Part III

Interpretations of Eurasian Archaeology
The Bronze Age

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Bronze Age Textiles of the Caspian Sea Maritime Steppes

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Abstract
Textile goods played an important role in the culture of many Eurasian peoples. New methods and new data concerning ancient textiles allow us to study the textile goods produced by the Eurasia nomadic population of the Bronze Age (third–second millennium BC). The specific area of our study is the Kalmyk steppe, and the general region is the Black Sea and the Caspian Sea maritime steppes, the Ural region, and the northern Caucasus region of the Eurasian steppe belt. We identified and classified sources that included 50 objects. This was followed by technological analyses that included identifying and studying the textiles and their structure; determining the type of fiber used for yarn; the type of twisting; the type of thread spinning; the structure of the sample; and the type of thread weave. The analysis of the raw materials base provided indisputable evidence that plant and wool fibers both were used during the Bronze Age. A comparison of archaeological finds with the components found on historical and ethnographic looms helped establish the types of weaving devices used in prehistoric times. Finally, it became possible to characterize the significance of textiles within the context of steppe cultures, not only in the everyday life, but in ritual practices as well.

Key Words
textiles, nomads, Bronze Age, Eurasian steppe

Introduction
The economies of the cultures of the west Eurasian steppe were strongly affected by local ecological and natural conditions, particularly during the Bronze Age. The steppe changed ecologically from the third millennium BC onwards, and an economy of mobile herders evolved. This shift in economy was accompanied by the gradual development of a new mode of life and new technologies, which were directly linked to the economy. Recent studies of bone and wood working, pottery manufacturing, and metallurgical production in this region has allowed us to evaluate the skills which typify the Yamnaya (Pit-grave), Catacomb, Srubnaya (Timber-grave) and other Eurasian cultures that lived in the steppe (Remeslo 1994; Chernykh 1997). Such studies present a new perspective on the development of the new type of economy, i.e. a system of mobile pastoralism. This perspective reveals the relationships that existed between the individual elements of this system, and the identification of these links increases the significance of all sources. In addition, in a number of cases it has been possible to identify previously unknown aspects of these cultures. The textiles originating in sites located within the Eurasian steppe belt are an understudied economic commodity. Textile goods played an important role in the culture of many Eurasian peoples (e.g. **Tayzhanova** 1995; Zhitetsky 1893). Historical studies have indicated that textiles had not only an everyday, but also a social and religious role in these societies.

While scholars became aware of the existence of Bronze Age textiles as early as the beginning of this century (Gorodstov 1910), an almost complete absence of textiles from either burial or settlement sites made their study (an organic material) difficult. Very often the only evidence for the existence of various weaving or plaiting types was the tools associated with textile technology, or imprints of textile goods on ceramics. This information has contributed to our understanding of ancient weaving, but scholars limited their studies to the analysis of certain types of archaeological goods thereby linking the latter with a series of technological operations (e.g. Glushkov and Glushkova 1992). The current diversity of opinions which exists concerning the methods used by the Eurasian peoples to weave and plait their cloth is indicative of the active research in the field. The authors believe that each study conducted to achieve this objective has greatly contributed to the identification of the origin of this ancient technology.

New methods and new data concerning ancient textiles has enabled us to return to the study of the textile goods produced by Eurasian groups. The region of our study is, in particular, the Kalmyk steppe, and in general the Black Sea and the Caspian Sea maritime steppes, the Ural region and the northern Caucasus

region of the Eurasian steppe belt. The borders of the research area have been determined to a large extent by the geography of the collections curated at the State Historical Museum in Moscow.

In order to assess the role of woven and plaited materials in the economic system of the Bronze Age nomads of the Eurasian steppe our research design included technological analysis, ethnographic comparisons, information on the types of raw textiles, the analysis of local and regional paleoecology, and historical reconstruction. The archaeological data includes: (1) fragments of mats and cloths found in Bronze Age steppe burials and settlements, and imprints of cords, bands, and woven cloth present on ceramics, and house and grave floors, and (2) preserved components of weaving tools. The role played by textiles in the funeral and domestic contexts of the Bronze Age nomads is also reviewed.

Objectives of the research

The objectives of the research were as follows:
(1) To identify the source of genuine textiles and mats recovered from graves;

(2) To analyze major technological characteristics of the textiles and closely related goods made of non-fiber materials. This aspect of the analysis including the determination of the types of fiber used for making yarn; the method of twisting; the method of thread spinning; the structure of the sample, and the identification of the method of weaving the thread;

(3) To determine the technology of textile dyeing;

(4) To reconstruct possible types of textile devices which could have been used for making textile goods of classified types;

(5) To correlate preserved components of weaving tools with hypothetical textile devices;

(6) To study ethnographical textile devices and determine their correlation with preserved archaeological components of weaving tools;

(7) To determine the role played by textiles in the funeral and household practices of Bronze Age nomadic economy.

Archaeological data

A total of 59 archaeological samples recovered from the burials (two samples came from settlements) of the Bronze Age Eurasian steppe nomads were included in the analysis. These materials have been attributed to textiles and have been categorized in the following groups: (1) impressions and imprints; (2) fragments of "real" textile goods; (3) fragments of mats; (4) heavily mineralized textile goods, and (5) samples which are disputable as textile remains (Orfinskaya *et al* 1999). It is now possible to provide a detailed analysis of textile goods recovered from the burials of the Yamnaya (Pit-grave), Yamnaya-Catacomb, northern Caucasus, Catacomb and other cultures of the Eurasian Bronze Age.

(1) Impressions and imprints
Firstly, the imprints of mats and cloths apparent on clay pots were analyzed (Figs. 1 and 2). Many scholars have noted that simple cord and double cord ornamentation on pottery became a typical element of steppe decoration starting from the Early Bronze Age. The earlier Khvalynsk Culture (Eneolithic period) of the Volga region had impression ornamentation that was not only made with the help of a cord, but also with the use of a genuine woven cloth. A number of examples indicate that the cloth was decorated with embroidery, or had been obtained by twining the weft all across the warp based on the "backstitch" principle. Textiles with a twined warp were also used to decorate ceramics of the Bronze Age Yamnaya Culture (Fig. 1). When decorating a vessel of the Yamnaya Culture, a narrow cloth band – which was sufficiently soft to be folded – was used to imprint a pattern on the exterior surface of the still damp clay. Mat and cloth imprints have also been found on the bases of vessels of the Bronze Age culture of the northern Caucasus, for example, from the Bamut burials. Sackcloth of a plain weave or a cloth with a twined warp has been recovered from one of the Bamut burials, while another of these burials contained a knotted fabric (Fig. 2). Imprints of multi-row cloth band and cord impressions are the characteristic ornamentation used on Catacomb Period (Middle Bronze Age) ceramics. Imprints of plaited mats on the bases of large turnip-shaped Catacomb Culture vessels provide evidence of the structure of these mats. Apparently, during the manufacture of the ceramics, the unbaked vessels were placed on plaited mats or sack-type coarse cloths to dry and, consequently, the imprints of these mats are clearly preserved on the exterior aspects of their bases.

(2) Fragments of "real" textile goods
The second stage of the analysis involved the examination of real cloths, which were recovered from Bronze Age graves. It is very important to note that the Novosvobodnaya and Maikop textiles of the Early Bronze Age were manufactured from plant fibers; substantial evidence also exists to indicate that wool fibers (Fig. 3) came into use in the steppe during the Middle Bronze Age (latter half of the third millennium BC). As for the technological reconstruction it is possible to state that these cloths comprised twined and plain weave, a finding which may be indicative of the use of different types of weaving devices.

(3) Fragments of mats
The next step in the investigation involved the analysis of mats retrieved from graves (Golyeva 1999). The objective of the analysis was to determine the type of fibers that had been used in the production of the mats. Well preserved mats are only occasionally recovered from burials, and these mats include those in which it is possible to see the woven pattern of fibers, the fibers are clearly morphologically distinguishable, and are easily separated one from another. Such mats provide the greatest amount of information, since it is also possible to identify the plant materials used for their manufacture. It is also very important in these cases to be able to determine if several different plants (e.g. cereals, sedge, dicotyledon grasses, or branches of bushes and grasses) were used to create a mat. Two well-preserved textile mats found in Catacomb Culture burials of the Eastern Manych River have been studied. The analysis of the microstructure and separate plant filaments apparent in the mats has made it possible to identify the nature of their

manufacture, and define which plants were used. One of the mats is woven with the use of fine twisted plant reed fibers, and the phytolith of this plant has been identified (Fig. 4). The second mat is made of thick fibers. A visual study has not identified any differences in the structure of the individual fibers, but a microscopic analysis has shown that the textiles are made of two types of plant fibers. In some cases uniform thick fibers were used, while in others several fine fibers twined together were used. Since their structure is the same (reed mace), the differences in the fiber quality can be explained by the fact that various threads were used to weave the mat.

Semi-decayed mats are frequently recovered from graves (Fig. 5). In these cases it is not possible to define the type of weave - even its very presence is unclear - but it is possible to identify separate plant fibers. As plants decay in natural conditions at a different rate, the whole substance under investigation is heterogeneous in terms of morphology. This situation means that if different plants were used, some of them could have been completely mineralized and decayed, thereby making their identification impossible (Fig. 5d). This finding means that there may be some losses during the definition of plant diversity. The situation is dependent on the specific plants that were used. A comparative and morphological analysis of the plant's anatomy is possible for preserved sectors, and one should also undertake the analysis of phytolith, pollen, and plant detritus (the reinforcing, mechanical plant tissues).

(4) Heavily mineralized textile goods
The majority of materials discovered during excavations belong to the category of completely decayed substances (Fig. 5 a–c). Macromorphologically, this type of mat is defined as a dark, in some cases, completely black layer with a thickness of several millimeters which overlies the soil surface and is located in the vicinity of a skeleton. No separate fibers are distinguishable, and the substance itself cannot be easily attributed to plant type. In this case the comparative and morphological method is not efficient since the extent of decay is so high. Phytolith, pollen and detritus analyses will provide most information. This complex of analyses will enable a clear definition of the genesis of the material (plant or animal) and, to a certain extent, which materials were used in its manufacture. This system of analysis was undertaken on a highly decayed mat retrieved from Burial 1 of Kurgan 8 at Zunda-Tolga.

When the mound was removed a series of wooden boards were uncovered and a decayed plant substance was found to be lying both on the boards and around the walls. A scaffold, which had been entirely covered with a decayed mat that differed from the surrounding surface in color and density, had been placed in the bottom of the burial pit. Analyese of the samples revealed the presence of phytoliths and fine fragments of cane detritus, while a sample retrieved from the bottom of the burial pit contained reed phytoliths (Fig. 4). It would appear, therefore, that the facing of the walls and the upper part of the said burial had been made from cane mats. In addition to cane, reed had been used to make the mat recovered from the surface of the scaffolding.

(5) Samples that are disputable as textile remains
In some cases it is possible to predict that a mat would have been present, for example, in a burial. The complete mineralization of plant material occurs in certain environments, which means that morphologically a mat is not identified within the burial. In the past, the occurrence of a mat in this location was based on evidence derived from analogous burials where such mats were found. The use of a complex system of analysis—phytolith, pollen and plant detritus—allows us to define the presence or absence of a mat, and identify the plants that had been used in its manufacture.

During the excavations of Burial 1 of Kurgan 2 at Zunda-Tolga a cenotaph without any signs of a plant mat in a supposed burial place was uncovered. A "grid" method was used, whereby a grid was created on the floor of the grave, and samples were taken from each of its corners. Further studies have allowed us to conclude that plant matter, which consisted only of flowering wormwood stems, was restricted to the center of the burial chamber. Considerable differences in the pollen record for the grave have enabled us to conclude that plants were deliberately placed and oriented within the grave, but that plant mats were not present on the grave floor. Therefore, the existence of textiles in steppe burials provides evidence that textile goods played a significant part in the funerary rites of the steppe peoples throughout the Bronze Age.

Paleoecological investigations

By adopting an "ecological approach" to the research problem through the reconstruction of local paleolandscapes, the identification of plant types, and the evaluation of their use in plaiting and weaving, it was possible to reach a very important conclusion. Analysis of the raw material base provided indisputable evidence that plant fibers which were typical for the preceding Neolithic Age continued to be used in the steppe during the Bronze Age. Phytolith analyses of mat and textile fragments, and the identification of a wide use of plants including reeds and reed mace for ancient weaving, provided evidence that indicated that plant fibers played an important role in ancient steppe textile technology.

Tools used in textile manufacture

The study of the associated archaeological artifacts was another important aspect of the research design. A comparison of archaeological finds with components of historical and ethnographic looms helped establish the types of weaving devices that were used during prehistoric times (Barber 1991; Rutschowskaya 1990). Components connected with other operations (e.g. fiber combing and plaiting) also provided indirect evidence for the types of fibers that were used.

Analyses of the tools associated with weaving and plaiting, including spindle whorls, needles (Fig. 6d), spools (Fig. 6c), combs (Fig. 6 a, b) and loom parts (Fig. 6 e–g) was also undertaken. These elements, plus the technological analysis of cloth fragments and cloth and mat imprints, enabled the reconstruction of the weaving devices that could have been used by the Bronze Age cultures which inhabited the Eurasian steppe.

It is clear that textile goods were made both by weaving and plaiting from the earliest occupation of the steppe. The study of artifacts suggested that primitive weaving devices had appeared on the steppe as early as the Eneolithic period. The earliest "looms" comprised a horizontal or a vertical frame (Fig. 7a) that was used to hold the warp threads stretched and rigid, and a rectangular placket was used for separating threads. Classical looms appeared as early as the Yamnaya Age, and these consisted of a frame, a thread separator and a device for making a second loom shed. Looms of the Catacomb Culture were more diverse, and in the majority of cases the loom appears to have been a primitive weaving device that consisted of a horizontal placket, was held rigid on vertical pillars, and had warp threads that were not held rigid. Similar looms also existed that already had a device for holding warp threads. Other types of looms (Fig. 7 b, c) included a simple loom with a horizontal or vertical frame and a variety of types of thread separators. Classical looms had reeds, planks, or rings that were used to create the second shed. The use of these devices enabled the steppe peoples to manufacture cloth with a plain weave and a twined warp.

Raw materials

The evidence indicates that plant fibers were the major raw material used for making the earliest textiles on the steppe. The use of wool as a major textile material on the steppe began during the Middle Bronze Age. Its fiber collection and treatment was a carefully considered operation, and the remains of tools associated with wool collection and processing have been recovered from the burials of both men and women. Over time other devices were used for these purposes, such as combs and needles.

Weaving techniques

We can make inferences about the techniques of weaving which were employed on the basis of preserved textile goods and their imprints on ceramics. Simple looms of a horizontal or vertical type were initially used and, at a later stage additional devices, including planks, heddle frames, reed and woven planks were used in the weaving process to make narrow textile bands. A more complex method of plaiting plant mats and bands was developed, and special constructions for plaiting seem to have been used. Finishing and dying plain cloths must have been of particular importance, but our study of this aspect of archaeological textiles is in its infancy.

Ethnographical and historical comparisons

Finally, it became possible to characterize the significance of textiles within the context of steppe cultures, not only in the every day life of the people, but also in their ritual activities. The analyses of the textiles were undertaken with a view to determining the levels of adaptation to the different steppe environments; data derived from the history and ethnography of the nomads that lived in the region under investigation during recent and historic times have been used to interpret the archaeological materials.

Ethnographic and historical comparisons (e.g. Zhitesky 1893; Popov 1955; Faegre 1979) indicate that mats were used in the construction of light portable houses, fences (e.g. for cattle), in the manufacture of pottery, and as matting, covers, and beds. Bronze Age steppe people are likely to have plaited these items in addition to baskets, boxes, cases, and, possibly, wagon bodies. Traditionally, woven cloth was used to make clothing and distinctive nomadic gear, including cases, boxes and bags. While the ancient steppe peoples must have possessed felting skills and, maybe, even carpet-making techniques, no definitive archaeological remains which provides evidence relating to the antiquity of these technologies have yet been identified from the steppe region. The results clearly indicate that the early steppe peoples employed many plaited and woven goods in their burial rituals, and they were used not only for decorating the burial pit, but also as funeral clothes, shrouds, and canopies. The similarity of the weaving and plaiting techniques used by the different modern peoples of Kazakhstan, Central Asia and Siberia, with the weaving technology of the Bronze Age steppe peoples provides evidence for the preservation of a traditional technology which has a deep antiquity.

Conclusions

Given our current understanding of ancient steppe textiles, it is quite clear that they played an enormous role in the ability to survive in these environments. In each region, separate cultures made their own contribution to the development of diverse textile technologies, and to some extent, the variation was determined by the natural features of the local ecological niches – including the irregular spread of plants which were suitable for weaving, such as flax and cotton. The spread of the technologies associated with the preparation of wool fibers and their use in weaving occurred at a later stage and was a much slower process. It appears that the mobile mode of life (typical for the nomadic cultures of the Eurasian steppes) did not promote the appearance of bulky weaving devices. While models and parts of primitive and improved horizontal and vertical looms were used throughout the 3rd and 2nd millennia BC in adjacent regions of Europe, Egypt, Mesopotamia, and Asia Minor, we only have evidence for the use of simplified wooden constructions in the western part of the Eurasian steppe. All seven tasks of the analysis seem to be interrelated and, in the long run, the use of this multidisciplinary approach will enable us to learn a great deal about not only the textile technology of the steppe Bronze Age, but also the role played by textile goods in the ancient nomadic cultures.

