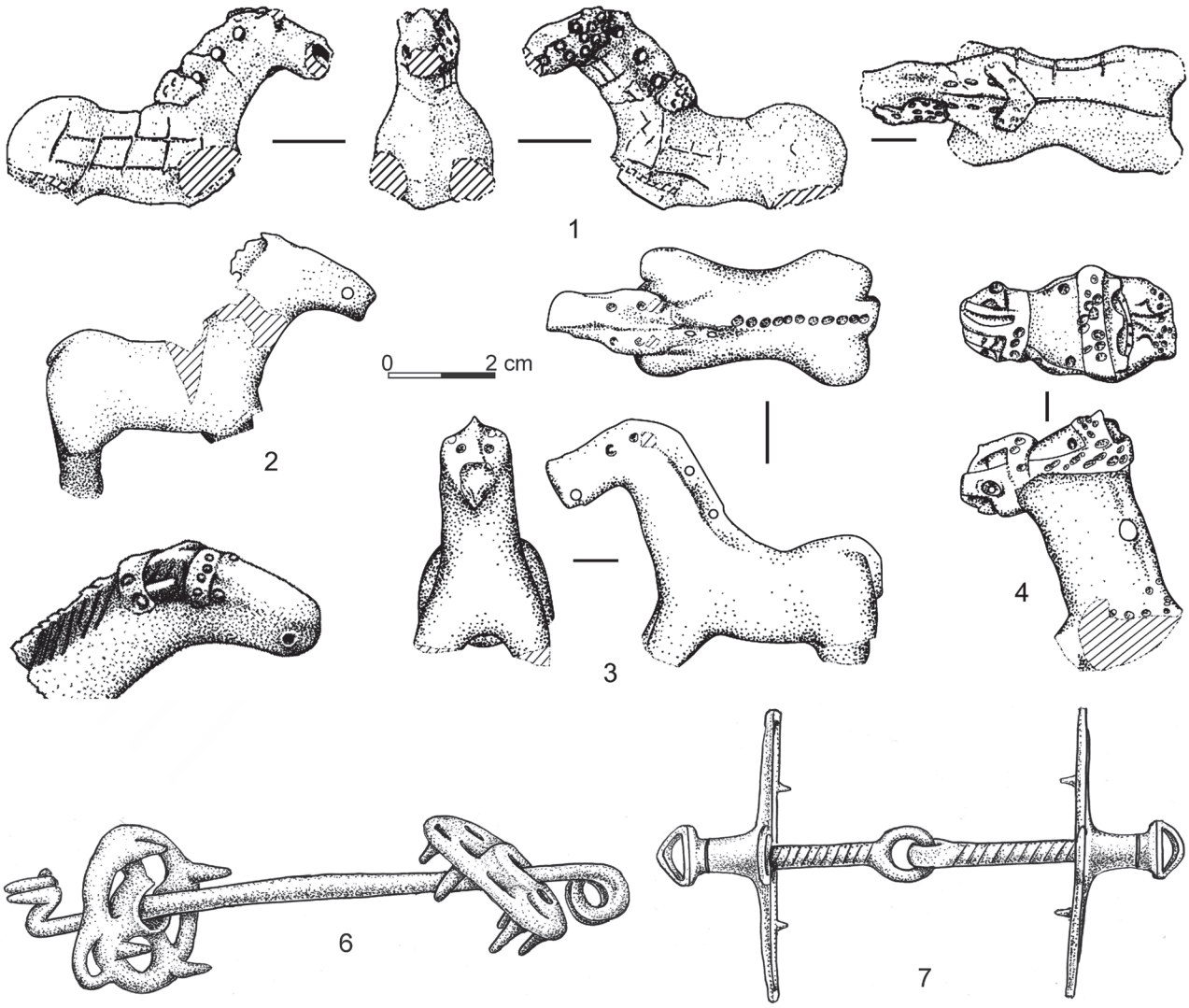

Fig. 8. Evolution of harness in western Asia: clay models of equids from Tell Arbid, Syria (1–4 after Makowski 2014, Figs. 4, 6, 12, 14; the scale shown refers to numbers 1–4) and Tell Taya, northern Iraq (5 after Littauer, Crouwel 2001, Fig. 3) and metal bits (6, 7 after Littauer, Crouwel 2001, 329, 333 and Figs. 1, 4, modified by O. Orlova). – 1, 3. Post-Akkadian period. – 2. Early Dynastic III period. – 4. Akkadian or post-Akkadian period. – 5. Akkadian period. – 6. Tell Haror, 17th century BC. – 7. Tell Amarna, 14th century BC.

At the settlement of Tell eṣ-Ṣâfi in Israel in the EB III layer with a radiocarbon date of 2800–2600 calBC, teeth of donkeys or its hybrid with an onager were found with traces of the use of organic bits. Bits are necessary for riding, but they are not needed for controlling pack animals, for which nose rings are sufficient.[121] However, bits made from organic material are not preserved. Early metal bits were first discovered at Tell Haror in the Negev (17th century BC), and this type is widely represented in subsequent sites in the Levant, Egypt, Iraq, Greece, Turkey, and Luristan (Fig. 8/6–7). Earlier bits of this type for harnessing donkeys were found in the settlement of Tell Brak in Syria with a date of c. 2200 BC. In southwestern Iran and Nubia, copper patina on donkey teeth is known dated to the same period. But on figurines that look like a horse's muzzle from Tell es-Sweyhat (2300–2100 BC) and Tell Arbid (second half of the 3rd millennium BC) in Syria, and from Tell Taya in northern Iraq (Old Akkadian period), there are holes on the muzzle at the place of the bit (Fig. 8/1–5).[122] Thus, in the Levant, already in the first half of the 3rd millennium calBC,

121 Greenfield et al. 2018, 1, 2, 4, 12.

122 Littauer, Crouwel 2001, 329, 331, 332.

organic bits began to be used to control equids. Around the mid-3rd millennium BC ('Middle' chronology) in Syria already full headstalls with organic bits are known, and about 2200 BC metal bits appear, and perhaps the use of this type of bridle in horse harnesses begins.