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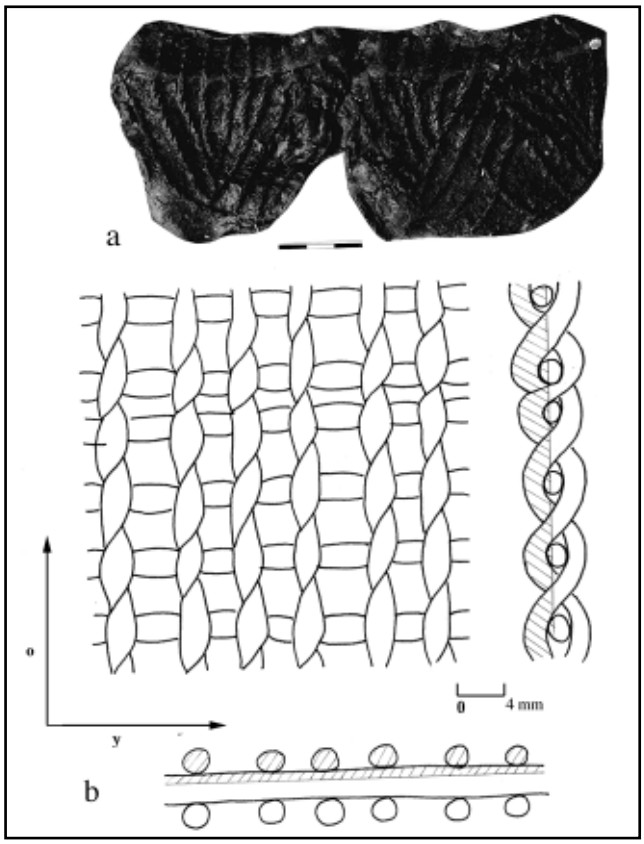


Fig. 1. Yamnaya Culture, Dneprorudny village: a - two imprints of a cloth with a twined warp obtained from a single ceramic vesse; b - diagram of a textile weave.

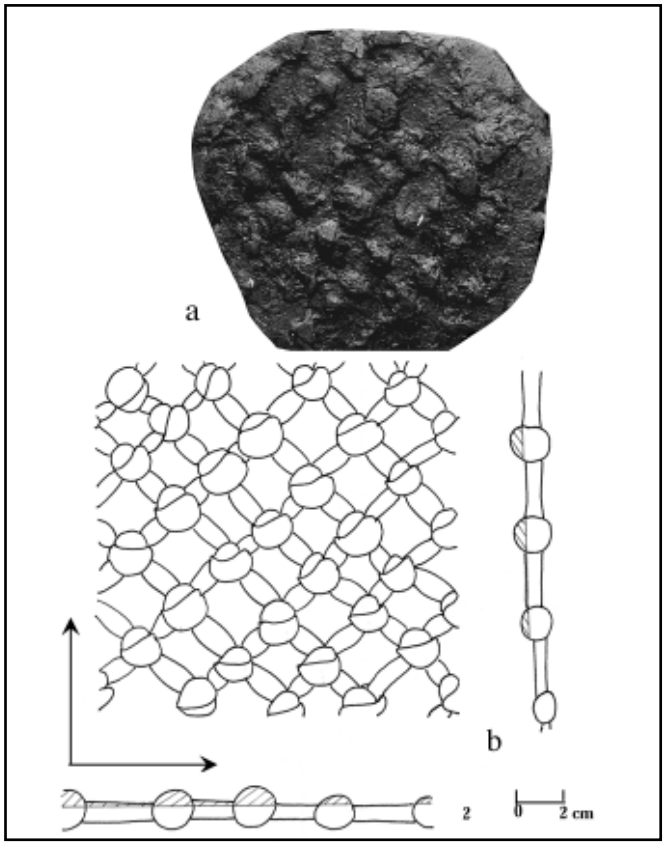


Fig. 2. Northern Caucasus Culture, Bamut Burial Mound: a - imprint of a cloth with a twined warp; b - diagram of a textile weave.

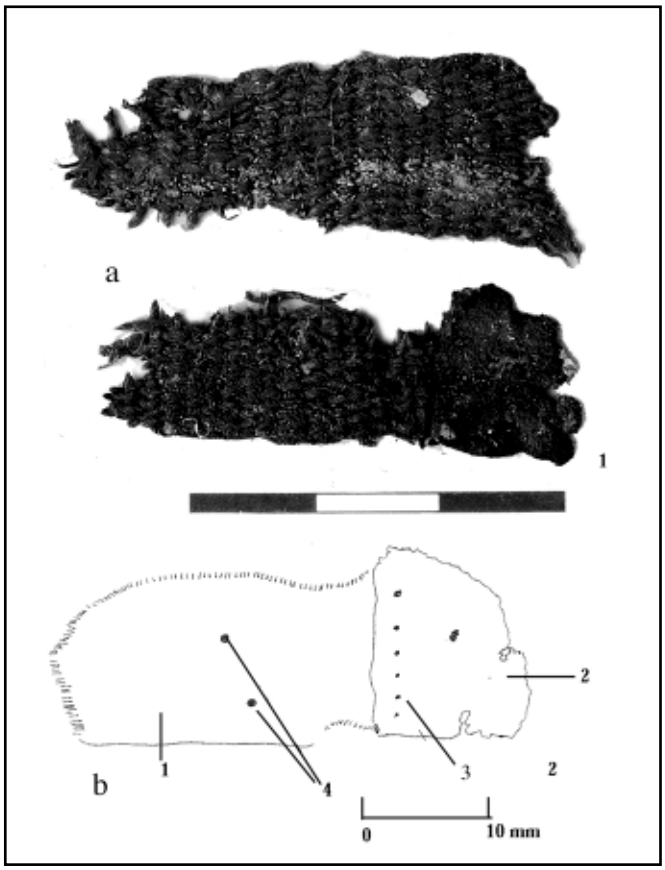


Fig. 3 (left). Catacomb Culture, Vostochny Manych: a - a secondary textile item of a belt type, consisting of a woolen cloth, leather, and "threads" made of non-fibrous material: b - diagram of a secondary textile item of the belt type. (1) woolen cloth with a plain weave (the solid line indicates the selvage of the cloth, and the dotted line indicates the rupture of the cloth); (2) leather; (3) "threads" that join the leather with the cloth; (4) fragments of the "threads" that pass through the cloth that might have been used to attach the sewn parts to the belt.

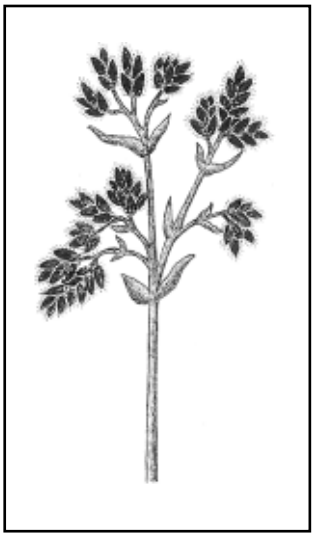
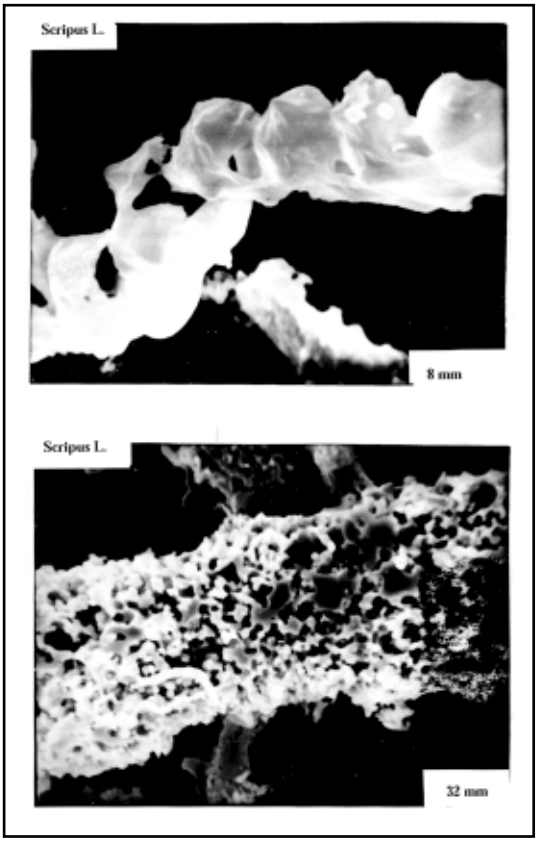


Fig. 4 (right and left). The general appearance and forms of reed phytoliths (*Scirpus L.*).



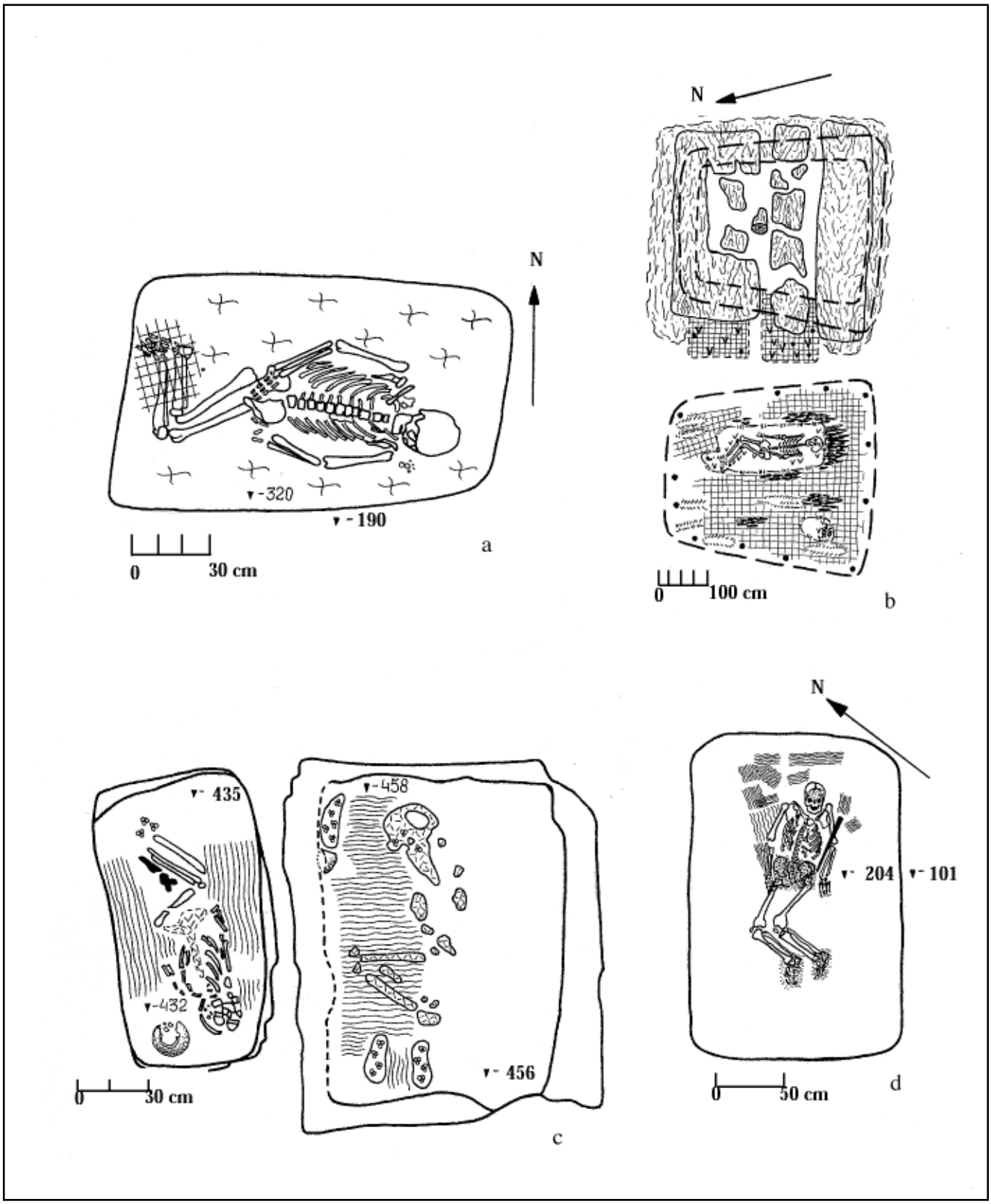


Fig. 5 . Mats. Yamnaya Culture and Yamnaya-Catacomb Culture burials: a - Kalmykia. Burial ground KVCH-56, Kurgan 6, Burial Ground 17 (excavations conducted by N. Shishlina); b - The Ingul Basin. Malozakharyino village, Kurgan 1, -c -) Chernyshevsky Burial Ground, Burials 82 and 85, d - Middle Volga. Kutuluksky I burial ground, Kurgan 4, Burial 1.

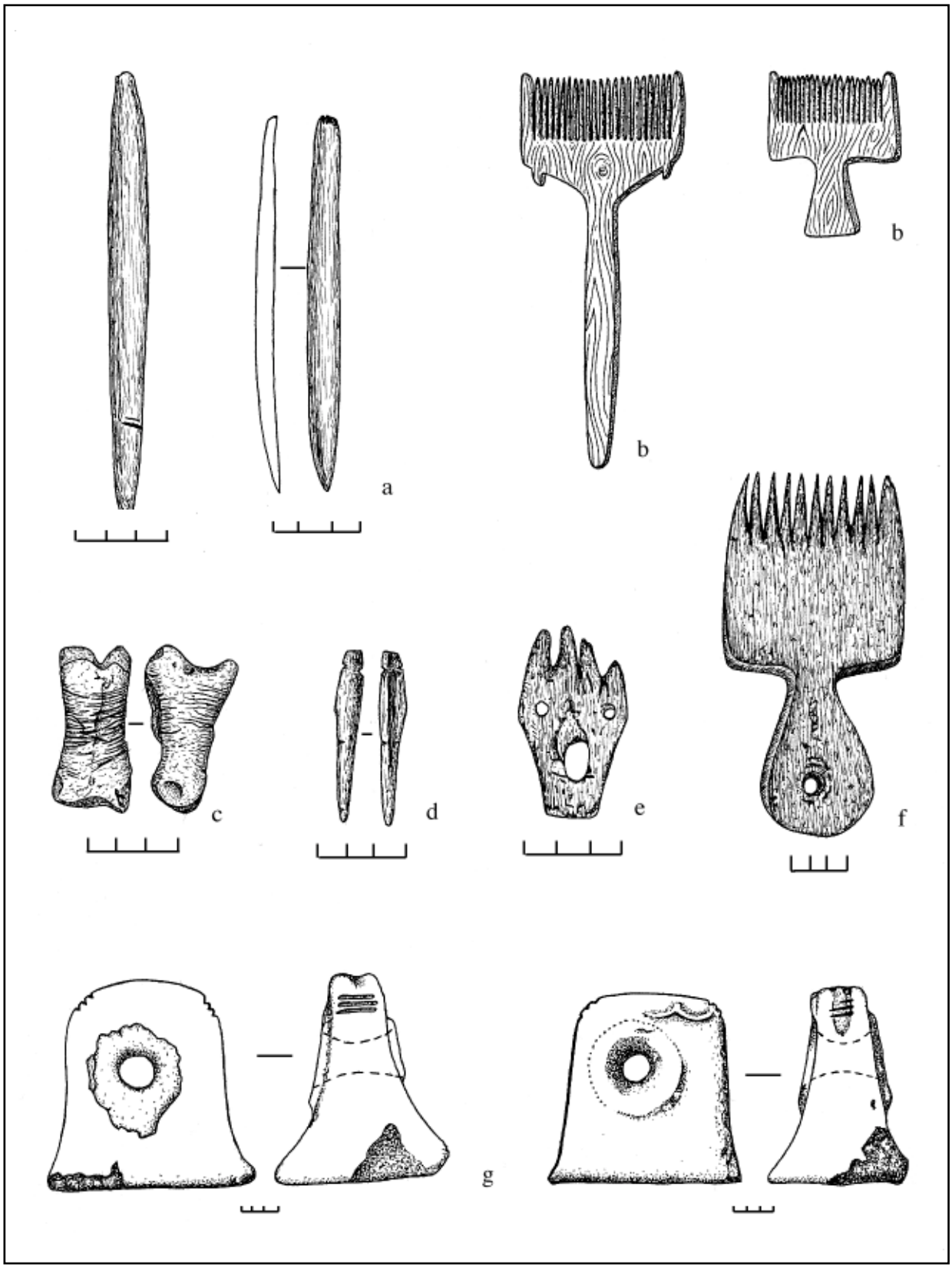


Fig. 6. Textile devices: a - curved awls from the Botai settlement; b - Slav combs for combing fibers; c - spool for winding threads from the Liman settlement, Ukraine; d - needle from the Liman settlement, Ukraine; e - comb from the Arich Burial Ground, Armenia; f - comb from the Uzerliktepe settlement; g - cone loom weights (?) from the Galyugai settlement, northern Caucasus (a and c-f, bone; b, wood; g, clay).

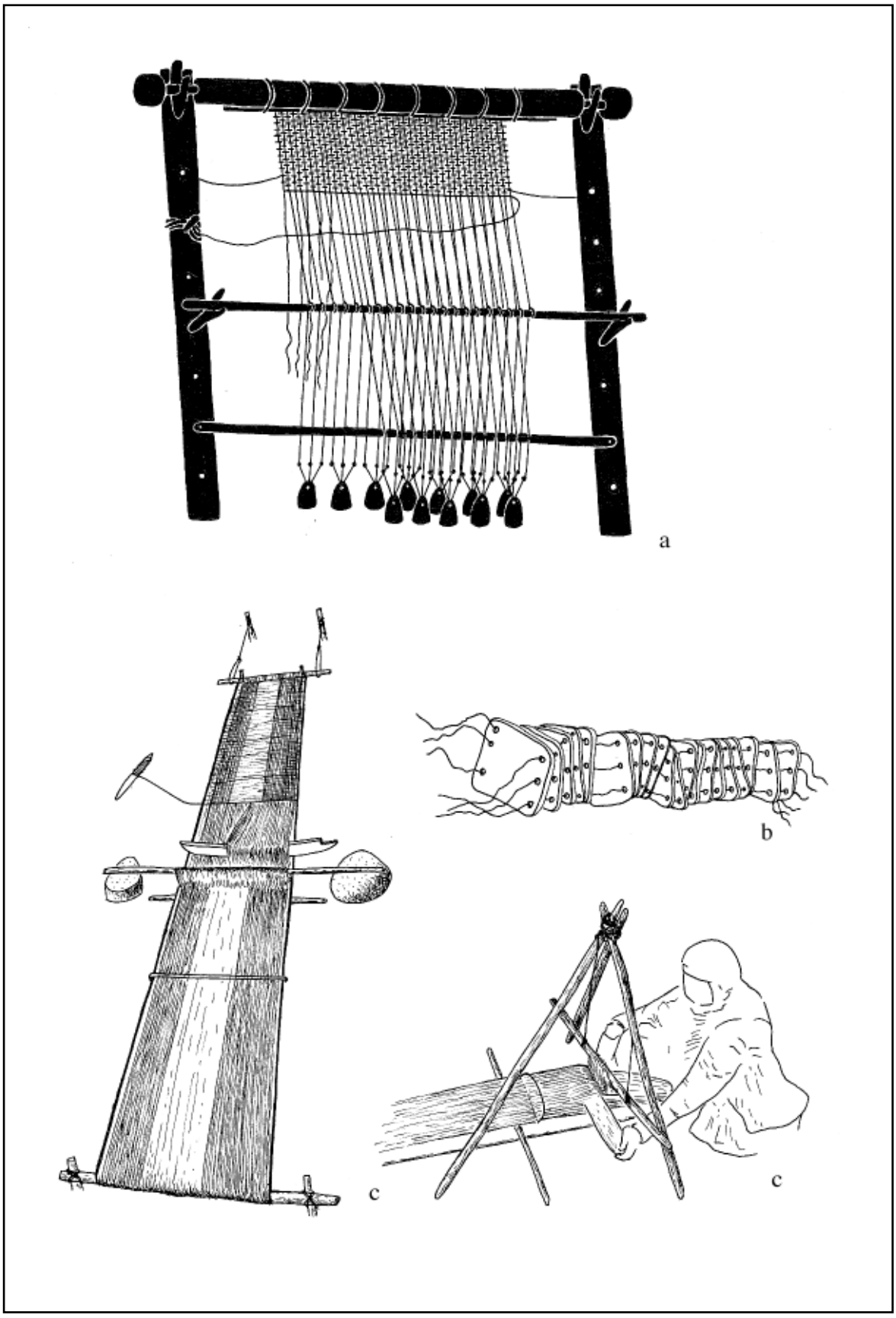


Fig. 7. Loom designs: a - vertical loom; b - planks with six holes for making narrow cloth; c - horizontal loom used in the "black tents" regions. (after Faegre 1979)

The Eurasian Steppes
The Transition from Early Urbanism to Nomadism

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Abstract
In this paper I will discuss some of the disputable problems in the light of recent data relating to the origins and development of pastoral nomadism. Contrary to A. Hausler and M. Levine, I believe that the horse was domesticated in the Pontic-Caspian steppes during the fourth millennium BC. Contrary to the opinions of D. Teleguin, V. Danilenk, N. Shmaglii, M. Gimbutas, and D. Anthony, I am of the opinion that horses were not used by riders for forays into Europe at neither 4000 BC nor 3000 BC. At this time the animal was bred only as a source of food. The period preceding the formation of the Timber Grave and Andronovo Cultures was of key importance and developed from a synthesis of the late Catacomb and Abashevo Cultures. It was also marked by the emergence of proto-urbanism, advanced bronze metallurgy, and the battle chariot. The chronology of this period is quite disputable, but in general covers the third and second millennia BC. However, contrary to Besedin (1966) and Trifonev (1996), following Renfrew (1955), the basis of the chronology that was synchronized with the Mycenaean Culture, is far from a definitive solution. The generally recent dating of the Mycenaean Culture—based upon Anatolian connections—and of European cultures—dated by dendrochronology—probably will modify the dating of this period in the steppes to the 18th-17th centuries BC. The specific steppe environment conditioned the extensive evolution of a complex economy and then nomadism, instead of the development of intensive urbanization.

Keywords
stockbreeding, horse domestication, charioteers, warriors, nomads

Introduction
A considerable proportion of humanity was nomads, or tribes of stockbreeders, with a non-sedentary lifestyle. A number of academics including Toynbee (1935), Brodel (1969), and White (1959) have an understanding of the history in which the nomadic populations played a catalytic role in many of the major historical processes of the Old World. The development of nomadic societies is, therefore, of major importance to our understanding of the dynamics of the past, yet a number of aspects relating to this process are still the subject of much dispute.

The problems of horse domestication
Over thousands of years the Eurasian populations developed their economy based upon the changing ecology of the steppes in conjunction with contacts established with the land-tillers of the Danube area (Kuzmina 1994; 1996). During the Late Neolithic period, an economy that concentrated on the stockbreeding of cattle, sheep, goats, and pigs extended from the Danube to the Pontic-Caspian steppes.

Sites of the Chalcolithic period (fourth millennium BC) have been found to have high proportions of horse bones in their osteological assemblages. During the 1970s archaeozoologists recognized the steppes of southern Russia as a center of horse domestication, and from this region the practice spread to the land-tillers of the Dnieper and the Danube (Biblikova 1967; 1970; Zalkin 1970; Bökönyi 1974). The prerequisites for horse domestication included the existence of wild horses in the steppes, knowledge of a stockbreeding economy, and requirements for food. A number of recent researchers have disputed the development of horse domestication during the Chalcolithic period (Levine 1990; Uerpmann 1990; Häusler 1994). Their arguments do not appear convincing, but the decisive word in this dispute can be that of the palaeozoologists, and most recognize the steppe horses of the Chalcolithic period to have been domesticated animals (Petrenko 1984; Beneke 1993; Bökönyi 1994). We can also add such evidences as (1) artistic images of horses including those with bridles; (2) ritual burials of horse and bull heads and legs in the necropolii of Syeszhaya and Khvalynsk, indicating that these animals played an important role in mythology and the formation of cult (Kuzmina 1977).

The nature of early horse exploitation
The occurrence of butchered horse bones testify that these animals were exploited for food. This was the initial stage of domestication, according to Bökönyi (1994). The hypothesis that the secondary use of the horse was for riding fighters in the Chalcolithic is not acceptable. Kozshin (1970) interpreted perforated horn objects recovered from Afanasevo Culture sites in Siberia as riding bits, but a number of scholars, including Gryaznov disagree with this interpretation. Danilenko and Shmaglii (1972) and Telegin (1973) have interpreted similar artifacts from Dereivka (Srednii Stog), and declared that the steppe horsebreeder warrior-riders had launched distant military raids. Gimbutas (1990), who received her internship in Germany, and in turn became anti-Soviet (Häusler 1996), wrote

about aggressive warriors invading European farmers with fire and a sword, thus attaching a political character to the study. Recently, Anthony (1986), Anthony and Brown (1991), and Liehardus (1984) have revived the hypothesis of militant riders.

The riding of horses by warriors of the Chalcolithic period has been already contended (Kuzmina 1977; 1994). Some European cultures, including those that were not familiar with the horse (Dietz 1992) as well as those in China (Komissarov 1980), have produced a number of bone objects that were similar, and according to ethnographic analogies, they may be compared with tools for uniting knots or weaving nets. This interpretation corresponds to the information obtained for fishing in Dereivka and Switzerland.

It would have been possible for herders to ride horses using a leather bridle without a leather bit, but it would have been impossible for warrior riders to maintain control of their horses without a bit. The nomadic lifestyle of the early horse breeders, moreover, is refuted by the existence of settlement sites with evidence of pig husbandry. In addition, no clear evidence exists that reveals mass migrations of steppe peoples to the Danube.

The spread of wheeled transport

The dissemination of wheeled transport was the main precondition that led to the formation of a mobile form of stockbreeding. lsbizer (1993) recorded the presence of approximately 250 burials that contained the remains of carts in the Novosvobodnaya and Novotitarovskaya cemeteries; these cultures are characteristic of the Kuban and Pit Grave Cultures in the region that extends from the Dneister to the Urals. These graves have been dated to the second half of the third millennium BC (Mallory and Telegin 1994). The vehicles appear to have been adopted from the Danube and Caucasus regions; most of them would have had four solid wheels, and would have been pulled by a pair of oxen. Contrary to the opinion of lsbizer (1993), however, the remains of two-wheeled vehicles and models of the latter have been recovered from a number of burials.

A deterioration in the ecology of the steppes (Kremenetskii 1991; Spiridonova 1991) encouraged the widespread adoption of the cart as it enabled populations to settle in new areas, and thereby helped alleviate problems of overpopulation. The appearance of ochre in graves in the Danube and Carpathian regions is indicative of the beginnings of contacts with copper ore producing regions. In addition, copper was necessary for the manufacture of carts. The use of carts for transport, and copper tools for their manufacture, resulted in the tribes of the Pit Grave Culture developing a specialized form of stock-breeding that became the most suitable form of economy for the steppe environment. This innovation represents the earliest adoption of this form of economy in the Old World.

Metallurgy, chariots and fortifications

A crisis occurred involving the Carpathian metallurgical center (Chernykh 1978) and thus it became necessary for the tribes of the Pit Grave Culture to master the local metallurgical deposits at some time between the third and second millennium BC. The largest of the local ore deposits was situated at Kargaly in the southern Urals (Chernykh 1993; Morgunova and Krazov 1994). Progress in their own metallurgical industry initiated the development of the most important cultural inventions characteristic for the Sintashta sites. Intensive metalworking resulted in a change from the forge technology to one in which casting was undertaken in closed molds. The new technique resulted in the mass production of a number of new tools and weapons including axes, chisels, spears, and shafted arrowheads (Grigoryev 1994). Increasing progress in metallurgy was also connected to the development of warfare; this theory is supported by burials containing the remains of warriors, weapons, and pieces of ore (e.g. Kamennyi Ambar, and Bestamak). Pairs of horses (which in some cases have shield-shaped cheek pieces), in addition to the imprints of wheels with 10–12 spokes have been recovered from a number of Sintashta Culture burials. These findings should be considered as evidence for the use of horse-drawn chariots for warfare purposes (e.g. Sintashta, Kamennyi Ambar, and Soinze II in the Urals; Ulubaj, Berlik II, Bestamak in northern Kazakhstan, and Satan in central Kazakhstan). Horse bones associated with shield-shaped cheekpieces have also been found in sites of the Potapovka Culture in the Volga region as well as in the related complexes of the Don and Seversky Donetz regions. Apparently, at this time fighting techniques, based on the use of chariots, had become the most important invention in warfare.

The struggle for ore deposits in the Urals resulted in the construction of fortresses in areas where large-scale metalworking took place. Using information derived from military aerial photography, the geologist, Batenina (1935), identified a number of these fortresses during the 1960s. A complex of 17 fortresses was discovered in the southern Urals in the region of Magnitogorsk, Troizk, and Orenburg. Excavations have been undertaken at the settlements of Sintashta, Arkaim, Ustje, Kujsak, and others (Genning et al 1992: fig. 1; Zdanovich 1995; Vinogradov 1995; Malutina et al 1995). The distance between the fortresses is approximately 40–70 km. In general, the walls of the fortresses were constructed from wood and earth, and in a number of cases, they were strengthened with stone slabs (e.g. Olgino, Alandskoie). The walls were constructed so that they formed an oval, ring, or square, and they were invariably surrounded by a moat. In some cases, evidence for rebuilding a fortress wall has been noted. The Arkaim site has two rings of defensive walls and moats in addition to an entrance gateway. The internal area of the fortresses generally displays a regular plan that was subdivided by radial or perpendicular streets. Evidence for the occurrence of metalworking has been recovered from the interiors of all the excavated fortresses.

The discovery of "country of proto-cities"[1] is not an unusual finding as earlier, smaller but similar constructions, are known from northern Kazakhstan that belonged to the Petrov Culture settlements (e.g. Petrovka II, Novonikolskoie, and Bogolyubovo) (Zdanovich 1988), and in the Urals (e.g. Kulevchi III and Semiozernoye) (Pamyatnik. . .). Defensive fortresses

have also been discovered in the Crimea (e.g. Kamenka) and along the Don River (e.g. Livenzovka) (Karataevka and Bratchenko 1976). The architecture of the fortresses is considered to have its origins in the traditions of Eastern Europe (Merpert 1995).

Site of the Sintashta-Potapovka Type

Twenty years ago, on the basis of the stratigraphy of Kurgan 25 in the Novuyi Kumak Cemetery, K. Smirnov and I proposed that the Novokumak Horizon should be positioned between the Catacomb Culture and the Srubnaya and Andronovo Cultures (Smirnov and Kuzmina 1977). It was also suggested that the Novokumak cultural sites should be included within the sphere of European cultures that appeared in the Urals and Kazakhstan as a result of the westward migration of Abashevo, Poltavka, and Babino (KMK) cultural tribes. Now it is possible to affirm these conclusions more precisely.

The lower layer of the settlement site of Kujsak belonged to the Pit Grave Culture; ceramics recovered from the middle layer indicate a combination of the Pit Grave and Abashevo Cultures, while the upper layer is characteristic of the Sintashta Culture. At the site of Beregovka I, the lower layer is characteristic of the Abashevo Culture, the middle layer is indicative of the Novokumak Culture, and the upper layer displayed attributes of the Srubnaya Culture (Vasiliev et al 1995). The main graves at the cemeteries of Tanabergen, Kuraili, Zshaman, Kargaly, and Barrow 11 at Bolshekaragan are characteristic of the Poltavka Culture, while Sintashta Culture burials at these sites should be considered to be later intrusions. At the site of Alexandrovka, ceramics of the Poltavka and Abashevo Cultures were commingled (Tkachev 1996). The main burial of the Kondrashkino Kurgan, located in the Don River region, was of a Catacomb type while a burial from the Abashevo Culture represented a later intrusion (Pryahin et al 1989). A large number of sites from the Catacomb Culture have been discovered in the Lower Volga region, and have been found to predate sites of the Srubnaya Culture. These findings should be considered evidence that the Abashevo and Poltavka Cultures integrated to form the Sintashta Culture.

Within the framework of the Novokumak Horizon, stratigraphy indicates the Sintashta Culture sites are earlier than those of the Petrovka Culture (e.g. the settlement of Ustye and the cemeteries of Krivoye Ozero, Stepnoye I, and Kamenni Ambar) (Vinogradov 1995). Analysis of buckles has indicated that the Babino Culture (KMK) was contemporary with the Abashevo, Sintashta, Monteory I C3, and Perjamosh Cultures located in the Danube region (Litvinenko 1996).

The origins of cheekpieces and chariots

Sites of the Babino Culture in the Dnieper and Donets River regions, and in the Crimea; the Abashevo Culture of the Don, Volga and the Ural river areas; the Potapovka Culture found in the Don and Volga river regions; and the Sintashta and Petrovka cultures of the Urals, western, northern, and central Kazakhstan all had disc-shaped cheekpieces made as a single element. I have mapped and classified these artifacts on the basis of a typological and technological method of manufacture (Kuzmina 1980; 1994). Novozshenov (1994) also combined my classification with a functional methodology. The initial bridle type had a single strap over the horse's nose affixed to a cheekpiece carved from a single piece of bone representing Type I A, B (a single central hole in the disc-shaped cheekpiece). Further development of the bridle indicates that the cheekstrap was afixed to Type II cheekpieces (up to five or six holes in the disc-shaped cheekpiece); the next improvement was the appearance Type III cheekpiece (two, and up to four, spikes were inserted though apertures on the disc-shaped cheekpiece; a small extension was added on the top side of the disc).

Goncharova (1996) developed a more detailed but less convincing classification. This was based on secondary indications, such as the construction of tenons and the shape of the lath. Her conclusions confirmed my conclusions: that cheekpieces with monolith tenons from Western Europe were more ancient than those with a marked lath, and finally cheek-pieces appeared with inserted tenons and occasionally with holes in the other plane. Unanimously, we acknowledge Western Europe as the center for the invention of cheekpieces, and from there they were spread to the Balkans and Greece.

The most recent discoveries of cheekpieces, including those which have been recovered from stratified sites, reveals their evolution. The most ancient cheekpieces of Type 1 are typical for the European Babino and Abashevo Cultures; these could serve as a basis for the developing elements of the Sintashta Culture. Type 1 cheekpieces are not decorated. Type II cheekpieces from the area between the Danube and Volga Rivers are often decorated with Mycenaean ornamentation. These cheekpieces are typical for the late Abashevo complexes in the Don River region, Pokrovka, and Petrovka, along with Alakul; they are decorated with post-Mycenaean ornaments. This reveals the independent evolution of horse harnesses and provides some reason to consider the European steppes as the center of chariot origin.

Chronology

A chronology for the sites has been derived on the basis of the following synchronization:

a) Cheekpieces and ornaments from Shaft grave IV at Mycenae, are dated from 1570-1550 BC; these provide a terminus antequem for Type I cheekpieces.
b) Cheekpieces and pendants with the Monteoru Culture.
c) Segmented faience beads from a number of European cultures.

During the final stage of the Babino Culture, contacts with the Danube region increased and spread westward to the Danube River (Chernyakov 1996; Litvinenko 1996). Cultural links with Greece could have been maintained through the Danube region as well as by sea. The Kamenka settlements and ports exhibiting lighthouses, and populations that included fisherfolk, were discovered in the Crimea. These may be interpreted as evidence for coastal navigation (Kislvf 1996) (Table 1).

The absolute date of the Sintashta Culture has been defined on

the basis of European chronologies that re defined on the basis of the Mycenaean Culture. The arguments for the chronologies are as follows:

1. Synchronization with monuments of Egypt and the Near East.
2. Revision of the G. Karo and A. Furumark schemes.
3. The radiocarbon date of the volcanic eruption on the island of Santorini.

A trend also exists to make the traditional chronology older in Central Europe (Stages A1 and A2, after Reinecke), on the basis of dendrochronological data (Krause et al 1989; Sheratt et al 1991; Ransborg 1992; Kroemer et al 1993; Kuniholm 1993). The dendrochronological dates are one to two centuries older than the traditional dates, but much younger than calibrated radiocarbon dates (Dietz 1991; Warren et al 1989; Betancourt and Michael 1987; Manning 1988; Astrom 1987; Dickinson 1994).

There is also a trend to lower the chronology of the Sintashta-Potapovka Culture on the basis of the new radiocarbon dates obtained from the Krivce Ozero, Patapovo, and Utevka cemeteries. These new dates position the Novokumak horizon close to the boundary of the third and second millennium BC (Vinogradov 1995; Anthony and Vinogradov 1995; Kuznezov 1996; Trifonov 1996). Renfrew's (1968) article, "Wessex without Mycenae," caused major debate. The calibrated dates were neither accepted in Germany or Russia because they differed greatly from the historical chronologies of Egypt and the ancient Near East (Cherynh1997), thus creating a large time gap.

It is very important to check the chronology and define the southern contacts of the steppe tribes. Ceramics of the Andronovo-Fedorovo type have been found in post-Harappan levels at the settlement site of Shortughai in Afghanistan, dated to 2000–1700 BC (Francfort 1989). Lapis-lazuli beads were found at Sintashta, and molded ceramic plates modeled after wheel thrown pottery, were found in the Petrovka cultural levels at the Ustitje settlement (Kuzmina 1994; Vinogradov 1995). The most important discovery was the metallurgical settlement, Tugai, near Samarkand, located near the polymetal layer near Zarafshan; Petrovka type ceramics occur in the complex along with the pottery from the neighboring agricultural settlement, Sarazm IV (Avanesova 1996). The calibrated date of the stratum is 2300–1900 BC (lssakov 1991). This date is overstated, according to Lyonnet (1996), and is understated, according to Avanesova, but it is close to the calibrated dates of Potapovka.