The appearance of the bridle in Iran is dated to a later time, where at the settlement of Malyan, bit wear on horse teeth has been found.[123] Horse remains in this settlement were found in the 2000–1800 calBC layer.[124]

Reliably documented cheekpieces used in horse harnesses appeared in the Near East only in the LBA,[125] although there is evidence of the use of chariots already in the MBA. This may have two explanations: the manufacture of cheekpieces from non-preserving material, the absence of cheekpieces, or the control of the team only by means of the headstall and bridle. The use of cheekpieces may be indicated by an antler cheekpiece from Alaca Höyük, but it is poorly documented.[126] A rod-shaped cheekpiece from the first half of the 2nd millennium BC was discovered in Karahöyük, but I am not sure if it actually is a cheekpiece.[127] A more compelling argument is the cheekpieces and metal bits from the Zardča Chalifa in the south of central Asia (Fig. 4/1, 2).[128] These cheekpieces are commonly used as evidence of the steppe origin of chariots in the region, but they were found in a typical BMAC complex, with the corresponding burial rite and ceramics, and together with metal bits, analogies to which are known only in the Near East since the late 3rd millennium BC.[129] Therefore, an opinion was expressed that these are complexes of local elites who borrowed the chariot,[130] but, if it were not for this narrative of the steppe origins of chariots and cheekpieces, which we discussed in the introduction, we would consider it as evidence of the appearance of chariots as a result of influence from the Near East. A cheekpiece from a burial at Sazagan (Fig. 4/3–6) is dated to the same time, and it was also found in a complex with local ceramics of the early Sappali stage (northeastern version of BMAC), without the admixture of steppe elements. Somewhat later (LBA Ib, 18th–17th centuries calBC) is a cheekpiece from Dzharkutan in Uzbekistan. All these cheekpieces are of early types, which are considered as a sign of the presence of chariots in the region at a very early stage; and their emergence in the contact zone of the BMAC and Andronovo Culture is assumed. In accordance with the traditional point of view, it is assumed that cheekpieces were borrowed from the steppe, and metal bits from the southwest, where they were used for harnessing donkeys, although the long evolution of the equid harness in the Near East is emphasized.[131] But it seems to me that since these two elements in the harness are interconnected, they came from a single source. Likewise, it is generally accepted that the cheekpieces of the Carpathian Basin were borrowed from the east, as were the cheekpieces of the Mycenaean shaft tombs. But for the Carpathian chariots, it is more likely to assume the Anatolian source; and for the Greek one, the Carpathian origins.[132]

However, cheekpieces have only an additional effect on the horse; the headstall and the bit play the main role in this control. Therefore, what was discussed above is more important for solving the problem. In the Near East, around the mid-3rd millennium BC, in connection with the need to use equids for pulling carts, a corresponding harness was being developed, and we are able to trace its logical evolution from the type of harness that was used for bulls. In the Volga-Ural region, such data are absent, and the harness appeared there in a fully developed form along with chariots, which makes it possible to doubt its creation in this region.

4. Correlating the Chronology of the Near Eastern and Steppe Chariots

The issue of chronology is of fundamental importance in this problem. Elena Efimovna Kuz'mina wrote that the dates of chariots in the Near East fall within the 18th–17th centuries BC, and the dates of the Sintashta chariots within the 17th–16th centuries BC in the traditional chronology, noting that the radiocarbon dates of the Sintashta chariots fall in the interval of the 20th–18th centuries calBC.[133] Thus, the Near Eastern chariots are somewhat older, and subsequently she preferred to use the traditional dates for the Near Eastern chariots and radiocarbon dates for the Sintashta ones. The paradox is that mentions about the difference between radiocarbon and historical dates and their identification may be present in one of her works to substantiate different aspects.[134] Likewise, Drews, who in the pages of his book repeatedly emphasizes the difference between radiocarbon and historical chronology, as well as the fact that he uses the

123 Anthony, Brown, George 2006, 148.
124 Vila 2006, 120.
125 Moorey 1986, 198.
126 Boroffka 1998, 104.
127 Güneri 2016.
128 Bobomulloev 1993.
129 Littauer, Crouwel 2001.
130 Burmeister, Raulwing 2012, 105.
131 Teufer 2012, 276, 278, 279, 282, 285, 287.
132 Maran 2020, 512. – Grigoriev 2021a.
133 Anthony, Vinogradov 1995, 38, 40. – Kuz'mina 2000, 14, 19.
134 Kuz'mina 2007, 232, 334.

'Middle' chronology, compares the historical dates of the Near East with the radiocarbon dates of the Urals, and concludes that chariots were invented in the steppe.[135] Unfortunately, all other researchers do the same.[136] And this mistake is repeated at a new level, using more modern methods, which gives an impression of more credibility to the conclusions. The use of Bayesian statistics for the AMS dates of the Sintashta burials of the Kamenniy Ambar cemetery made it possible to obtain the date 1950–1880 calBC, which is not later than the image of the chariot on the seal from Kültepe.[137] However, there is a difference between historical dates in the Near East and radiocarbon dates, and the difference is significant.[138] I discussed in detail the problem of the comparisons of these dates, also in relation to the Sintashta chronology, which, within the framework of radiocarbon chronology, is dated to the 20th–18th centuries calBC, and within the historical chronology, to the 18th–17th centuries BC.[139] Additionally, Roman A. Mimokhod suggested the possibility of synchronizing chariot cultures of the steppe with the Old Babylonian period of Mesopotamia within the 19th–18th centuries BC.[140] Therefore, even if we synchronize the lower boundary of these complexes completely (for which there are no grounds yet), there is no way to assert the priority of the steppe chariots. The difficulty is that the main parallels of Sintashta in the Near East are dated to the 19th–18th centuries BC. There are individual analogies with artefacts from layer II of Karum Kanesh, but since most of the parallels fall in the 18th century BC,[141] this date was recognized as the most probable. As we see from the discussion above, the wheels with a large number of spokes, as in Sintashta, appeared in the Near East not earlier than the 18th century BC. I considered the invasion of the Kassites into the Khabur Basin c. 1740 BC as a reason for Sintashta migration from the Syro-Anatolian region. Some lowering of the date is probable, since this was not the only event that could destabilize the situation. Around 1775 BC, the kingdom of Mamma expanded to the south of Taurus, capturing Zalwar, Uršu and Haššum. The ruler of this kingdom, Anum-hirbi, was in correspondence with King Varšama of Kanesh, who ruled in 1775–1750 BC. Varšama Palace belongs to layer Ib. However, the possibility of partial synchronization of the Sintashta migration with the final part of layer II of Kanesh is not excluded, since the Assyrian king Shamshi-Adad I (1808–1776 BC) also carried out active campaigns to the west, into the Euphrates bend.[142] However, the final part of Sintashta in the framework of traditional chronology is close to 1600 BC,[143] so we have a long (200–175 years) interval for the culture, although we see only one restructuring in settlements with dwellings made of logs and soil. But in any case, the beginning of the Sintashta Culture is later than the Karum Kanesh II, while the Sintashta radiocarbon dates correspond to historical dates of this layer.

This inappropriateness of the comparison of radiocarbon dates for Sintashta chariots and historical ones for the Near Eastern chariots finally became obvious to supporters of the steppe priority hypothesis. Therefore, Igor Chechushkov tried to compare the radiocarbon dates of the appearance of different types of wheeled vehicles in the steppe and Mesopotamia, and collected some Mesopotamian dates, comparing them with historical ones. In particular, for the Third Dynasty of Ur, the interval 2306–2141 calBC (68.2 %) was obtained. From this, it was concluded that this interval in general coincides with the 'High' chronology of the Near East, which indicates its legitimacy, and has no significant contradiction with the 'Middle' chronology, as well as the conclusion about the priority of the dates of the steppe

135 Drews 2017, 42.

136 Kuznetsov 2006. – Anthony 2007, 402, 403. – Novozhenov 2012, 189, 310. – Shev 2016, 133.

137 Lindner 2020, 361–377. – In fact, it is difficult to talk about the application of Bayesian statistics in this work, since the latter implies a possibility of estimating the probability of an event. As such, the concept of an earlier or later character of the pottery of the Kurgan Complex was chosen. But in many Sintashta complexes, ceramics with early and late features coexist, and today we do not have works that allow us to reliably undertake a chronological division of ware in this period. Moreover, there is a reason to believe that the scheme of cultural genesis in the Transurals during this period was more complex, and the Sintashta, Petrovka, and early Alakul types formed almost simultaneously (Grigoriev 2016). This is confirmed by the latest ^{14}C analyses of the Petrovka burials, which show dates within the Sintashta interval (Krause et al. 2019). Moreover, the Seima-Turbino, Sintashta, Petrovka and Alakul traditions coexist even within the same complex, Stepnoe VII (Grigoriev et al. 2018, 141). Likewise, this statistic cannot be applied to isolated complexes, for example, mounds of different cultures and territories, since this method is based on assumptions and not objective material. Moreover, when trying to do this, we will have another problem: incorrect use for comparisons of dates arrived at different laboratories and at different times. And this is inevitable when trying to compare many materials from a huge territory. The application of this method is correct only in the case of stratified sites and when using a high-precision radiocarbon method with narrow confidence intervals. In all other cases, this creates only the illusion of a strict procedure, which it is not. Therefore, we can leave this problem without further discussion, turning only to the most fundamental questions.

138 Michael 2004, 18.

139 Grigoriev 2020b, 67. – Grigoriev 2020c.

140 Mimokhod 2013, 263, 264.

141 Grigoriev 2002, 135, 136.

142 Barjamovic, Hertel, Larsen 2012, 36, 50, 91.

143 Grigoriev 2020b, 67. – Grigoriev 2020c.

'Ultra-High' chronology	1930–1888 BC
'High' chronology	1848–1806 BC
'Middle' chronology	1792–1750 BC

Tab. 1. Dates of Hammurabi's reign in different chronological systems of the Near East (after Hasel 2004, 8).

chariots.[144] However, this conclusion is an exaggeration, since the 'High' chronology of this period corresponds to the interval 2161–2054 BC, and the 'Middle' chronology to 2112–2004 BC. Accordingly, even the 'High' chronology shows a noticeable difference with the radiocarbon dates. An attempt to solve this problem was continued in the article by Andrey Epimakhov and Igor Chechushkov.[145] The most fundamental issue in this case is the dating of the Old Babylonian period, which can be synchronized with Sintashta, and the reign of Hammurabi. Referring to the work of Michael G. Hasel, they assumed the adequacy of the 'High' chronology and its comparability with radiocarbon dates. The Egyptian chronology is regarded as less problematic. Another reason for the adoption of the 'High' chronology was the work of the statistician Peter J. Huber, who, based on the analysis of the 'Venus Tablets', proved a greater likelihood of the correspondence of astronomical events to the 'High' chronology. As a result, a more cautious conclusion has been reached about the lack of priority of the Near Eastern chariots, on the grounds that most of the images and textual evidence relating to them belong to a later time. However, the actual later 'majority' does not allow us to ignore the earlier 'minority' of these data.