Early Sintashta type bone cheekpieces were found in the Zardcha Halifa grave near Samarkand, in a complex with pottery of the Namazga VI type–the Mollali stage of the (BMAC) Bactria-Margiana Archeological Complex. Other findings include gold and silver vessels and ornaments similar to those from Tepe Hissar III and from the BMAC Culture (Bobomulloev 1997). These date to beginning the second millennium B.C according to the C_{14} chronology.

It seems acceptable to refer to both chronological systems because the historical dates and the calibrated radiocarbon dates do not correlate. The date of the Sintashta-Potapovka cultures, therefore, may be defined with the following periods (1) 17th–16th century BC according to traditional chronology or, (2) to the 18th–17th century BC on the basis of the new European chronology, or (3) the 22nd to the 18th century BC according to radiocarbon dating.

The transition from early urbanism to nomadism

The Srubnaya and Andronovo Cultures were formed in the steppes in the middle of the second millennium BC on the basis of the Potapovka, Sintashta, and Petrovka cultures. The Srubnaya Culture spread from the Dnieper River to the Ural Mountains, while the Andronovo Culture was found from the Urals to the Yenisei River. Despite the evident features of genetic continuity, the cultural groups underwent a dramatic transformation; fortified towns and high status chariot burials of warriors vanished while metalworking changed from a very specialized industry to one that was practiced even in small villages. These changes were due to the cessation of intertribal conflict over mining sites that led to the unification of tribes into a single ethnic group; these tribes continued to develop under a more stable situation. Once the threat of conflict had ended and fortified settlements and a mass production of weapons were no longer necessary, the warrior elite attained a lower status.

Another important factor that contributed to this development was related to the specific ecology of the steppes. The climate became warmer and wetter between the 18th to the 15th centuries BC. This led to the development of a sedentary agricultural and stockbreeding economy. Stockbreeding, concentrated upon the production of meat and milk, guaranteed a stable food supply, that eventually resulted in a significant population increase. In turn, more livestock was required. As the availability of adjacent pastures strictly limited the number of animals that could be maintained, excess human population and livestock brought pressure on the environmental resources. The solution was the exploitation of the largely uninhabited steppes. The nature of this cultural development was one that involved an expansion of a population's territory, as opposed to an intensive form of urban civilization. The scope for the territorial expansion of the steppes became exhausted at some stage between the 13th and the 12th centuries BC. When the crisis arose, it was aggravated by a brief climatic deterioration and a lowering of temperature.

Conclusions

The solution to the crisis was the development of more suitable forms of stockbreeding. The economy became semi-nomadic pastoralism; a proportion of the tribe maintained a sedentary lifestyle, living in the villages while herdsmen moved with their livestock from pasture to pasture at specifice times during the year. Factors that permitted the change to this new type of economic system were: 1) an increase in the numbers of horses and sheep that were able to make long marches and could get fodder from beneath the snow; 2) the invention of light portable dwelling—the prototype of the yurt; 3) the spread of horseriding; 4) bar-shaped cheekpieces invented in the 13th–

12th centuries BC (found in many settlements) and; 5) perfection in controlling the horse while riding that was developed because of the necessity to dominate as well as to protect herds while nomadizing. Thus, warrior-horsemen appeared in the steppes, not in the fourth millennium BC but at the end of the second millennium BC.

Endnote

1. The district in the Urals where the large fortified settlements were discovered.

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Table

Traditional dates (Centuries before Christ)			Type of site	C_{14} dates (Centuries before Christ)			
China	South Asia	East Europe		non calibrate	calibrated		
					? 1	? 2	
13 - 11	13 - 11	13 - 11	Alexeev	13 - 11			
14 - 13	15 - 14	15 - 14	Fedorov				20 - 17
	15 - 14	15 - 14	Timber-grave	16 (15) - 15 (14)			
	17 - 16	17 - 16	Novo Kumak	18 - 16 (15)	23 - 17	24 - 20	23 - 18
		19 - 18	Catacomb	23 - 21			
			Pollavka	23 - 21			

Table 1.Comparataive traditional and C_{14} dating for China, southern Asia, eastern Europe with the Eurasian cultures/sites, Alexeev, Fedorov, Timber-grave, Novo Kumak, Catacomb, and Pollavka.

Sintashta Burials and their Western European Counterparts

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Abstract
The Bronze Age site of Sintashta provides the best documented burials from the Arkiam cultural region which occupies an area approximately 400 km x 200 km east of the southern Urals. The Sintashta burials, and those found at other Arkiam sites, vary greatly in detail but provide a number of significant similarities with burials further west in Europe. As a group, these burials also seem to provide archaeological evidence for numerous aspects of the burial rituals set down in the *Rig Veda* and *Avesta* and, thus, also furnish us with some of the earliest evidence that might be called Indo-Iranian if not Indo-European. This paper examines the Sintashta burials, and draws parallels with the Sintashta burials and those from other parts of the Indo-European World, in order to provide further evidence for the hypothesis that an Indo-European burial rite can be defined.

Key Words
Sintashta, Arkiam, *Rig Veda*, *Avesta*, Indo-European, burial

Introduction
The Sintashta-Petrovka cultural area runs along the eastern Urals of the Eurasian steppe for about 400 km south of Chelabyansk and to the east for about 200 km. There are 23 sites recognized as belonging to this group (Fig. 1); the first of which was only discovered approximately 35 years ago. The sites have been called "towns" and, because most of them have been discovered through aerial photography, we can see that they are laid out in round, square, or oval shapes. While only two of these "towns," Arkaim and Sintashta, have been excavated to any great extent, they are characterized as being fortified, having connecting houses, and having extensive evidence for metallurgy. The best documented burials from this cultural area come from the first site found and excavated, that of Sintashta. These burials, and those found at other sites, vary greatly in detail but have broad similarities. The excavator of Sintashta, Gening (1977; 1979), has shown that the burials from Sintashta do, however, provide archaeological evidence for numerous aspects of the burial rituals set down in texts of ancient Indo-Iranian provenience, the *Rig Veda* and *Avesta.* Thus, they also furnish us with some of the earliest archaeological evidence for a culture that may be called Indo-Iranian; that is, a period before this group split and went their separate ways. Because the *Rig Veda* and the *Avesta* are written in two Indo-European languages, Indic and Iranian, it follows that the rituals they prescribe are of Indo-European origin. It also follows that we should find similar rituals in other areas that also spoke Indo-European languages. The purpose of this paper is to discuss some of the similarities.

There are, of course, problems. These texts are not always clear, are often contradictory and, thus, open to conflicting interpretations. The problem is compounded by the differing ages and the incompleteness of the *Avesta*.

The *Avesta*, the sacred book of the Parsi, was composed by the religious reformer, Zoroaster, who attempted to erase the earlier practices of the Indo-Iranians. Nevertheless, traces of the earlier traditions can be gleaned from the *Avesta*, and they often correspond with what is given to us in the Indic *Rig Veda*. While "no single exclusive belief was held by the Indo-Iranians about death and the hereafter" (Boyce 1996: 109), it is generally believed and the evidence would tend to suggest that they practiced burial.

The dating of the *Avesta* is problematic, at best, since we do not even know when Zoroaster himself lived. The best guess is ca. 600 BC, but claims have been made for as early as 6000 years before Plato. All scholars, however, agree that the *Avesta* itself does preserve material that is much older than 600 BC. In the case of the disposal of the dead, the *Avesta* prescribes excarnation of bodies, and once they have been defleshed, the bones are to be placed in an ossuary. Only in the event of bad weather was inhumation allowed as a temporary measure.[1] Herodotus tells us that the Persians sometimes disposed of their dead in this manner.

> But there are other matters concerning the dead which are secretly and obscurely told-how the dead bodies of Persians are not buried before they have been mangled by bird or dog. That this is the way of the Magians I know for a certainty; for they do not conceal the practice. But this is certain, that before the Persians bury the body in earth they embalm it in wax (Herodotus I, 140, see 1920: 179).

Reference to both cremation and burial, however, can be found in the *Avesta*. There are, for example, references to "corpse-burning" *nasu-pāka* (Bartholome 1904: 1059 as quoted in Gamkrelidze and Ivanov 1995: 727) and "giving the corpse over to the earth" (z*amē ni-kan* Benveniste 1962: 39-43 as quoted in Gamkrelidze and Ivanov 1995: 727), both of which are condemned. Moreover, there are passages (Vd.VII.47.51)[2] which would tend to suggest that exposure was not at first generally adopted or enforced (see also, Boyce 1996: 326).

At Sintashta, most of the skeletons were found in a flexed position and some seemed to have been tightly wrapped in cloth.

There are several instances of excarnation where the bones had been picked clean of all soft tissue and cartilage, and were then laid neatly on the bottom of the burial pit. Cremation is not found, but large bonfires were built over some of the graves creating a "pseudo" cremation or more likely a sacrifice, probably to a fire god-Agni in the *Rig Veda* and ātar in the *Avesta*. We should remember that fire forms a key component in both the *Rig Veda* and the *Avesta* and that the Indo-Iranians are the only Indo-European people who have actual fire deities. Numerous classical authors refer to Iranian fire worship.

The most widely accepted date for the composition of the *Rig Veda* is no later than 1300 BC and perhaps as early as ca. 1500 BC, although the first actual written text dates to the 11th century AD (Macdonell 1900). While the primary mode of disposing of the dead in the *Rig Veda* is cremation, there are also several instances which indicate that inhumation was practiced and can be seen in *RV*.X.16.1 and X.18.11.

> *RV*.X.16.1 - Do not burn him entirely, Agni, or engulf him in your flames. Do not consume his skin, or his flesh (O'Flaherty 1981: 49).[3]

> *RV*.X.18.11 - Open up, earth; do not crush him. Be easy for him to enter and to burrow in. Earth, wrap him up as a mother wraps a son in the edge of her skirt (O'Flaherty 1981: 53).

It has been suggested that cremation and excarnation are alternatives of the same ritual (Litvinsky 1967). This may in fact explain the presence of cremation, but one would expect more evidence of excarnation which outside the Iranian World is conspicuous by its absence. Gamkrelidze and Ivanov (1995: 730) suggest that cremation was a method of preventing the spread of the plague which seems to have had its center in Egypt having been brought up from the African lakes, and it may have been fear of disease that inspired the exposure of bodies. In Vd.VII.47.51, Zoroaster asks how long it takes for bodies to return to dust when exposed, placed in the ground, and placed in a *dakhma* or tomb. The answer comes back one year, 15 years, and until the tomb falls. We can suppose that the entombed body was embalmed, perhaps in the manner suggested by Herodotus-that of covering the body with wax. In Vd.VII.56-58 the tombs are said to be places of corruption which generated disease (Boyce 1996: 326). The burial place is also called a place of corruption in Vd.III.35, and in the same passage the grave is referred to as the place of darkness; there is a connection with the Zoroastrian hell. It is through this type of reference and condemnation of older practices that Zoroaster preserves for us the practices that he sought to eliminate, and we are thus able to see that the Indo-Iranians did, indeed, practice burial.

That cremation and inhumation may have been interchangeable to Indo-European speaking people can be seen in the wealth of literature written in various Indo-European languages. *Beowulf* provides us with two burials, one is a cremation and the other describes a body set adrift in a kind of floating inhumation (Heaney 2000; Jones-Bley 1997: 195). The Hittites also give evidence for both; the Royal Funeral Ritual prescribes cremation,[4] but Hattusilis I, during the Old Kingdom, leaves instructions to be buried in the earth. There are also conflicting messages from Old Norse while Odin ordered the dead to be burned (Snorri 1964: 12), "they raised a burial mound for Gunnar and sat him upright in it" (Magnusson and Pálsson 1960: 172), but "Sigurd's body was then prepared according to the ancient custom and a tall pyre was built. When it was fully kindled, the body of Sigurd, the bane of Fafnir, was laid on top of it" (Byock 1990: 93; Jones-Bley 1997: 196). In Greece, although inhumation was the standard burial rite, after ca. the 13th century BC cremation became more common and between the 8th and 4th centuries BC they were practiced concurrently (Garland 1985: 34). Between AD 150 and 300 the Roman burial rite changed from cremation to inhumation (Morris 1992: 201). The alternation of these two rites is not a riddle that can be solved here. It is enough to recognize that both cremation and inhumation were common practices among Indo-European speaking peoples.

In a paper a few years ago, I attempted to define Indo-European burial. Taking as my starting point the eight burial points laid down by Marija Gimbutas (1974: 293-294), I attached to them both literary and archaeological evidence. I believe it is useful to revisit these points in order to show the connection between the Sintashta graves and those found in the rest of Europe from the Bronze Age onwards in order to demonstrate their connections. I rearranged Gimbutas' eight points in order of priority beginning with a point she did not specifically mention, that is individual burial, and here it should be made clear that I mean "one-time" burial. Several of the Sintashta graves are called "collective or multiple" burials due to more than one skeleton being positioned in the burial chamber, but they were all placed there at the same time and were therefore "one-time" burials. This is in contrast to what are also called collective or communal tombs which are found so frequently during the Neolithic, particularly in megalithic tombs where corpses were added to the tombs over often great lengths of time. In order to avoid this confusion, I propose a change in terminology. I propose the use of the term "repetitive" burials for the Neolithic tombs and "one-time" burials where a chamber was used once and then closed for good.

Sintashta Burials and the Eight Points of the Indo-European Burial Tradition

There were five burial sites at Sintashta: (1) SM–a large flat cemetery with 40 graves; (2) SI–a complex kurgan with 16 burials; (3) SII–a small flat cemetery with ten graves; (4) SIII–a small kurgan with one grave; (5) SB–a large kurgan robbed in antiquity. Each of the eight points can be illustrated with examples from the Sintashta burials, other areas of the steppe, and across Europe.

(1) One-time burial

According to my definition, I believe that all of the Sintashta burials fall into this category. That is, there were no signs for the reopening of the burial chambers (see Gening et al. 1992).

One-time burial is first seen on the steppe on a wide scale with the Yamnaya people (ca. 3500-2100 BC), and early Yamnaya burials are found as far west as the Hungarian Plain (Ecsedy 1979). The Corded Ware people also practiced this one-time burial but often the graves contained more than one skeleton. From the Early Bronze Age onwards, one-time burials became the rule not the exception across Europe.

(2) The kurgan
Kurgans (burial mounds) were built over most of the grave pits at Sintashta. Only three of the adult burials and many of the children in the SM cemetery lacked kurgans. None of the kurgans were of a great height, and those that were preserved were only 30-40 cm high (Gening 1979: 26). While there were two substantial flat cemeteries at Sintashta, there were also kurgans and perhaps the most elaborate grave, SB, was under a kurgan (Gening et al. 1992).

Many, if not most, kurgans found throughout Europe and Eurasia contained secondary burials which should not be confused with "repetitive burials." These secondary graves are entities within themselves and the kurgan acts more like a cemetery than a single tomb. While some kurgans may have only contained one or two secondary burials some have dozens. The Magdalenenberg in Baden-Würtemberg, Germany, for example, contained 127 graves (Collis 1984: 85) .

Earlier people, beginning with the Yamnaya, buried their dead almost exclusively in kurgans, and although flat graves do occur (see Jones-Bley 1999), they are rare. It was because of the ubiquity of kurgans that gave rise to Gimbutas' term "Kurgan Culture" which she used as a blanket term to cover many more closely defined cultures but ones that she, and other scholars, believed to have been Indo-European speakers.

It is the kurgan as the most visible part of the monument that signaled the burial of someone of importance. Although not specifically prescribed in the *Rig Veda*, we find a definite reference to burial mounds - "Let them live a hundred full autumns and bury death in this hill" (*RV*.X.18.4; O'Flaherty 1981:52).

From the Early Bronze Age, burial mounds with one-time burials are found across Europe not only on the landscape but in the literature. Achilles built a great mound for Patroclus and the Trojans did likewise for Hector. In *Iphigenia in Tauris*, Euripides has Orestes say "heap up a mound for me" (see 1938: 702). Odin prescribes mounds for notable men (Snorri 1964: 12), but mounds were built not only for the great but the near great. "A burial mound was erected for King Hrolf, and his sword Skofnung laid beside him; and for each champion his mound, and some weapon beside him" (Jones 1961: 318). As late and as far west as the Germanic territory, Tacitus tells us that "The tomb is a mound of turf" (Tacitus, Germania 27 1981:171). The Hittites are a major exception here as they did not build barrows over their burial chambers.

(3) A mortuary house-like structure
Most, if not all, of the graves at Sintashta were enclosed in wooden structures. Some were large enough to require central supporting posts and again the most elaborate was discovered in SB. In the *Rig Veda* the House of Yama is the Otherworld; the Greeks had the same concept but called it the House of Hades; and the Germanic reference is to the Hall of Heljarann. All these words for the Otherworld employ a word that means a constructed building. By extension, it is not difficult to see why bodies were put in a "house-like structure."

In *RV*.VII.89.1 "the house of clay" is used as a metaphor for the grave, and it could also refer to the urn in which the cremated bones were placed. Actual house structures can be found at numerous sites including the Únetice burials at Leubingen in Saxony (Gimbutas 1965: 264-265, fig. 173; see also Piggott 1965: 127, fig. 67; Collis 1984: 26) and Helmsdorf (Gimbutas 1965: 260-264, fig. 172). Many Greek funerary vases and Roman reliefs feature the deceased in a house (e.g., see Gilman 1997: 93; Burn 1992: figs. 81 and 154), and Mycenaean chamber tombs were sometimes painted to resemble a house. Furthermore, coffins from the Late Bronze Age and from the Classical period often imitated houses (Vermeule 1979: 48). The Villanovans frequently fashioned clay cinerary houses, particularly in the early period (Hencken 1968). These clay houses were often decorated with swastikas much as the Sintashta people decorated the clay vessels found in their graves (see Gening et al. 1992: fig. 47).