In fact, Egyptian chronology has the same significant problems: the offset between traditional and radiocarbon dates is 100–300 years, and for the reign of Cheops, 200–300 years.[146] But even for Mesopotamia, as can be seen from Table 1, the Sintashta interval (2010–1770 calBC) only corresponds to the 'Ultra-High' chronology. The 'High' chronology, as in the case of the chronology of the Third Dynasty of Ur, shows noticeably younger dates, although we cannot synchronize them strictly.

However, the adoption of the 'High' chronology raises questions. Since the time of Huber's first works, which began to appear 40 years ago, his chronological changes have not been accepted, and there are reasons for this. In his works, a greater correspondence of the statistical probabilities of astronomical events to the 'High' chronology is demonstrated only for Akkad and the Third Dynasty of Ur. He could not explain the impossibility (which he emphasized) of lowering the dates of Hammurabi's reign.[147] There are works criticizing his position. They are based on the fact that the 'Venus Tablets' were rewritten over 1000 years and contain numerous errors and gaps. Therefore, the choice of any variant is arbitrary. The interpretation of the data from this source is also very difficult. Obviously, statistics cannot improve the situation if the data used is incorrect. In addition, the observations of Venus do not allow conclusions to be drawn on the chronology; it is necessary to use other data, for example eclipses. Therefore, Huber's chronology is erroneous and is not supported by alternative sources.[148] Taking into account all the possible data shows the correctness of the generally accepted 'Middle' chronology, although it has several variants, and astronomical data do not allow us to choose one of them with absolute reliability, although of the six variants, the canonical 1646 BC as the first year of Ammi-Saduqa's reign is the worst candidate.[149]

The validity of the 'Middle' chronology is also confirmed by other studies, which are more important for us because they were realized on Anatolian material and allow us to date the Kanesh layers discussed above. First of all, is an extensive project in Gordion in central Anatolia, where dendrochronology was carried out for many samples and individual tree rings were analysed with a high-precision radiocarbon method. In total, 128 such measurements were made. By comparing these data with each other ('wiggle-match' procedure), a floating dendrochronological scale was obtained for the region, in which the deviation from absolute dates is ±10 years.[150] It was used in the excavation of the acropolis at Kanesh, where the Waršama Palace was discovered, built over the Old Palace destroyed before this. Archaeological material and a huge number of texts from Kanesh with an extensive epigraphic list (and links with other Near Eastern texts of this period) were associated with dendrochronology and the layers of the Lower City (Karum Kanesh): the Old Palace with layer II, and the Waršama Palace with the later layer Ib. Trees for the building of the Waršama Palace were cut c. 1835–1832 BC, and layer II of Karum Kanesh is dated to 1970–1840 BC. This coincides strictly with the 'Middle' chronology, which is derived on an unrelated basis.[151] Subsequent studies of

144 Chechushkov 2014, 280–283.
145 Epimakhov, Chechushkov 2018.
146 Hasel 2004, 16, 17.
147 Huber 1999/2000, 50, 67, 68.
148 Gurzadyan 2000. – De Jong 2013, 149, 153, 155.
149 De Jong 2013, 152.
150 Manning et al. 2010.
151 Barjamovic, Hertel, Larsen 2012, 29, 34 and Fig. 11.

samples from Kültepe and Acemhüyük confirmed the realism of the 'Middle' chronology, with variations of several years, but shifted the date of the building of Waršama Palace to 1852–1843 BC (68.2 % probability).[152] Accordingly, layer II of Karum Kanesh is somewhat older.

Therefore, this attempt to show the earlier chronology of the steppe chariots by adopting the 'High' chronology of the Near East should be considered unsuccessful, and the problem of the discrepancy between the historical and radiocarbon dates remains. However, even if we admit the validity of this chronological system for a moment, nothing will change. The difference between the 'High' and 'Middle' chronologies is 50–60 years, which is noticeably less than their deviation from radiocarbon dates. In addition, the dates of the Near Eastern chariots in this article are taken from the work of Roger Moorey, who used the 'Middle' chronology.[153] Within the 'High' chronology, these dates will be older. Therefore, while earlier supporters of the priority of steppe chariots suggested using radiocarbon dates for the steppe and traditional ones for the Near East for this comparison, now we are invited to use the 'High' chronology for the steppe and the 'Middle' one for the Near East. And there is no other way to demonstrate the Steppe priority.