(4) Class distinction by the inclusion or absence of grave equipment or architectural elaboration
Neither the *Rig Veda* nor the *Avesta* speak of grave goods, but the placing of goods in the grave is such a widespread practice that we can only assume that those who were carrying out the burial process believed that the goods were things that were needed or wanted in the Otherworld. The literature is filled with descriptions of burials and a listing of their grave goods. It is these grave goods that are often-but not always-the clearest statement to class distinction. No one would deny that a grave filled with items of great wealth was the grave of a wealthy and important person. There are many examples of this. A Middle Bronze Age grave from the Poltavka Culture from the Volga-Don steppe demonstrates a variety of wealthy and diverse items. This grave which held a possible adult (sex unknown) contained over 20 items including bronze tools and weapons, a serpentine macehead, ceramics, and more exotic items such as petrified wood, a freshwater pearl, and a snake skeleton (Jones-Bley 1999: 74-75). Later in time graves and grave goods became much more elaborate as seen by many Saka[5] graves such as Aul'ul and Arzhan (see Rolle 1979) and further west with graves such as those found at Hochdorf (Biel 1985), Vix (Joffrey 1979), Hochmichele (Filip 1977), and as late as Sutton Hoo (Evans 1986) which is frequently compared to the burials described in *Beowulf*.

We cannot, however, dismiss graves that lack elaborate goods as belonging to someone poor because we do not know what was placed in the grave that has not been preserved. This may also be where grave architecture becomes important. At Baranovka on the Volga-Don steppes the primary grave—

in a study of over 120 kurgans–by far the largest kurgan (34 m diameter x 4.21 m height) contained a cenotaph which held only a single well-made and well-decorated vessel (Sergatskov 1992; Jones-Bley 1999: 73-74).

The burial of Ockov in Slovakia (Paulík 1962; Gimbutas 1965: 319-321, fig. 219) is an excellent example of a grave that had both extremely rich grave goods and elaborate architecture. This Early Urnfield mound was 6 m high by 25 m in diameter and contained an elaborate interior with the burned remains of 144 items including metal and elaborate pottery. A somewhat later burial further east, again with elaborate architecture and grave goods, is that of the Scythian grave of Ordz'onikidze (Rolle 1979: 22-27). Both of these graves have every indication of being the burials of important personages.

This point is illustrated in several graves from Sintashta but two examples will suffice. SIII was a small kurgan and contained a number of important grave goods including a two-wheeled vehicle (see below Point 6 for additional grave goods). The structure under the mound was fairly elaborate (Gening et al. 1992: 333-334, fig. 198) and can be compared to Ockov. The best example of elaborate architecture is seen by the burial at SB even though it had been robbed in antiquity and only a human femur remained to attest to the fact that it was a grave. Here an elaborate mortuary house had been built above the grave and a large mound placed over it. At a later time a temple was built over this kurgan which may also attest to the importance of the grave's occupant (Gening et al. 1992: 342-374, fig. 213).

(5) Central burial of males with secondary position given to children or females

At Sintashta, inferior position was seen in some female graves as they were the only graves that did not include animal sacrifice. By its presence in such quantity, animal sacrifice was clearly very important to the people of Sintashta, and its absence suggests low status. Although children were among the buried at Sintashta, they did not have the rich grave goods given to earlier Yamnaya or even Catacomb children (Mallory 1990; Jones-Bley 1994; 1999). The gap between females, children, and males seems to widen after the Middle Bronze Age since fewer are found in either primary position or with elaborate grave goods. In the case of females, however, there is something of a reversal of fortunes in the Iron Age particularly in the Celtic area as seen by such graves as Vix (Joffrey 1979), Waldal-gesheim (Megaw and Megaw 1989: 113), Rheinheim (Megaw and Megaw 1989: 90), and on the steppes in the Sarmatian area as demonstrated by the Kobyakovskiy burial (Prokhorova and Guguev 1988), and the Altai Mountain Saka burials such as the Ak-Alakh (Polosmak 1994) and Kara-Kobins (Polosmak 1998).

(6) Human and animal sacrifice including the presence of suttee

Animal sacrifice, particularly that of the horse, takes on a position at Sintashta not seen earlier and rarely again until the first millennium BC burials of A zhan and Aul Ul' where 150 and 360 horses respectively were sacrificed (see Rolle 1979: 41, 45). We do, however, have ample textual evidence for animal sacrifice. The Brahminian texts tell us that in Vedic times the descending order of sacrifice is man, horse, cattle, sheep, and goat. The Hittite ritual texts prescribe human and animal sacrifice. Both Homer and Germanic literature provide many examples of the sacrifice of both humans and animals.

There seems little doubt that animal and human sacrifice was widely practiced in Indo-European society (Sauvé 1970; Ward 1970; Puhvel 1981) Although the reason for sacrifice may not always be clear, here we are primarily concerned with burial sacrifice. Homer is explicit when he tells us - "many goodly sheep and many sleek kine of shambling gait" (*Iliad* 23: 166-167), nine dogs, four horses, and "12 sons of the great-souled Trojans" (*Iliad* 23: 175) are placed on the pyre with Patroclus. The call for sacrifice is frequently found in the Germanic literature, and Baldr's horse, for example, is put on his pyre in a clear case of sacrifice (Snorri 1954: 83).

At Sintashta, a number of dog burials were found in the backfill over the burial chamber (Gening 1977, 1979). The dog had important chthonic connections in Indo-European burial beliefs. *RV*.X.14.10-12 describes the two dogs of Yama, (Avestan Yima) who, like their Greek counterpart Cerberus, guard the gates of the Otherworld. In Vd.VIII.3.14, the *Avesta* also gives special place to the dog and speaks of the "carcases of dogs or corpses of men" (Darmesteter 1880: 97), and the yellow dog with four eyes or the white dog with yellow ears appears to be the counterpart of Yama's two dogs and Cerberus. References to the dogs of the underworld can also be found in Celtic, Germanic, Armenian, and Latin (Lincoln 1991: 96; Schlerath 1954). The sacrifice of animals can be found in both earlier times and in other parts of the steppe. At Tsatsa in the southern Volga-Don area, 40 horse skulls were found in one secondary Catacomb grave along with a single male (Shilov 1985: 99; Jones-Bley 1999). At Botai in Kazakhstan, in burials that date to ca. 3700-3100 BC cattle, sheep, and dogs were found as well as at least eight horses buried with humans (Olsen 2000). There is abundant evidence that animal sacrifice was a part of the Indo-European burial ritual. *Rig Veda* I.162-163 and *Atharva Veda* IX.5.1, 3, call for a goat to be burned with the horse and human corpses, but later Vedic ritual calls for either a goat or cow (Macdonell 1900: 125).

The Hittite royal texts are quite exact on this point, calling for a specific number of oxen and sheep to be sacrificed. In non-royal Hittite graves bones of the usual cattle, sheep, and pig are found, but the remains of dogs, horses, and donkeys (presumably used as a less expensive substitute for horses) are also recovered (Macqueen 1975: 134). Although the Greek literature mentions only sheep and oxen as sacrificial animals, bones found in graves during the Geometric period include cows, pigs, goats, and hares. Only female or castrated animals were sacrificed and preferably those which were black in color (Garland 1985: 112). In 594 BC, Solon introduced legislation that banned the excesses of burial sacrifice which may indicate that it had become extreme.

Human sacrifice is much less common than animal sacrifice and often difficult to prove from the archaeological record.

There are instances, however, where there are strong indications of such a practice including the burials of Leubingen, and a number of Saka[5] burials, particularly that at Arzhan where 17 retainers appear to be sacrificed for the central male along with a female, presumably his wife (Gimbutas 1965: 264-265; Piggott 1965: 127; Rolle 1979: 42-44). There are also cases where a male and female are in the same grave but there is no indication that one is sacrificed to the other. At Ak-Alakh in the Altai Mountain area 14 km from the Chinese border, a grave contained two elaborately made larch coffins, one which contained the remains of a 45-50 year old male and the other a 17 year old female. Both coffins held warrior equipment and other goods indicating that the two were social equals (Polosmak 1994: 354), but there was no indication of sacrifice. Just because more than one person is buried in a grave does not mean that one was sacrificed to the other. To judge a body as a sacrifice, we need to look at burial position and distribution of grave goods-and even then it is not always clear.

The *Rig Veda* details both animal and human sacrifice (*puruṣamedha*), and we have textual evidence in other parts of the Indo-European world that clearly state that both were practiced. What is of interest in the *Rig Veda* is that there are indications that at least human sacrifice was no longer practiced. One of the clearest indications is in regard to the practice of suttee. *RV*.X.18.8, suggests that it was no longer appropriate for a woman to die along with her husband:

> Rise up; come to the world of life, O woman;
> Thou liest here by one whose soul has left him.
> Come: thou hast now entered upon the wifehood
> Of this thy lord who takes thy hand and woos thee
> (Macdonell 1900: 126).

Still, we have numerous examples of suttee in the Germanic literature, and in Scandinavia we have quasi-historical accounts of human sacrifice from Saxo in his *Gesta Danorum*. As late as the 9th century AD, we are told in a passage from *Flateyjabók* I: 63:

> Now at this time Sigrid the Proud had left King Eric, and people said that he felt disgraced by her behaviour. For it was in fact the law in Sweden that if a king died the queen should be laid in howe beside him; she knew that the king had vowed himself to Odin for victory when he fought with his kinsman Styrbiorn, and that he had not many years to live (Davidson 1964: 151).

There even seems to be a case of female servants being sacrificed to an upper class woman at the site of Birka, Sweden (Brønsted 1965: 293).

We have instances in Greece of the sacrifice of horses and apparently suttee. At Euboia during the 10th century BC a grave with two compartments was found. In one compartment there were three horses that seem to have been thrown into the pit. The second compartment contained the skeleton of a female and an amphora with ashes, presumed to be male, along with an iron sword, a spearhead, and a whetstone (Garland 1985: 35).

SIII at Sintashta may be an example of human sacrifice. The remains of a two-wheeled vehicle were found in the northern part of the pit, five bodies, four defleshed, were in the cart with vessels in and out of the cart. At the opposite end of the grave near the cart pole were the skulls of two horses and a human skull cap. Here also were several clay vessels, a bronze knife, awls, a stone macehead, talc plates, clay nozzles, and additional stone and bronze artifacts (Gening *et al* 1992: 333-340). This person would seem to be the dominate skeleton as suggested by his singular position and grave goods. The numerous bronze artifacts imply an elevated position but perhaps more important is the macehead, which I have suggested elsewhere (Jones-Bley 1999) is a symbol of power, just as similar maceheads found in Britain have been said to be power symbols (Clarke et al. 1985).

(7) Dead placed on the floor of the grave in a contracted position
Many of the Sintashta skeletons were found in a contracted position. These corpses may have been wrapped in cloth to preserve this position, but we have no ritual or literary record for this practice. In addition, the position of the corpse appears to change over time both in position[6]—crouched during the Bronze Age, extended supine during the Iron Age—as well as orientation.

(8) Burial of animals in separate graves
The burial of animals at Sintashta is of great importance. Large numbers of cattle, sheep, horses, and dogs were found in human graves and buried in separate graves.

It is the *aśvamedha, RV*.I.162, that is the most prominent of animal sacrifices and horse sacrifice is found at the far ends of the Indo-European world in the forms of the *Roman October Equus* and the Irish ritual as described by Giraldus Cambrensis in his *Topographic Hibernia* (Puhvel 1987: 269-276). A Hittite vase (Özgüç 1988) shows a man and woman copulating as beasts which, although associated with a bull rather than a horse, Watkins (1995: 267) interprets as another possible reference to the *aśvamedha*. But these are ritual sacrifices, not burial sacrifices, and while the *aśvamedha* sacrifice might be associated with horse alone burials, it cannot be applied to horses that accompany human burial.

Conclusions

We can see that all eight points are apparent in the Sintashta burials, but it is clear that there was a greater emphasis placed on some than others. This situation causes me to slightly revise my earlier thinking on the importance of the burial of animals in separate graves and the sacrifice of animals. I had suggested dropping the separate burial of animals, but now believe that although it may not be as prevalent in some later Indo-European societies, it is clearly an important factor to the Sintashta people. Because of its importance in a society that displayed so many characteristics of what we know of Indo-Iranian people it should be maintained.[7] It may be that the practice of sacrificing animals in the grave absorbed the earlier practice of the separate burial of animals when it became less economically

feasible to sacrifice so many animals. This would be particularly true in areas that had less access to large herds of horses. A further extension of this may have been the substitution of figures of horses, such as on the Hochdorf yoke (Biel 1985: plates 45 and 46) and the Vix diadem (Joffrey 1979: plates 71, XIII, and XIV). Such variation is to be expected in the evolution of a tradition that spans millennia.

It is the variation within the Indo-European burial tradition that I believe has caused many scholars either not to recognize or to reject (Häusler 1998) the idea that there was a continuity of burial rite that began in the Eurasian steppe and spread across Europe. At Sintashta we see a remarkable amount of variation, but variation that we can connect with Indo-European texts. The Indo-European burial tradition would, of course, be easier to see if there was exact duplication. Unfortunately, for the archaeologist, human societies may accept an idea, but almost always add their local stamp to it.

Endnotes

1. Vendîdâd VIII.II.10 tells us that the body shall be taken "to the building of clay, stones, and mortar, raised on a place where they know there are always corpse-eating dogs and corpse-eating birds" (Darmesteter 1880: 96; see also Jones-Bley 1997).

2. For all Vendîdâd references, unless otherwise specified see Darmesteter (1880).

3. In most cases, I have chosen to use O'Flaherty's translation because it is the most accessible to English readers.

4. Though we have fragments for 13 days of Le Rituel Des Funérailles Royales Hittites, it may have lasted longer. Moreover, although the tablet for the first day has a number of lacunae, the tablet for the second day is nearly complete, and this tablet makes it clear that the body has been cremated. "Le deuxième jour, le matin, les femmes vont au bûcher recueillier les ossements. Elles éteignent le feu avec dix cruches de bière, dix cruches de vin, dix cruches de walhi-" (Christmann-Franck l971: 65). Moreover, both cremation and inhumation of non-royal persons have been found outside Bogazköy (Gurney 1952: 140; Jones-Bley 1997).

5. These burials belong to the Saka culture. (Ed. note).

6. If these individuals had died during the winter, they may have been wrapped and stored until the ground thawed enough to be dug. I am grateful to A. V. Yepimakhov for bring this suggestion to my attention.

7. Perhaps the point to be eliminated is Number 7 because the burial position is so fluid. As I suggested earlier (Jones-Bley 1997: 211) little weight should be given to this item which does not even exist in the case of cremation. After additional thought, I believe this item should be eliminated completely due to its fluctuation over time and lack of literary reference.

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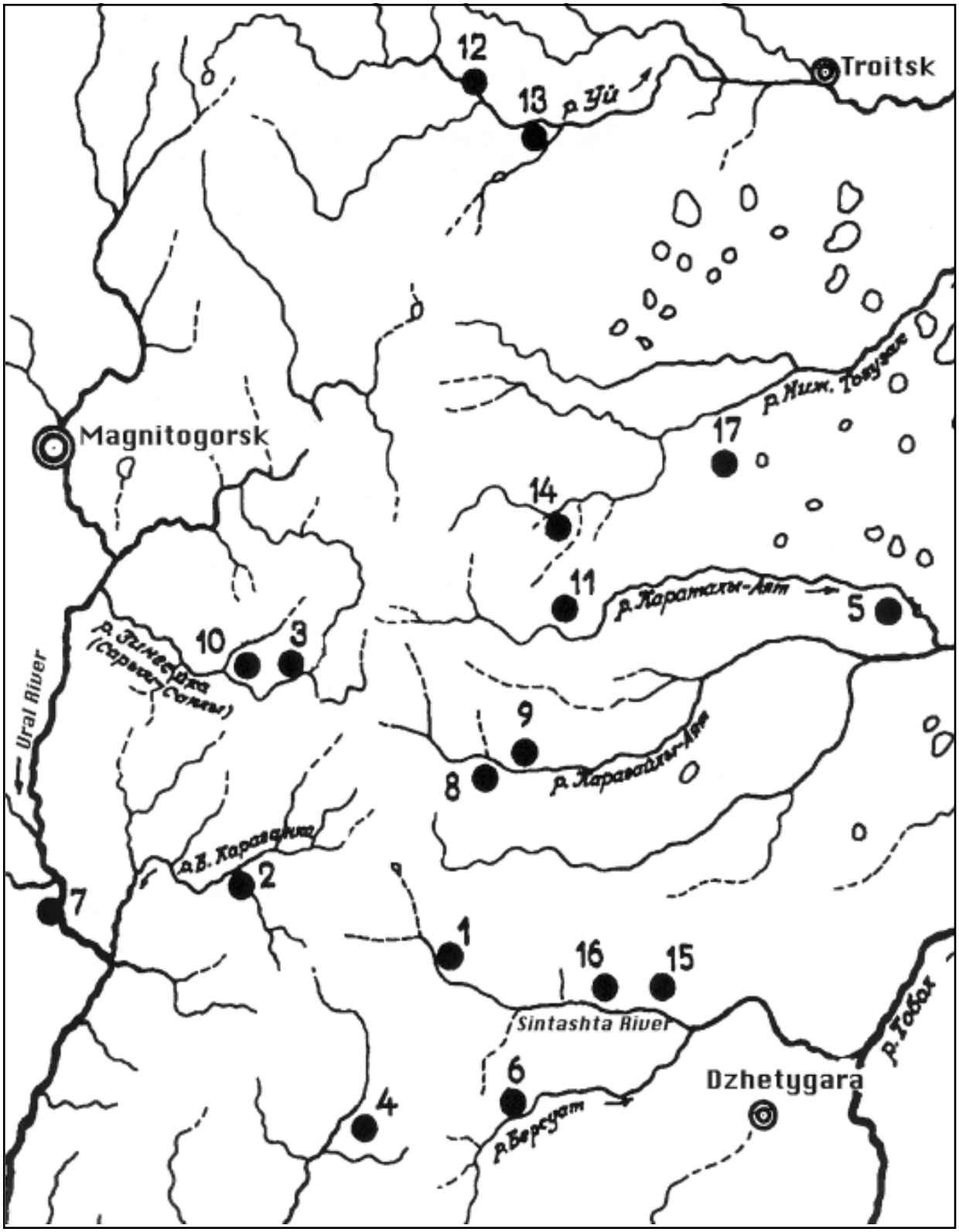

Fig. 1. Sites of the Sintashta-Petrovka Cultural Area (only 17 are mapped). 1 - Sintashta; 2 - Arkaim; 3 - Sarym-Sakly; 4 - Alandskoe; 5 - Isiney; 6 - Bersuam; 7: Kizil'skoe; 8 - Zhurumbay; 9 - Ol'ginskoe; 10: Kuysak; 11 - Rodniki; 12 - Smepnoe; 13 - Chernorech'e III; 14 - Usm'e; 15 - Andreevskoe; 16 - Sintashta II; 17 - Chekomay.

The Sintashta "Chariots"

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Abstract
In the 1970s a group of two-wheeled vehicle burials, called "chariots burials" was reported by V. V. Gening. A subsequent discovery of an additional two-wheeled vehicle "chariot" burial associated with the Sintashta cultural group has stimulated comment on the function of these "chariot" burials. Looking at the textual and iconographic evidence for chariots, it appears that ritual was in fact the earliest use for chariots. We see this from Hittite texts, the *Rig Veda*, and seals from Mesopotamia. This ritual, however, took several forms: transportation for the gods, burial, ritual racing, and warfare. In this paper I will look at chariots found in graves and discuss their possible use. The overriding question is what was the function of chariots found in graves. Three alternatives are presented: war chariots designed for combat, ritual racing chariots intended for speed and maneuverability, and ceremonial chariots designed as burial vehicles to carry the deceased to the Otherworld. I will deal with the linguistic, textual, and archaeological evidence, and I am specifically concerned with the vehicles found east of the Urals connected with the Sintashta-Petrovka Culture.

Keywords
chariot, horse, *Rig Veda*, ritual, steppe, burial

Introduction
Numerous chariots have been found in graves in Eurasia and several hypotheses have been presented to account for their presence and function. Three alternatives are examined here: war chariots designed for combat with a bow, ritual racing chariots intended for speed and maneuverability, or ceremonial chariots designed as burial vehicles to carry the deceased to the Otherworld. In order to examine this question fully, it is necessary to deal with the linguistic, textual, and archaeological evidence. While chariots are dealt with in general, this paper is specifically concerned with the "chariots" found east of the Urals connected with the Sintashta-Petrovka Culture.

Definitions of Chariots
About 250 wheeled vehicles consisting of wagons, carts, and chariots have been found in steppe graves. While we are certain that these remains do indeed constitute vehicles, some debate exists around the use of the term "chariot." Different scholars have drawn distinctions among vehicles and especially between carts and chariots in different ways. There is general agreement that a chariot is a two-wheeled vehicle and that they differ from carts. Carts can have solid or spoked wheels, but they are confined to the transport of people or goods; a passenger usually sat. Chariots have spoked wheels and the occupant presumably stood. They were used for hunting, war, or ceremony (Littauer and Crouwel 1979: 4-5), and the linguistic evidence agrees with this definition (Gamkrelidze and Ivanov 1995). These are the current definitions for the chariot:

- "A light, fast, two-wheeled, usually horse-drawn, vehicle with spoked wheels; used for warfare, hunting, racing and ceremonial purposes. Its crew usually stood" (Littaurer and Crouwel 1979: 4-5).

- A vehicle "lightly built brought with it the potentialities of greater speed as a new enhancement of prestige in transport in peace and war" (Piggott 1992: 40). This modifies Piggott's earlier more military definition for one which de-emphasizes war in favor of a prestige vehicle.

- Anthony (1998:105, fn. 10) follows Piggott but attaches the horse, defining the chariot as "a light vehicle with two spoked wheels, pulled by horses, and designed for speed."

Discussion
Carts may have heavier frames, a medially placed axle, solid or spoked wheels, and be suitable for a seated occupant. Chariots, on the other hand, have lighter frames, a rear-positioned axle (particularly in later periods), must have spoked wheels, and the driver stood. The specific chariot features, of course, have a common purpose: the reduction of weight and the consequent increased speed potential. Placement of the axle at the rear of the vehicle allowed the driver to stand and easily exit. A further consequence of the evolved design of the chariot is its takeover of uses that had earlier been carried out by wagons and carts.

Among the above definitions, I believe Littaurer and Crouwel's is the most useful as it describes the vehicle and its use and makes the horse the usual, but not mandatory, form of traction. Although Piggott (1992:45) included the horse as part of the "chariot package-deal", the inclusion of the horse in Anthony's (1998) definition is limiting as it is clear that the earliest chariots in the Near East were pulled by equids other than horses (see Littaurer and Crouwel 1979). Moreover, in cases where the means of traction is not specifically known, Anthony's requirement of a horse to make a chariot introduces an added element of inference or uncertainty. Furthermore, we have iconographic and textual evidence that, while fanciful, indicates that ancient people did not believe horses were a require-

ment for chariots. In mythology, as seen on Greek pots, even griffins and snakes were used for traction. *Rig Veda* VI: 55.6 tells us that goats pulled the chariot of Pūṣán, a fact mentioned in all descriptions of this god (Macdonnell (1917: 111; Hillebrandt 1927: 206; O'Flaherty 1981: 194–195; Gamkrelidze and Ivanov 1995: 502).[1] In this paper, it is the vehicle rather than the source of traction that is our concern.

By the middle of the second millennium, however, the horse did become the traction animal of choice, and its importance can be seen in the numerous texts that speak of the care of horses. The most famous of these texts, as well as the most complete, is the Hittite text of Kikulli (Kammenhuber 1961), a Mitanni horse trainer. Kikulli's vocabulary, like that of the Mitanni elite, uses a noticeable Indo-Aryan element, especially in technical terminology and the names of the ruling elite. The everyday language of the Mitanni, however, was Hurrian a non-Indo-European language (Mayerhofer 1966, esp. Sections 4 and 5). The location in northern Mesopotamia of the Mitanni kingdom with its Indo-Aryan *ad strate* is important because their Indo-Iranian ancestors are often placed in the Central Asian steppe—a place well-known for its horses.

Looking at the textual and iconographic evidence, it appears that ritual was in fact the earliest use for chariots. We can see this from Hittite texts, the *Rig Veda*, and the seals from Mesopotamia. This ritual took several forms: transportation for the gods, burial, ceremony, and warfare.

The evidence is plentiful for chariots serving both war and ceremony, but some of the earliest evidence for ceremony indicates that solid or possibly triparte wheels[2] were used initially for two-wheeled vehicles acting as a forerunner of the true chariot (Littaurer and Crouwel 1979, figs. 17 and 28). That chariots can have both the ceremonial and war aspect is seen on seal impressions and on a stone relief at Abydos of Rameses II—(Littauer and Crouwel 1979, figs. 28 and 45). The seal, from Kültepe, Karum II, shows a two-wheeled vehicle pulled by two hooved animals carrying a figure holding what appears to be a drinking vessel. A second seal (Littaurer and Crouwel 1979, fig. 29; MMA acc. no. 66.245.17b) has a similar vehicle but with spoked wheels, pulled by two horses, carrying a figure holding a hafted macehead or axe. Both figures are dressed in skirts wearing pointed hats. Both seals seem to be ceremonial, but the second seal might also have a war aspect. Earlier four-wheeled "battle cars" (Littaurer and Crouwel 1979, fig. 3) also speak to a military purpose. War chariots are well documented in the Near East (see Littauer and Crouwel 1979) and the use of war chariots by the Hyksos in Egypt is legend. The war chariot was considered the principal offensive weapon of the Hittites and their Near Eastern contemporaries.

The use of a single word for chariot that could be used for both ceremony and war is a source of ambiguity but not a new problem. Hittite distinguished between light carriages harnessed with horses and heavy wagons harnessed with bulls, but the light two-wheeled chariot harnessed with horses was used for "military and ceremonial purposes and for ceremonial competitions" (Gamkrelidze and Ivanov 1995: 628). Nevertheless, the heavy wagons could also perform ceremonial functions, and this can be seen in the burial ritual where the image of the royal personage was placed in a light chariot while the remains of the king were put in a heavy wagon and transported to the place of cremation (Gurney 1977: 61; Gamkrelidze and Ivanov 1995: 629). The use of a heavy wagon, *ána[s-]*, was also used in Sanskrit tradition to carry the dead to the funeral pyre. Cattle pulled it (Gamkrelidze and Ivanov 1995: 632). It is interesting to note that in the earlier wagon burials found north of the Caucasus, the dead were placed in a sitting position (Izbitser 1993: 21). It should also be mentioned that this is the word used for the vehicle which is driven by the Dawn goddess Uṣas and which is often translated as "chariot" (see Dexter 1990: 37-38 and n. 20).

A Hittite hymn tells us that the sun god rides out on a chariot harnessed to four horses "O Sun God! Great king! You constantly ride [in a chariot] around the four corners of the world" (Gamkrelidze and Ivanov 1995: 627). The *Rig Veda* clearly states the cultic and mythological use of the chariot in a war context "O divine chariot, accept the sacrificial libations" (*RV* VI: 28; Gamkrelidze and Ivanov 1995: 631). The importance of this sacred chariot can be seen in that this same verse was repeated in the later *Atharva veda* (VI.125.1-3; Gamkrelidze and Ivanov 1995: 631). In the *Rig Veda*, war chariots are usually ridden by gods who compete with one another which in itself emphasizes that war is an extension of ceremony or perhaps the ultimate ceremony.

Four-wheeled wagons were used in the burial rite in Sumer from the first half of the third millennium BC. We have depictions of Sumerian two-wheeled chariots from the Early Dynastic Period. They show a chariot pulled by four horses or onagers[3] with a standing figure, presumably an image of the deceased (Gamkrelidze and Ivanov 1995: 630). This iconographic depiction is very similar to the Hittite royal burial ritual described above. By the second third of the third millennium BC, we also have wagon burials in the Caucasus (Izbitser 1993: 20) and in the Ural River region (Izbitser 1993). Let us now turn to the Sintashta vehicles.

Sintashta "Chariots"

At Sintashta, five two-wheeled vehicle burials were found and reported by Gening (1977).[4] They have sometimes been referred to as "war chariots" (Masson 1992: 347; Anthony 1995; Kuzmina 1998: 73), but Gening referred to them as transport to the Otherworld. Yet another interpretation has been presented by Anthony (1995) and Anthony and Vinogradov (1995) who have called them "chariots" for ritual races.

The only remains we have of these vehicles are the lower part of spoked wheel impressions left from rotted wood. We do not have remains of the vehicles themselves and thus we do not know if they were carts or proper chariots (Littaurer and Crouwel 1996). We do know that the wheels have diameters up to 1 m with ten spokes. The gauge has been reported variously from ca. 1.07-1.30 m. Because we have no actual wheels,

we are deprived of valuable information regarding wear on the wheels. There was also no evidence of a draft pole nor of the vehicle itself; and thus, we do not know if the axle was placed at the back or medially. These must have been lightweight vehicles ca. 0.90 m wide, drawn by horses, which have also been found in the graves. An additional vehicle was found at Krivoe Ozero about 80 miles north of Sintashta and reported by Anthony (1995) and Anthony and Vinogradov (1995). Radiocarbon dates of ca. 2000 BC were reported for this last site (Trifonov 1997; Anthony 1998). The grave goods associated with all these graves include pottery, weapons, and ornaments, and in several instances complete horses were buried above the human and his vehicle as well as horses in the actual grave. The grave from Krivoe Ozero was the same type of burial as reported by Gening (1977). These vehicle burials are all connected with the Sintashta-Petrovka Culture, located east of the Urals.

Although Anthony and Vinogradov first suggested that these vehicles were war chariots, they ultimately put them down as chariots for racehorses. Several suggestions authored or co-authored by Anthony require comment:

Anthony and Vinogradov (1995) asked why chariots were used for warfare when horse riding, which Anthony (at the time of the publication of the two 1995 articles) placed at 4000 BC, already existed.[5] The answer they give is that perhaps the short bow had not yet been invented. There is, however, evidence that the short bow was already in use in Egypt. It is depicted at Mari and dates to the earlier third millennium (Littaurer and Crouwel 1979: 92, fn. 72). While we have iconographic representations of the use of the long bow on chariots (Littaurer and Crouwel 1979: 44, 53, and Rameses at Abydos [see Anthony and Vinogradov 1995]), a short bow is also depicted (Littaurer and Crouwel 1979: 36, 56–58), and the length is similar to that shown with riders (Littaurer and Crouwel 1979, figs. 76 and 78). Whatever the reason, all the evidence shows that chariots were used in warfare prior to the use of a cavalry, but the bow does not appear to be the reason. In regard to the Sintashta-type chariots, Anthony and Vinogradov do note that if used in battle, they would have been "somewhat top-heavy on high-speed turns" (Anthony and Vinogradov 1995: 38) due to the narrow wheel base, which they put at as between 3.6 to 3.9 feet (1.07-1.14 m). Littaurer and Crouwel (1996: 939) point to aspects of the Sintashta vehicles—gauge and dimension of the naves—that make them inherently unstable and unsuitable for speed or maneuverability. Numerous Hallstatt vehicles, both two- and four-wheeled, have been found with gauges of 1.1–1.3 (Pare 1992: 133), and while Pare argues against a purely funerary use for the Hallstatt wagons he does concede that their construction precludes "travel and transport over long distances" (1992: 135).

Based on the fact that the gauge of the Sintashta vehicles is narrow, Anthony and Vinogradov (1995: 38) suggest that "the narrow wagon gauge was retained suggesting that these vehicles were local improvisations representing an early phase in chariot evolution." It is certainly possible that these were early chariots or proto-chariots, but Izbitser's comprehensive work on wagon burials states that by the middle Bronze Epoch, the gauge had been determined by tradition at no less than ca. 2 m, for the Early Bronze Age period and later, up to the end of the Catacomb culture (ca. 3000-1700 BC) (Izbitser 1992: 23 and per. comm.). The two-wheeled vehicles from Lchashen in the Caucasus, which were probably carts[6] and are traditionally dated to the 15th-13th centuries, have a significantly larger gauge of 2.25 m than the Sintashta vehicles. The gauge for Egyptian chariots in the later second millennium was 1.54–1.8 m. (Littaurer and Crouwel 1979: 78).

The purpose of the Sintashta vehicles accepted by Anthony (1995) and Anthony and Vinogradov (1995) is that they were racing chariots attached to racehorses; several verses from *Rig Veda* hymns are quoted (Anthony and Vinogradov 1995) to support this. Anthony and Vinogradov say that "Horses were often sacrificed during the mortuary rites of the Sintashta-Petrovka Culture. Many like the pair at Krivoe Ozero, appear to have been chariot teams and may possibly have been racehorses" (Anthony and Vinogradov 1995: 40). This alternative has several problems. First, although the horserace is a common motif in the *Rig Veda*, it is most often used allegorically. Sparreboom (1985: 13) points out that it is often used in an attempt to curry favor with the gods and that metaphorically "the chariot represents the word, speech, or, more specifically, the hymn of praise or the ritual as a whole." Second, there is no clear distinction between a ceremonial race and a raid (Sparreboom 1985: 14). Last, if these were racehorses (attached to chariots) used for "ritual races that offered prizes or settled disputes" (Anthony and Vinogradov 1995: 40), why would they be carrying weaponry? There is no indication in the *Rig Veda* that racehorses or their chariots carried weapons or that weapons were buried with them. However, this might be explained away by the fact that athletic competitions were often a preparation for warfare, one example being that the ancient Olympic Games had a foot race in full armor.[7] Presumably these and other games were preparation for warfare, but the distinction between military exercises and sports is blurred. In fact, the evidence for racing (on which the outcome was bet) is only clear in later Classical Sanskrit literature like the *Mahābhārata*. We should also remember that the word 'race' means two things: 'run very fast' and 'run in competition.' Furthermore, and more importantly, the *Rig Veda* hymns in question, I.162 and I.163, have only one horse, and thus there is no competition.

A more difficult problem is the use of the term 'racehorse' in the quotations from Hymns 162 and 163 of the *Rig Veda*. Here, Anthony and Vinogradov depend on the translation by O'Flaherty (1981). While this translation is the best known to English speakers unfamiliar with the Vedas, it is not the only translation.[8] Geldner (1923), the great German scholar, on whom all other Vedic scholars depend and refer (including O'Flaherty), translates what O'Flaherty calls 'racehorse' in various ways including *Streitross* (war-horse). In the two hymns in question there are in fact four different "horse" words 1) *arvann* translated by O'Flaherty as 'swift runner' and Geldner

as simply 'runner'; 2) *vājy-arvā* is translated by both as 'racehorse' but *vājyarvā* is merely a synonym of *arvan*; 3) *vāji* is translated by O'Flaherty as 'racehorse' and Geldner as alternately 'war-horse' and 'triumphant horse'; and 4) *áśvō* is the simple word for 'horse'. O'Flaherty translates *áśvō* as both just 'horse' and 'racehorse' but Geldner translates it as simply 'horse' and 'war horse.' The 19th century scholar Griffith (1889) translated the same words more romantically as either 'steed' or 'charger.' It is clear, therefore, that there is no compelling reason to translate these "horse" words as 'racehorse' and, in fact, it is misleading.

Anthony and Vinogradov (1995) quote Hymn I.163 which is a hymn in praise of a horse, and I.162 which describes the *aśvamedha*, the sacrifice of the horse. It is possible that these hymns may apply to the horse burials found alone without vehicles at Sintashta, but they do not apply where human burials are concerned. There is nothing in either hymn to indicate a human burial connection. It is also highly questionable as to whether or not the horses in the hymns are chariot horses. The chariot is mentioned only once in each hymn and in the O'Flaherty translation the clearest reference is from *RV* I.163.8:

> "The chariot follows you, Swift Runner; the young man follows, the cow follows, the love of young girls follows. The troops follow your friendship. The gods entrusted virile power to you" (O'Flaherty 1981: 87).

Geldner's (1923: 225-227) translation is similar, but why the chariot and all the others follow the horse is unclear. Perhaps because of the swiftness of the horse, perhaps because this is the order in which they are favored by the gods, or perhaps as a logical description of the acquisition of wealth dependent on the domestication of the horse.

Only at the end of Hymn I.162.21 is the chariot mentioned. According to O'Flaherty (1981: 91-92):

> "...the two bay stallions, the two roan mares are now your chariot mates. The racehorse has been set in the donkey's yoke." *RV* I.162.21 .