Above, we discussed the problems of dating the lower boundary of the Sintashta Culture based on Near Eastern data, and the likely 'window of opportunity' is 1800–1740 BC. Since layer II of Karum Kanesh is dated to the interval c. 1970–1850/1840 BC, then the images of spoked wheels of a vehicle and a chariot on the seals from this layer significantly preceded the appearance of chariots in the Sintashta Culture. The latter are generally synchronous with the images on the Syrian seals, but the lower dates of these seals (1850 BC) are earlier. The Carpathian chariots are somewhat earlier than the Sintashta ones, but they are later relative to the Near Eastern ones. In terms of historical chronology, their appearance dated back to the 19th or 18th century BC.[154]

Thus, chariots appeared in the Near East c. 20th century BC within the 'Middle' chronology; and in the 18th century BC there are images of chariots with eight spokes and mentions of the same in the texts. I doubt the validity of the date 2350 BC for the seal from Tepe Hissar, since the earlier radiocarbon dates are older than the modern AMS dates on which the Sintashta chronology is now based. But in any case, the seal from Hissar is older than the Sintashta chariots, since it belongs to layer IIIB, and we can synchronize layer IIIC, which is part of the BMAC, with Sintashta. Layer IVB on Tepe Yahya may be synchronized with the Akkadian period, and the radiocarbon dates also clearly precede the Sintashta ones; therefore the eastern Iranian images of chariots are noticeably older than the Sintashta chariots. They are older than Anatolian evidence, but it is too early to draw a final conclusion based on single objects.

In any case, Chechushkov is right when he emphasizes that radiocarbon dates are only intervals of possibilities.[155] Unfortunately, when trying to build a chronology based on the typology of artefacts and written sources, due to a possible duration of the type's existence, we also get an interval of possibilities, and not a specific date. All this needs further detailed studies in both directions, but in the coming years this problem will not be solved in this way. The reason for this is that the difference in the dates of the appearance of chariots in both regions is small.

And the amount of data on earlier Near Eastern chariots is scarce. Perhaps this is due to the fact that the spread of this tradition to the steppe began soon (100–200 years) after its appearance in the Near East. But this is supported by the fact that if we consider this phenomenon as a complex social and technical system, in the Near East we see a long, smooth, interconnected and completely logical evolution of all its elements; therefore, the conclusion about the invention of light chariots in the Near East[156] seems to me beyond doubt.

We do not see this evolution in the steppe. We may assume that at some early stages there was no tradition of placing chariots in burials, and cheekpieces were made of non-preserved material – for example wood – and both of these options are possible. But these will only be assumptions and speculations, not supported by facts.

5. Horse, Wheel and Chariot in the Light of the Indo-European Problem

The discussion of the origins of horse breeding and the appearance of wheeled vehicles and chariots is the most popular topic among supporters of the hypothesis of eastern European origins of the Indo-Europeans.[157] The roots of this phenomenon grow from an even older narrative *Germanen und Pferd*, although in reality, Proto-Indo-European vocabulary does not reflect the domestication of horse, there

152 Manning et al. 2016.
153 Moorey 1986, 198.
154 Grigoriev 2021a.
155 Chechushkov 2014.
156 Littauer, Crouwel 1979, 68.
157 E.g. Anthony 2007, 304, 341, 342.

is simply a word for it. And all the ideas about the significance of horses and chariots in the Indo-European societies are built on later Greek, Indian and Germanic sources.[158] In Proto-Indo-European, indeed, there is a common word for 'horse', but as we have seen, the area of the wild horse was not limited to the Eurasian steppes; therefore this terminology is absolutely ambivalent when trying to choose the 'steppe' or Near Eastern homeland.

The situation with wheeled transport is identical. In Indo-European studies, the terminology for the wheel and harness is considered as a sign that makes it possible to attribute the Proto-Indo-European stage to 4000 calBC, which corresponds to the localization of the homeland in the Ponto-Caspian steppes.[159] However, in the case of the Near Eastern localization of the homeland and the lowering of the formation of the Proto-Indo-Europeans to the 7th millennium calBC, the situation does not change, since the main migrations outside this homeland were carried out in the 4th – early 2nd millennium calBC.[160] Therefore, the only key to discussing the problem of the homeland is the later terminology for chariots.

Traditionally, the invention of the light chariot is ascribed to the Indo-Aryans, which is based on the presence of the Indo-Aryan vocabulary in the text of the Hurrian author Kikkuli on the training of chariot horses, which was discovered in an archive in the Hittite capital of Hattusa (Boğazköy). This is regarded as evidence of the appearance of chariots as a result of the Indo-Aryan invasion from the north.[161] Strictly speaking, this indicates only the presence of Indo-Aryans in the Near East in the preceding period, as well as the fact that this particular author of the text originated in an environment that learned these skills from them. We probably cannot talk about a single author, since the Hurrian word for charioteers in Mesopotamia in the Kassite period also goes back to Indo-Iranian. And in the Avesta and Rig Veda, a similar term for the chariots, or 'standing in a chariot', suggests a common Proto-Indo-Iranian basis.[162] Therefore, it can be assumed that the Hurrians in general obtained knowledge of chariots from the Indo-Iranians. But the words for 'spokes' (*akkandas*) and 'felloe' (*attak*) passed into Akkadian from Kassite.[163]

The same conclusions have been reached on the basis of analysis of the term 'marianni', which denoted the military class, mainly charioteers, in Syria and the Levant. The term does indeed go back to the Indo-Aryan language (*maria-* 'young man, man, hero'), but the suffix *-nni* is Hurrian. Therefore, it is assumed that initially this knowledge was brought to the Near East by Indo-Aryans, but the *marianni* were representatives of different ethnic groups, primarily the Hurrians.[164]

However, this conclusion does not at all mean an eastern European localization of the Indo-Aryan homeland. The proposed localization of the Indo-Aryan origins in the southeastern Caspian region is also quite consistent with this. This model assumes the migration of some of the Indo-Aryans to the Levant, where, in the so-called Intermediate Bronze Age of Palestine, catacomb burials appeared which had prototypes in the southeastern Caspian region.[165] Earlier dates of chariots in eastern Iran (c. 23rd–21st century BC in the 'Middle' chronology) than in Anatolia and Syria allow us to assume that this innovation was indeed introduced into the Syro-Anatolian region by the Indo-Aryans and that they were the authors of this invention. Recent paleogenetic studies of the Neolithic, Eneolithic and Bronze Age of the Near East have shown the absence of gene flows from other regions. However, an episode of a limited inflow from the southeastern Caspian to the northern Levant in the first half of the 2nd millennium BC is recorded.[166]

Now, in Palestine this period is called EB IV. The radiocarbon dates of its beginning were estimated at around 2500 calBC.[167] Recent radiocarbon studies at Jericho have shown an interval between 2580 and 1907 calBC, but thanks to studies of earlier and later layers, it was corrected to 2300–2000 calBC, which is closer to the traditional chronology.[168] The traditional date of the period is 2400/2300–2000 BC. It is synchronized with the First Transitional period of Egypt, dated to 2315–1991 BC, and the next MB I period may be synchronized with layer Ib at Kültepe and the reign of Shamshi-Adad I in Assyria.[169] Accordingly, the final part of the previous EB IV period may be synchronized with layer II of Kültepe, and this explains the appearance of a light chariot there.

But we have no evidence that it was with this impulse the spoked wheels and light carts were brought to Syro-Anatolia. Perhaps there were migrations of some

158 Kristinsson 2012, 392–394.
159 Mallory 1996, 9, 10, 16, 17.
160 Grigoriev 2002, 411–414.
161 Piggott 1983. – Anthony 2007. – Kuz'mina 2007.
162 Gamkrelidze, Ivanov 1995, 631, 632.
163 See W. Färber in Littauer, Crouwel 1980, 338.
164 Burmeister, Raulwing 2012, 96. – Drews 2017, 113.
165 Grigoriev 2002, 180–184.
166 Skourtanioti et al. 2020, 1158, 1161.
167 Regev et al. 2012, 560, 561.
168 Nigro et al. 2019, 25, 28.
169 Dever 1992, 2, 6, 10.

groups during the BMAC formation in the east. It is significant that the wheels on the seals from Karum Kanesh II have four spokes; wheels with eight spokes appeared on Syrian seals in the 18th century BC, and early images from Iran demonstrate wheels with more than four spokes. But more importantly, the Near East was closely connected at that time by trade networks, through which technological information was transmitted in various directions all the time. At the same time, some innovations could be used very limitedly, coexisting with old traditions.

From all this, it seems, it follows that the inventors of the light chariot were indeed the Indo-Aryans, but this happened in eastern Iran, from where this invention came to western Asia. The presence of Indo-Iranian chariot terminology in Hurrian also demonstrates this, since the Hurrians were the autochthonous population of this region, and if chariots were invented there, they would have their own Hurrian terminology. However, I would refrain from jumping to conclusions. Doubts about the association of chariots exclusively with Indo-Iranians have been expressed many times.[170] The Hittite language borrowed chariot terminology from Hurrian.[171] And it should be said that the texts of Kikkuli, constantly used to substantiate the Indo-Aryan provenance of this invention, are a somewhat more complex source. Tables I–IV are copies from the 13th century BC made from earlier documents of the 15th century BC, and there are originals from the 15th–14th centuries BC, reflecting the preservation of texts with instructions for training horses. But it is possible that the Hittites had earlier similar texts. Only a few technical terms in the texts are Indo-Aryan, there are also Sumerian, Akkadian, Hittite, Luwian and Hurrian terms. Therefore, these texts do not provide grounds for the assertion that it was the Indo-Aryans who were the inventors of chariots.[172] The texts from Boğazköy reflect precisely the participation of different ethnic groups in their gradual development. In any case, these texts are dated 400–500 years later than the first chariots appeared in the Near East, and in the texts, the permanent connection of chariots with the Hittites and Hurrians only emphasizes the local nature of this invention.[173] Therefore, for any localization of the Indo-European homeland, the chariot terminology is not the basis for justifying this. Thus, from the point of view of the Indo-European problem, the terminology for horses, wheeled vehicles and chariots is ambivalent. The presence in the Indo-European languages of a common terminology for horses and wheeled vehicles, as well as the absence of a common terminology for chariots, spokes, felloe and bridles,[174] fits well into the chronology of these achievements and the chronology of Indo-European migrations from the Near East.

6. Conclusion

The above facts allow us to propose new scenarios for the domestication of horses and the invention of chariots. In the first question, there was previously an unjustified consensus that this happened in the steppe, and from there horse breeding spread to other areas. However, we must proceed from a possibility that the domestication of the horse could have taken place in different areas where the wild species of this animal lived, and where cattle and sheep breeding existed before, since pastoralists could experiment with new species. The area of wild horse distribution includes Europe, the Eurasian steppes, Transcaucasia, Anatolia, the southern Levant and northern Iran. The time interval for this is the 4th–3rd millennia BC, since only from the 2nd millennium BC may we talk about horse breeding as a significant part of human life. The preceding period can be considered a time of trial and error, and in different regions different scenarios of these attempts could be realized, which by no means always ended in success.

We may even admit that horse hunters in Eneolithic Kazakhstan made attempts to domesticate young foals, and even used them for riding, but the final domestication was hampered by the lack of productive economy, of needs and by the psychological characteristics of horses, which prevented them from achieving a stable result.