But Geldner (1923: 225) translates the second half of the verse as

> Das Streitroß ward an die Deichsel des Esels eingestellt.
> "That war-horse has been set on the Ass's shaft"

It appears that the horse, be it race or war, has now become a chariot horse. But we should also remember that only gods drove chariots in the *Rig Veda* and that humans were buried in the chariot graves in the Sintashta-Petrovka type burials. Therefore, keeping in mind the allegorical nature of races in the *Rig Veda*, it seems questionable to interpret these horses with their "chariots" as racehorses.

Furthermore, if the vehicles would have been unstable as war chariots, which Anthony and Vinogradov admit, they would have been equally unstable for races. An added impediment to this theory is where would these chariots have been raced? The Steppe, although flat, is not even and would have been extremely hazardous as a place for racing vehicles. If race courses had been created, no trace of them has been found despite extensive aerial photography in the area.[9]

There is precedent, however, that chariots were the ceremonial transport to the Otherworld. We find this both in the Sumerian and Hittite examples already mentioned and in the wagon burials found in other parts of the steppe and the Caucasus (Izbitser 1993). This tradition of Otherworld transport continues both on the Steppe and in Europe down to the Iron Age (Piggott 1983; Pare 1992; Jones-Bley 1997). Moreover, that the chariot as transport to the Otherworld is spelled out clearly in *RV* X.135. Here it is the sacrifice, the means of transportation, to the world of Yama—the Otherworld (Macdonell 1917: 212-216).

Burial with wheeled vehicles seems to have begun soon after the invention of the wheel and continued through the Iron Age. There is nothing to suggest a tradition of taking racing chariots to the grave but there is a wealth of evidence to suggest that the vehicles—both four-wheeled and two-wheeled—were used for transport to the Otherworld (Jones-Bley 1997; see also Piggott 1983). Gening took this view in 1977 and no evidence has been presented for the burials of Sintashta-Petrovka for this view to be changed.

Although we have records of great chariot battles, where these battles took place had to be selected with care in order to have space for the chariots to maneuver and the ground had to be reasonably flat (Littaurer and Crouwel 1979: 92). While much of Anatolia would be unsuitable for chariot warfare (Macqueen 1986: 59), much of Egypt and the Near East would qualify. Another factor rarely mentioned are roads. One Hittite text refers to the king arriving at a ritual place, *hešti*-house, on a light chariot by way of a "great road" (Gurney 1977: 41). Roadways in areas outside the Near East are very problematic. Trackways are known from England, Ireland, and Germany but they are narrow and would hardly have serviced a wheeled vehicle. Wheeled vehicles require more than a path used by pedestrians that in a wet climate would often become impassable except on foot. Egypt and Mesopotamia have much drier climates with flat, less encumbered terrain more suitable for wheeled transport. Moreover, these very complex societies had extensive trade routes that were in constant use.

Conclusions

If the Sintashta-type "chariots" would not be stable for battle, they would also not be stable for a race. These are not the sturdy vehicles found in the Near East that provided heavy use on either the battle or playing field. This point was made by Piggott in 1983, and again in 1992. There is not enough evidence to indicate that the Sintashta-Petrovka chariots performed in the role of war chariot or race chariot. Piggott (1992) and Littaurer and Crouwel (1996) believe these were prestige chariots, and to some extent, I agree. More importantly they were burial vehicles. These chariots took their warriors to the Otherworld, and there is an enormous amount of evidence for the burial

vehicle (Pare 1992; Jones-Bley 1997). They were first seen in Sumer, and in the Indo-European speaking world first in the Russian steppe north of the Caucasus.

There is no reason to deviate from Gening's conclusion that the Sintashta-type "chariots" were anything but transport to the Otherworld. Given the technical problems with these vehicles, the narrow gauge and nave dimensions that rendered them markedly unstable (Littaurer and Crouwel 1996), Anthony's hypothesis that these were chariots used for racing competitions is based at the very least on incomplete information and on faulty assumptions. The Sintashta-type "chariots" were not the "Birth of the Chariot" (Anthony and Vinogradov 1995) but as Littaurer and Crouwel (1996: 938) suggest imitations of vehicles found in the Near East, but at Sintashta used as transport to the Otherworld.

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Endnotes

1. The Germanic god Thor also had a vehicle (alternately called a chariot or wagon) pulled by goats.

2. Huld (2000) has shown that there is a correlation between wheel words and the development of the wheel.

3. I am grateful to Mary Littaurer for pointing out to me the article by A. von den Driesch in which she shows that onagers were never domesticated. My thanks also go to Dr. von den Driesch who sent me the reference.

4. Gening (1977) was translated by Warren Brewer in 1979 under the auspices of Marija Gimbutas and published as "The Cemetery at Sintashta and the Early Indo-Iranian Peoples."

5. Anthony and Brown (1991) claimed, based on a single tooth from a stallion from the Eneolithic site of Dereivka in Ukraine, that horses were bitted and ridden. The radiocarbon date for this Derevika stallion was early on disputed and has been shown to be not 4000 BC but Early Iron Age, ca. 700-200 BC (Anthony and Brown forthcoming).

6. Littaurer now believes that the Lchashen vehicles to be chariots (per. comm.).

7. The foot race in full armor, *hoplitodromos*, was added to the 65th Olympiad in 520 BC after the four-horse chariot race, *tethrippon*, was added in 680 BC, but it is not clear if the chariots held weaponry (see Swaddling 1980: 38).

8. There is no complete modern translation of the *Rig Veda* into English. On the difficulty of this problem see Jamison (2000).

9. There are 23 sites that are of the same type as Sintashta and nearly all of them have been found through aerial photography.

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Investigation of Bronze Age Metallurgical Slag

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Abstract
The Sintashta Culture was formed in the southern Urals during the early second millennium BC. The objective of the investigation was to reconstruct the metallurgical technology of these tribes. The investigation of the metal ores was undertaken using spectral analysis. The results indicated that the ores recovered from Sintashta settlements did not contain arsenic while, in contrast, slag retrieved from the same sites contained high levels of the element. This finding may indicate that the metallurgists had alloyed copper with arsenic during the ore smelting process. The principal component of the current research was the investigation of slag, and by using optical mineralogy it was possible to identify four mineralogical groups of slag. Metallurgy was absent in the Transurals prior to the development of the Sintashta Culture. Metal structures of the Caucasus and Anatolia are similar to the metal structure of the Sintashta Culture, however, and it would appear that the tradition of alloying during the ore smelting stage was established in the Transcaucasus. This finding reaffirms the author's theory that the Sintashta people migrated from either Anatolia or northern Syria.

Key words
Bronze Age, metallurgy, Sintashta Culture, slag

Introduction
The Sintashta Culture of the southern Urals is one of the brightest archeological ensembles of northern Eurasia, and is represented by large fortified settlements and cemeteries with magnificent burial tombs. It was formed during the 18th century BC (in the traditional or non-calibrated chronological system) that in radiocarbon terms corresponds to the late third or very early second millennium BC.

The Sintashta Culture was the basis on which the subsequent Petrovka, Srubnaya and Alakul[1] Cultures of the Late Bronze Age developed. These cultures were localized in a vast geographic region from the Dnieper River to eastern Kazakhstan. The origins of the Sintashta Culture, therefore, always have been considered within the framework of the origins of the Indo-Iranian populations that have some features relating to the cultures of Eastern Europe, e.g., the Abashevo and Late Catacomb Cultures, the Multiroller ceramics, and the late Yamnaya Culture. This theory enables one to suggest that the Sintashta Culture originated as a consequence of Eastern European impulses (Smirnov and Kuzmina 1977), but these parallels are too limited. In addition, it is possible only to compare the contemporary complexes of Eastern Europe, which are dated to within the framework of the Middle Bronze Age II. Comparisons with earlier complexes are virtually impossible. This perspective has been the subject of discussion by Zdanovich (1997) who suggested local Eneolithic roots for the Sintashta Culture, although he assumed some degree of western impulses. He did not, however, adduce any proof for his point of view. This is understandable because of the enormous distance which existed between the hunter and fisher villages of the Transurals during the previous epoch and the developed economics of the Sintashta communities. More recently, a theory has been proposed which suggested that the formation of the Sintashta Culture was connected to the migration of Iranian tribes from the Syro-Anatolian region (Grigoryev 1996a; 1998; 1999a). All the features of the Syro-Anatolian cultures have parallels with the archaeological cultures of this region, the most remarkable of which are the Sintashta fortified settlements that are identical to Anatolian settlements, including Pulur, Demirciuyuk, and many others. In addition, we find many analogies with the Sintashta Culture in the ceramics, and stone and metal artifacts of the Syro-Anatolian cultures.

The problem of the correlation between the Sintashta Culture and Abashevo Culture has been reviewed. Kuzmina (1992) has suggested that the Sintashta Culture was formed on an Abashevo base and that it corresponds to the latest stages of development of the Abashevo Culture. In contrast, the author's opinion is that the Sintashta and Abashevo Cultures were contemporary.

Materials connected with metallurgical production including slag, ore, small ingots, and furnaces are very typical of the artifacts that are recovered from Sintashta settlements. As a consequence of this situation, a number of archaeologists consider the settlements to represent very important centers of metal production in the Volga-Urals region. The settlements are described in the archaeological literature as metallurgical centers with developed levels of craft production as well as trade and exchange. Accordingly, Sintashta settlements as a whole may be discussed and, in fact, are discussed in some instances as the first pre-civilization stage in the vast Eastern European territory as well as in the Urals and Kazakhstan (Zdanovich 1995). Therefore, the problem of Sintashta metallurgy is not only

archaeometallurgical, since it also has repercussions for the origins of the Indo-Europeans and the formation of early civilizations.

Objectives of the research

The main objective of the investigation was to reconstruct the metallurgical production technology found in Sintashta settlements, and examine how this technology corresponds to concepts of craft production, and in addition to the question of a Near Eastern origin for the culture. The following issues were addressed within the overall research framework:

(1) The types of ore (chrysocolla, malachite etc.) that were used.

(2) The types of ore bearing rock (quartz, serpentine etc.) that were used.

(3) The smelting temperature that was employed. This aspect of the research was determined through the investigation of molten, non-molten minerals, and metals.

(4) The smelting atmosphere that was used. This area of the research was determined through the correlation of the quantity of copper and oxides.

(5) The relative rate of smelt cooling that was followed. This was determined through the investigation of the shapes and sizes of crystallized minerals resulting from the melt.

(6) The presence of fluxes.

(7) The quantity of copper that remained in the slag.

(8) The volume of charge that was used.

The principle methods involved in the analysis included optical microscopy, x-ray diffraction (XRD), optical emission spectral analysis, and wet chemical analysis. A total of 637 analyses of 367 samples of slag and ores were undertaken. In addition, an attempt was made to classify the various metallurgical furnaces excavated at Sintashta settlements.

Furnaces

The predominant type of Sintashta metallurgical furnace was a small dome-shaped model with a diameter that ranged from 0.7 – 1.0 meters (Grigoryev 1996b). The furnace was generally placed in a small recess on the floor although in some cases it was attached to a well that provided an air supply, and had a flue. Metallurgical slag was found in some furnaces (Fig 1: 2) and some furnaces were joined to wells (Fig. 1: 4). Experimentation has confirmed that a temperature differential existed between the furnace and the well (Grigoryev and Rusanov 1995). Other furnaces had flues that were fixed to a ditch that a depth of 10 cm, a width of 35 cm, and a length of 120-180 cm; it cannot be ruled out that other furnaces had flues not affixed to ditches. Some furnaces were constructed of lighter weight materials, were subject to distruction, and now are recognized by a conglomerate of rocks or black markings on the floor (Fig. 1: 1-4). Flues were developed to remove hazardous gasses following the introduction of sulfide ores, although the use of these ores was not especially typical for Sintashta metallurgy. Covellite and chalcosite smelting was known to have occurred in some cases, but chalcopyrites were never used in the smelting process. The furnaces were multifunctional, and were also used as ovens (Fig. 1). Furnaces that had flues with a small smelting capacity were used for more specialized purposes, namely for ore and copper smelting. It is probable that this type of furnace had developed from dome-shaped furnaces with flues.

The second type of metallurgical furnace were those which comprised two sections. The first sector was used for ore smelting, while bellows were situated in the second section. This type of furnace came into use at the end of the Sintashta Culture, and at present only a single example of this variety of furnace is known. These furnaces became more typical of the Petrovka Culture that replaced the Sintashta Culture during the 16th century BC (Evdokimov and Grigoryev 1996). The Petrovka Culture furnaces, however, warrant further research as they display a number of variations similar to Sintashta Culture furnaces. It is possible that the second section of certain Petrovka furnaces were used for tapping slag, and similar furnaces at Timna have been investigated (Rothenberg 1990).

Ores

The investigation of ores was carried out by means of optical emission spectral analysis. According to Chernykh (1970), metallurgists of the Sintashta period exploited two main raw materials. Copper ores were obtained from the sandstone of the western slopes of the Urals and were exploited by the Abashevo populations, while ores derived from the Tash-Kazgan deposit were exploited by the Sintashta peoples (Chernykh 1970). The latter source was the more important of the two due to its richness in arsenic, and smelting these ores resulted in the production of natural arsenical bronzes. The current research of the author, however, provides a different conclusion. The ores recovered from Sintashta settlements were found not to contain arsenic, although the slag retrieved from the same sites had a high content of this element (Fig. 2). The majority of ores were mined from either serpentine or ultra basic ore-bearing rock deposits, although quartz is known to have been the ore-bearing rock of the Tash-Kazgan deposit. This finding may indicate that the metallurgists had alloyed copper with arsenic at the ore-smelting stage.

The chemical characteristics of the ores revealed the presence of three chemical types (I - III) and eight chemical groups (Table 1). Therefore, the Sintashta metallurgists used at least some ore deposits. The optical emission spectral analysis, however, does not indicate that the ore had originated from any specific deposit, and only isotopic analysis has the potential to provide such evidence. Nevertheless, the data obtained from this small number of deposits that were used during the Sintashta period, essentially changes the current state of knowledge concerning the nature of metallurgical production during this time.

Slag

The principal aspect of the research was based on the investigation of slag. Two types of non-tapped slag were identified; a non-forming type, and a variety that was flat (Table 2). The

latter form of slag was found to be dominant in the Sintashta collection (72%), while only 38% of the Petrovka examples comprised this type of slag. The forms of slag are identical to the varieties of early slag found in Eastern Anatolia and Iran (Hauptmann, et al. 1993, abbs. 2: 3–4).

Optical mineralogy enabled the identification of four mineralogical groups of slag (Table 3):

Group I - The main component comprised large olivine crystals. Other components included chromites, magnetites, copper (0.1 - 1%), and ores (predominately malachite, followed by azurite, covellite and chrisocolla). This type of slag had been obtained by smelting ores from serpentine and ferriferous ultra basic rock. Initially, it was identified from the presence of chromite grains. All varieties of this group relate to the flat form of slag.

Group II - The microstructure of the slag is similar to that of Group I, but without chromites. The slag contains grains of quartz associated with the ores, and it was produced from a quartz ore-bearing rock.

Group III - This variety of slag contained both quartz and chromite inclusions.

Group IV - This type of slag contained high levels of cuprite inclusions, and the level of crystallization was very poor.

Slag samples were also subjected to spectral analysis that enabled the determination of certain chemical groups. The correlation of chemical and mineralogical groups indicated that slag of the Group I and III mineralogical groups had been obtained as a result of smelting ore which was derived from deposits of a single type. Therefore, ore deposits in serpentine and ultra basic rocks sometimes contained quartz veins with additional rich copper ore. Slag from the Group II mineralogical group was found to have been obtained by smelting ore that had been obtained from diverse deposits located in quartz rock. The slag belonging to the Sintashta collection which had been smelted from ultra basic rock that comprised 82% of the sample (Groups I and III) (Table 3). At the beginning of the Late Bronze Age Petrovka Culture, the use of such ore was found to have been reduced to 14.5%. This finding therefore allows one to postulate that the Petrovka Culture had developed in northern Kazakhstan as a consequence of Sintashta impulses to this region. In addition, it would appear that the early stage of the culture was partially synchronous with the Sintashta Culture in the Transurals. The use of similar ores apparently was a characteristic of the early stage of the Petrovka Culture, and this finding has been confirmed by the paucity of similar slag among a significant number of Late Bronze Age slag samples that were investigated by the author earlier this year. It is also of interest to note that the Abashevo collections contain a larger quantity of the "later" group of slag, relative to the Sintashta collection.

The smelting of ores from ultra basic ore-bearing rocks and serpentine, that contain insignificant levels of copper is a curious paradox of Sintashta metallurgy. A great number of ore deposits of other types that are rich in copper are present in the Urals, but no evidence has surfaced for the use of such pure ores by the Sintashta metallurgists.

Technology

The technological characteristics of the Groups I to III types of mineralogical slag are similar, and it is therefore probable that they relate to a single technological group (Table 4). Smelting temperatures would have occurred at approximately 1200°C, and definitely at a temperature less then 1400°C as indicated by the crystallization of olivine, the overheating of cuprite, the non-molten condition of the magnetite, the occurrence of molten chalcosine, the presence of tridimite, and the lack of crystobalite. The rate of smelt cooling was low since the size of the crystallized metals produced during the smelting process were small. The atmosphere was reduction, a situation that is rarely associated with cuprite, and only low levels of copper were lost in the slag. The nature of the slag permits the identification of the quantity of loaded charge and copper that was produced. The copper ingots had a diameter of approximately 8–10 cm, with a depth of 0.5–1 cm, and a weight of charge of 0.5–1 kg. Therefore, the charge comprised 10–15% copper, although the preliminary ore was probably poorer.

The second technological type of slag that belongs to the Group IV mineralogical group was discrete. Although the smelting temperature was similar (1200–1400°C), the smelting atmosphere was oxidization, and higher levels of copper were lost in the slag. The technological processes were not, therefore, typical for Sintashta metallurgy although they became characteristic of the early stages of the Petrovka Culture. This change in technology appears to have arisen as a consequence of a change in the types of raw materials used. The technology practiced by the newcomers from northern Kazakhstan was not suitable for smelting ores containing quartz because of the tradition of using fluxes that may have been absent throughout the entire Sintashta period. This problem was solved when sulfide ores became used for smelting (Group III technological group).