We do not have data on the domestic horse in the Eneolithic, EBA and MBA in the Ponto-Caspian steppes, but the presence of horse remains in the Maikop Culture allows us to assume that horse breeding penetrated from the south into the steppe with this culture, and then remained in the steppe pastoral cultures of the Bronze Age, since it is difficult to assume that the horse was a specialized hunting species in these cultures. It is possible that some horses were used for riding to provide grazing of herds, although we cannot yet confirm it with reliable facts, as we cannot yet determine whether the EBA horse was tamed in the steppe or was brought in a domesticated form from the south by the bearers of the Maikop Culture. Both options are possible.

170 Moorey 1986, 197, 198. – Teufer 2012, 276, 301.

171 Ivanov 1999.

172 Raulwing 2005.

173 Littauer, Crouwel 1979, 71.

174 Burmeister, Raulwing 2012, 97, 98.

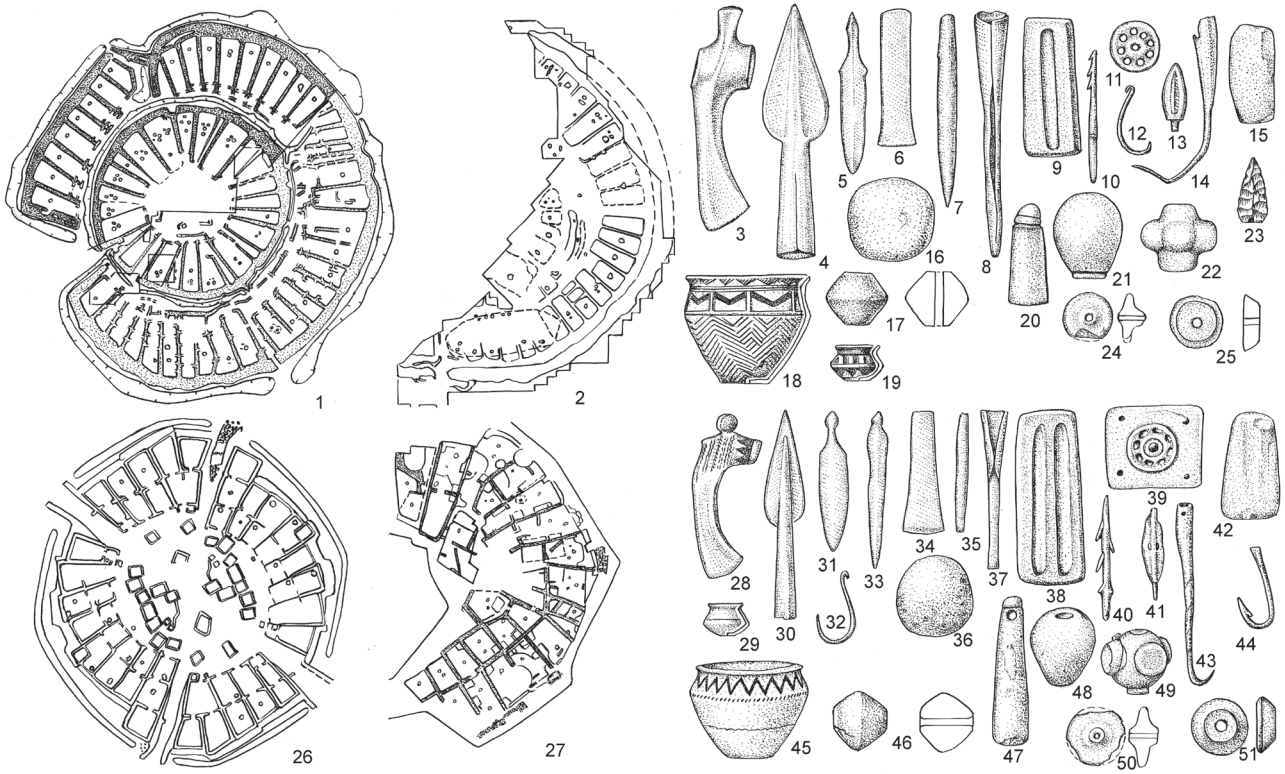

Fig. 9. Sintashta fortified settlements and artefacts (1–25) and their analogies in the Near East and Caucasus (26–51). – 1, 9, 11, 14. Arkaim. – 2, 3, 5, 6, 12, 13, 15–21, 23–25. Sintashta. – 4, 22. Kamenniy Ambar V. – 7, 8. Tyubyak. – 10. Bolshekaraganskiy. – 26. Demircihöyük. – 27. Pulur. – 28. Kumbulta. – 29. Tell Mardikh. – 30. Esheri. – 31. Ur. – 32, 44, 49. Susa. – 33, 34. Gaza. – 35. Calicaköyü. – 36, 42, 46, 47. Demircihöyük. – 37, 41. Alaca Höyük. – 38. Malatya-Arslantepe. – 39. Kültepe. – 40. Tell ed-Dab'a. – 43. Kirovakan. – 45, 50. Hama. – 48. Nahal Mishmar. – 51. Arich (after Grigoriev 2018, Figs. 2–3, modified by O. Orlova).

Based on the data available today, the possibility of domestication in Europe cannot be ruled out.

Another area of domestication could be Anatolia and Armenia, and another scenario could take place here, when in the mid-4th millennium BC the horse began to be used as a pack animal. The need for the transportation of goods in this economically developed region was quite high. In mountainous terrain, this gave advantages over carts drawn by bulls. However, horses' hooves wear out under such loads, so their use was not developed. There was no spread of this tradition to the neighbouring regions of the Near East, where the use of donkeys as a pack animal spread. Probably, after some time (if this really took place and the bone pathologies discussed above are evidence of such use) with the spread of other equids, such attempts were stopped. Moreover, some other explanations for the signs of domestication observed here are not excluded. We discussed above that in order to use horses as a pack animal, it was necessary to have this goal and to undertake long-term breeding work. It is impossible to take a wild horse and simply train it to work in this way. Consequently, this problem needs to be explained in some way. The optimal animal for the Mesopotamian trade was the mule. This became the main stimulus for horse domestication in the Near East. The peculiarity of this hybrid is sterility, which forced breeders to keep horses in captivity.

At the same time, since the 4th millennium BC, in the Near East there is a smooth and technologically logical development of wheeled transport, which was necessary for broad trade relations, but, above all, to provide agriculture and facilitate communication of the agricultural areas with growing cities.

The use of equids for harnessing to carts as well as the practice of crossing donkeys with onagers and horses, which made it possible to obtain hybrids more suitable for these purposes, could become fundamental for the development of horse breeding in the Near East. It was widely spread in the 3rd millennium BC, when two-wheelers appeared, more adapted for harnessing equids, although at first they were probably used with bulls. Undoubtedly there were attempts to tame onagers and horses and use them in vehicles, but this was only possible with horses. In any case, it was probably

here the 'chariot' horse (in Kosintsev's terms) was bred in the 3rd millennium BC. A hypothesis about importing horses from the steppe zone for this purpose can be excluded. These were events of Near Eastern history, although we do not know how and where exactly this happened. This process is reflected in the gradual evolution of the harness system, when in the early stages that type of harness was used which was typical for bovine harnessing, and then variants appeared, increasingly adapted for harnessing equids.

All this becomes the basis for the invention of chariots. The chariot is a complex system, consisting of many elements: two-wheeled carts, spoked wheels, horse harness, the availability of appropriate technologies for the manufacture of bent wooden parts, trained horses with specific qualities, in some cases a composite bow and the corresponding types of arrows, the need for its use in military affairs. An instant appearance of this complex is impossible. Each of its elements had to undergo not just a logical evolution; it had to be the evolution of the entire system in which all these elements were interconnected, and this evolution had to be conditioned by the socio-economic and political needs of society, and a tradition of using wheeled vehicles for military purposes. In steppe Eurasia, this complex appeared unexpectedly, in a fully developed form, and we cannot trace the evolution of any of its components here. Moreover, there were no socio-economic conditions not only for the emergence of this phenomenon, but also for its existence. It is no coincidence that we see its appearance with the Sintashta Culture and its gradual disappearance after its end. It is also important that this was accompanied by the emergence of the Anatolian type of architecture, metallurgical traditions, etc. (Fig. 9).[175]

It is necessary to understand that not only the spread of such a complex system as a chariot, but even horse breeding presupposes physical bearers, since it entails not just a dissemination of knowledge about the object, but the dissemination of a series of complex, interconnected practical skills, including veterinary ones. If we look at the problem more broadly, we see that gene flows in Eurasia quite accurately coincide with the spread of culture and genes from the Near East in various directions. There were no reverse flows.[176] Therefore, the appearance at Acemhöyük of horses genetically close to those in eastern Europe was not accompanied by the coming of people from eastern Europe, and solution of the problem needs further studies. Particularly noteworthy for our discussion is the presence of Anatolian DNA in the Sintashta population.[177] These people could replenish their herds with local wild horses. Accordingly, we may consider the spread of horse breeding, wheeled transport and chariots only within the framework of these processes, and the Near East was the heart of these innovations.

It is more difficult to choose a specific area in the Near East where these innovations originated. For wheeled vehicles, Mesopotamia is a generally accepted candidate, but Europe is not excluded. The situation with horse domestication is more complicated. Attempts may have taken place in different areas, the earliest documented in Anatolia, northern Iran and Armenia. But these attempts were not successful due to the biology of this animal and the absence of urgent economic needs. Therefore, the best candidate is Syria, where we have evidence of the hybridization of equids and their use in carts, but it could be some other region; this is just one of the possible scenarios. We do not have strict evidence on the origin of this horse, but the import of horses from the eastern European steppes can be ruled out. People who crossed donkeys with onagers could not hear about the existence of horses in the Eurasian steppes and order them from there. It should be understood that with the further spread of horse breeding and chariots to other areas, local wild horses could be included in this process. Probably, genetic studies of osteological remains will show this.

Syria and southeast Anatolia are the best places for the invention of chariots. However, the earliest evidence of their existence is presented by eastern Iran, for which we unfortunately lack facts about the presence of horses at this time. Therefore, ultimately, these innovations were born in the Near East, but we cannot determine a specific area, due to the limited facts relating to the early stage.

All this is closely related to the Indo-European problem. Since a word for horse (most probably wild) existed in the Proto-Indo-European languages, the presence of horses in Transcaucasia, northern Iran and Anatolia is fully consistent with linguistic data. Another fact used is a common word for 'wheel' with an individual variant in Anatolian dialects, which also corresponds to this picture, since the main migrations of Indo-Europeans from this region began from the 4th millennium BC. However, one should not equate the spread of Indo-European languages and the spread of horse breeding, wheeled transport and chariots because of this. It often coincided, but these innovations were common to the population of a broad region inhabited by speakers of different languages.

175 Grigoriev 2002.

176 Grigoriev 2021b.

177 Mathieson et al. 2015, Extended Data, Fig. 2.

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