The origin of Sintashta metallurgy

Metallurgy is not known in the Transurals before the advent of the Sintashta Culture The metallurgists of the Yamnaya Culture located on the western slopes of the southern Urals were not familiar with the production of arsenical bronzes. Alloys, in the form of copper with arsenic, were typical for the Circumpontic region during the Middle Bronze Age (Chernykh, et al. 1991, fig. 5), but ore smelting was not known in the northern Caucasus and Eastern Europe. Metallurgical production in the Balkan Peninsula was primarily of "pure" copper; copper alloyed with arsenic or tin was less typical. The metal structures of the Caucasus and Anatolia appear to have been more closely related to those of the Sintashta Culture (Fig. 3), but tin bronzes were used more extensively in these regions than in Sintashta metallurgy. This finding may be explained by a paucity of tin in the Urals. The tradition of alloying, as a stage of ore-smelting, was noted at the Uzerlik-Tepe settlement in Transcaucasia. This finding corresponds to the author's preliminary conclusions that the Sintashta people had migrated from Anatolia or northern Syria. Therefore, in the period directly previous to the migration into the Sintashta Culture, the enormous trade in tin that was occurring in eastern Anatolia, had been interrupted by the Hittite expansion and elimination

of the Assyrian trade colonies. Subsequently, this trade was re-established throughout northern Syria and the Mediterranean.

As noted above, the reasons for the use of poor ores from serpentine and ultra basic ore-bearing rock by the Sintashta metallurgists of the Urals is not clear, particularly since it is known that many rich deposits of other types occur in this area. The situation can be explained, however, if we take into account that copper deposits are also found in the ultra basic rocks and serpentine of southeastern Anatolia, the location from where the Sintashta people migrated (Seeliger, et al. 1985). A comparison of Sintashta metal structure with the metal structures of the various regions within the Circumpontic zone reveals that the ratio of quantity of tools and weapons with ornaments and other finds is similar to those from the Transcaucasus and Asia Minor (Fig. 4). This finding adds further support to the conclusion that Sintashta metallurgical technology originated from the Near East.

Conclusions

Iranian tribes appeared in northern Eurasia and settled primarily in the Transurals and along the Belaya River. In the vast region from the Dnieper River to the Ural Mountains, two discrete zones were formed–a metal-producing zone in the southern Urals, and a metal consuming zone in the remainder of the area (Fig. 5). Metallurgical slag dating to the end of the Middle Bronze Age has only been recovered from the first zone. This situation reflects the cultural and "political" system that formed as a result of Iranian migrations from the Near East. The distribution of slag in this region permits us to draw conclusions pertaining to the correlation of the Sintashta and Abashevo Cultures. The latest metal used was from the Urals (Chernykh 1970). The absence of Abashevo smelting in the Volga region indicates that Abashevo people imported metal from either the Sintashta settlements or from populations living along the Belaya River in the western slopes of the Ural Mountains. Nevertheless, the Abashevo settlements along this river have been found to contain a number of Sintashta cultural features. This finding is a very important aspect for the theory that supports a synchronization of the Sintashta and Abashevo Cultures.

In my opinion, however, it is not possible to describe Sintashta metallurgy as a craft production system associated with developed levels of trade and exchange. Every Sintashta settlement and every Sintashta dwelling contains metallurgical remains and, therefore, none of the settlements should be described as metallurgical centers. If this distinction is not incorporated into the terms of a "metallurgical center," the term loses its specific connotation. The beginning of craft production commenced with the division of labor. Moreover, the volume of production was very small and is more characteristic of typical home production. Metallurgical development of the Sintashta Culture does not correspond to the theory that it represents a "pre-civilization" stage; moreover, the term "pre-civilization" used by Zdanovich (1995), is very obscure. The term "civilization" apparently implies a social structure where "socio-individual relations within the system are realized through legal norms" (Grigoryev 1999b: 111). Even this situation cannot be assumed for the Sintashta society. Nonetheless, Sintashta must be a level of society that corresponds to the attainment of an early state. I do not know exactly what should be understood by the term "pre-civilization stage," and the conventional term "chiefdom" is also not concrete. Indeed, nothing exists within the Sintashta Culture that provides sufficient information to enable discussions relating to issues of whether the society was either a "civilization" or a "pre-civilization."

There is a possibility, however, that the appearance of Sintashta metals in Eastern Europe could reflect long-distance exchange, and could therefore be used as a basis for a "pre-civilization" theory. To understand this exchange system it is necessary to perceive the possible mechanisms of exchange that may have been in action. It is quite feasible that a certain distribution of metal may have occurred, if westward migrations of discrete Sintashta populations occurred during the later years of the culture. Subsequently, it is necessary for specific research to be undertaken to determine the relationship that existed between the Sintashta Culture and the populations of Eastern Europe. Without further investigation, the current state of knowledge does not permit us to envisage any extraordinary stage of development in the Sintashta society.

Endnotes

1. Currently, the majority of archaeologists include the Alakul Culture together with the Petrovka, Fyodorovo, Cherkaskul, and a few other cultures within the so-called "Andronovo Culture." A common point of view, and my own opinion, is that the Petrovka and Alakul Cultures were formed on the basis of the Sintashta Culture. The Fyodorovo and Cherkaskul Cultures, however, had different origins and developed in other directions. This is why the Andronovo Culture (or either the Andronovo family of cultures or any other terminology) should be considered to be an archaeological myth. The Andronovo cemetery belongs to the Fyodorovo Culture. Therefore, the overextension of this term results in the unjustified simplification of the very complicated processes that occurred during this era.

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Table 1. Chemical groups of the ores recovered from the Sintashta settlements.

Chemical groups **Settlements**	**I – 1**	**I – 2**	**II – 1**	**II – 2**	**II – 3**	**III – 1**	**III – 2**	**III – 3**
Sintashta	30	7	8	-	-	-	-	-
Ustye	-	-	7	20	-	-	-	4
Arkaim	-	-	3	-	4	-	-	5
Mayli-Yurt	-	10	-	-	-	-	-	-
Tash-Kazgan	-	-	-	-	-	-	4	-
Sergeevka	-	-	-	-	-	2	-	-
Burli	-	-	-	-	-	1	-	-
Rodniki	-	-	-	-	-	-	1	-
Yagodni Dol	1	-	-	-	-	-	-	-

Table 2. The distribution of the flat and non-forming slag over the various cultural groups

Cultural groups	**Slag**	
	Flat	Non-forming
Sintashta	54 73%	20 27%
Abashevo	6 30%	14 70%
Petrovka	8 38%	13 62%
Mixed cultural levels	70 70%	30 30%
Others	0 0%	7 100%
	140 **62,5%**	**84** **37,5%**

Table 3. Distribution of the mineralogical groups of slag over the different cultural groups.

Mineralogical Groups **Cultural Groups**	**I**	**II**	**III**	**IV**	**Others**	**Total**
Sintashta	45 60%	12 15.5%	17 22%		2 2.5%	**76** **100%**
Abashevo	7 35%	4 20%	3 15%	6 30%		**20** **100%**
Petrovka	3 14.5%	1 4.8%		14 65.2%	3 14.5%	**21** **100%**
Mixed cultural levels	36 36%	14 14%	31 31%	18 18%	1 1%	**100** **100%**
Others		4 4%				4 4%
Total	**91** **41.2%**	**35** **15.8%**	**51** **23.1%**	**38** **17.2%**	**6** **2.7%**	**221** 10 **0%**

Table 4. The distribution of the different technological types over cultural groups.

Technological types / **Cultural groups**	**I**	**II**	**III**	**Others**	**Total**
Sintashta	74 97.3%			2 2.7%	**76** **100%**
Abashevo	14 70%	6 30%			**20** **100%**
Petrovka	4 19.3%	14 65.2%	3 14.5%		**21** **100%**
Mixed cultural levels	81 81%	18 18%	1 1%		**100** **100%**
Total	**175** **79.2%**	**38** **17.2%**	**4** **1.7%**	**2** **0.9%**	**221** **100%**

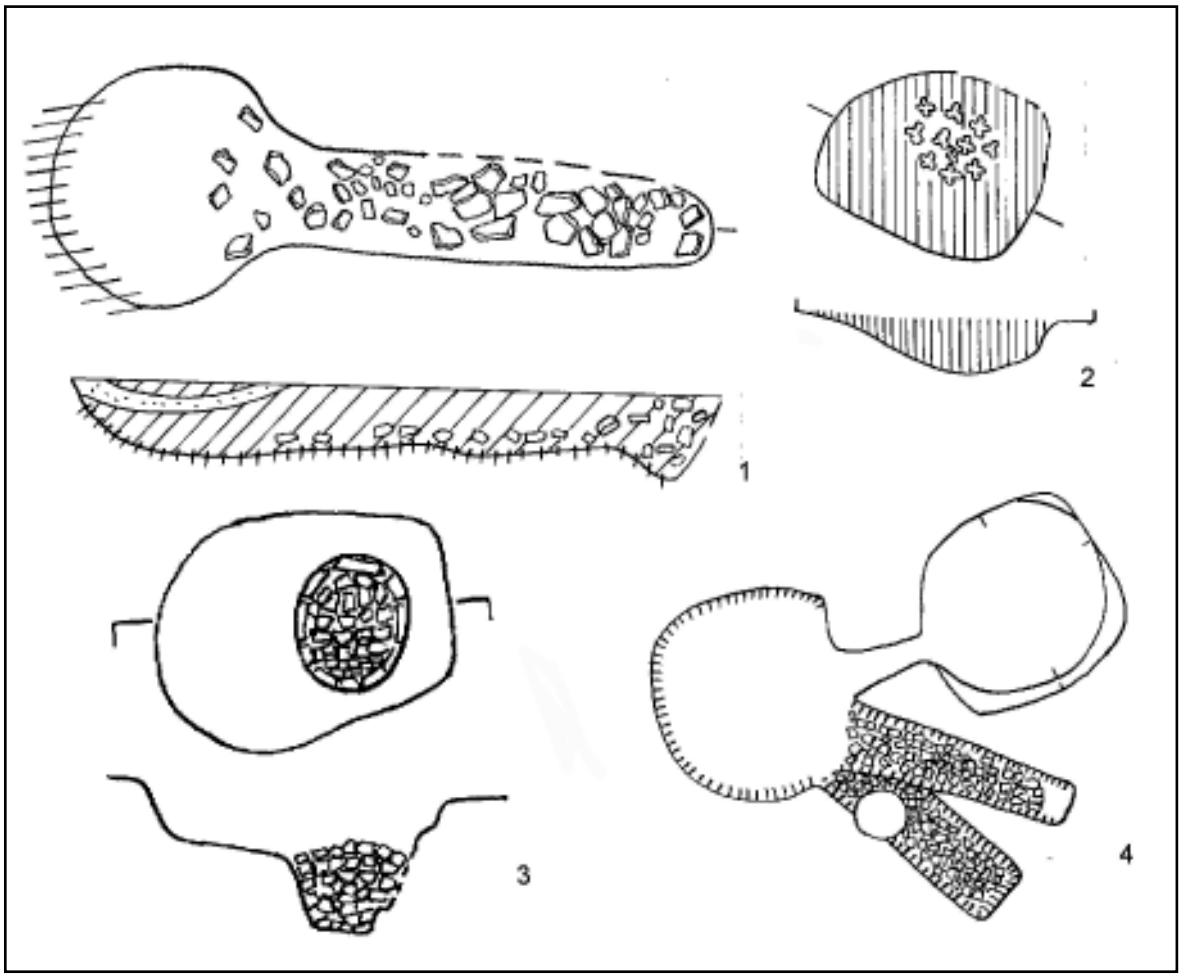

Fig. 1. Types of furnaces found in the Sintashta settlements.

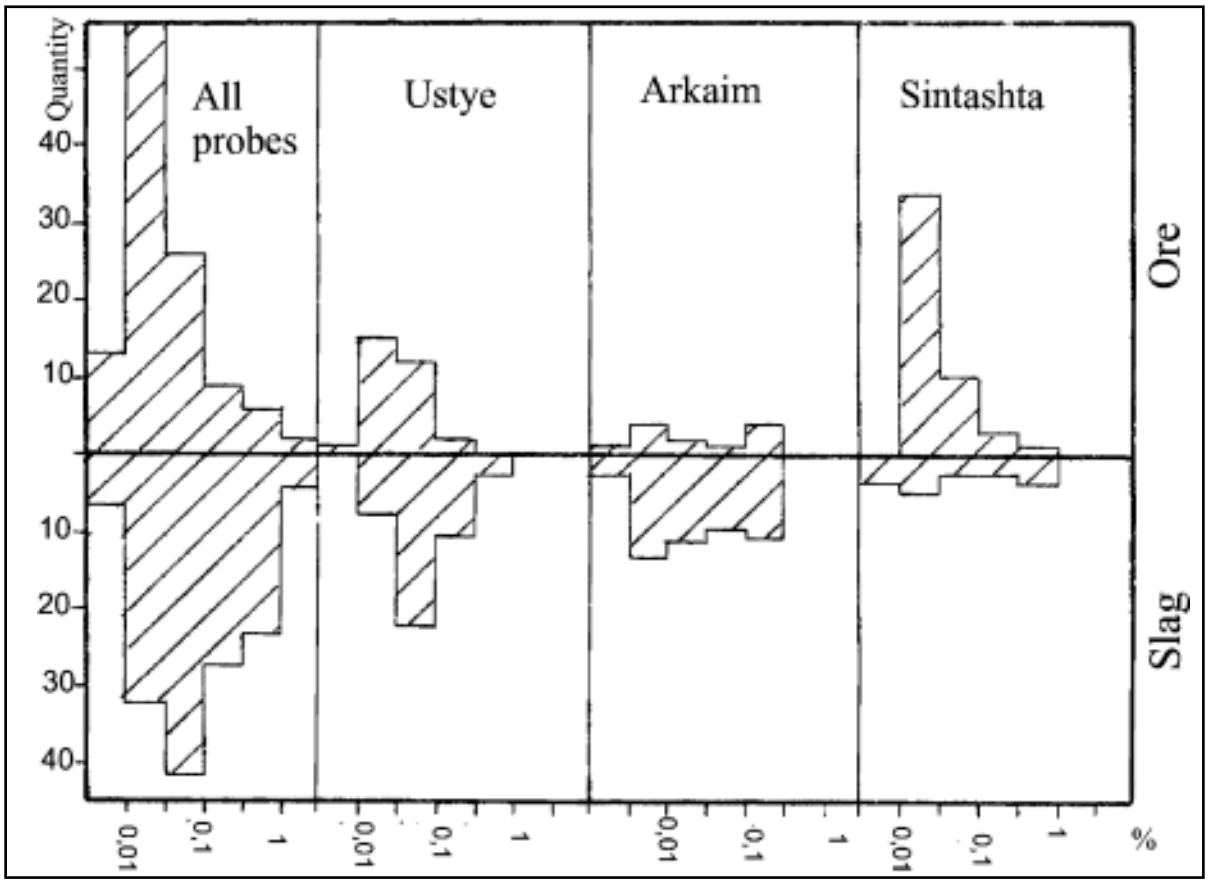

Fig. 2. Correlations of arsemic-inhalt in ores and slag in the Sintashta Culture.

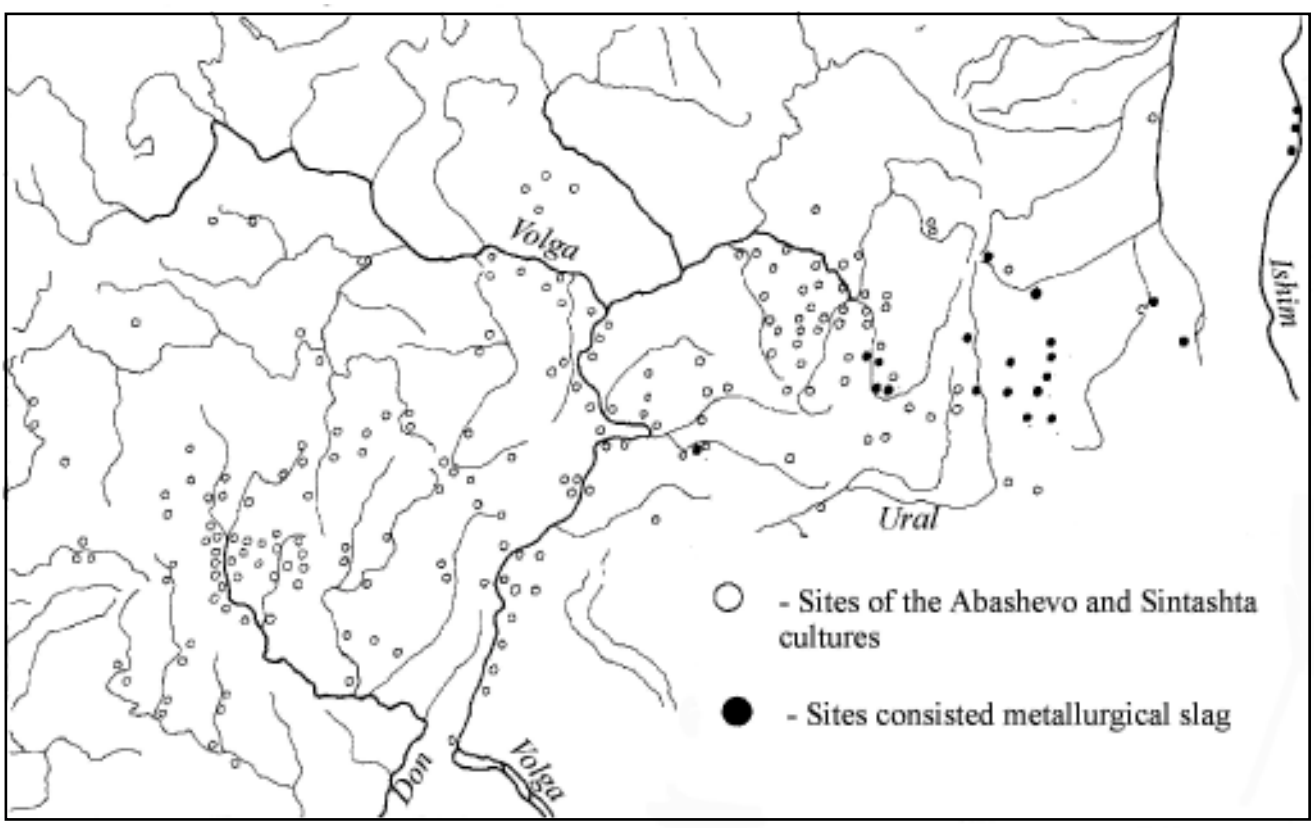

Fig. 5. Locations of slag found in the Volga-Ural region.

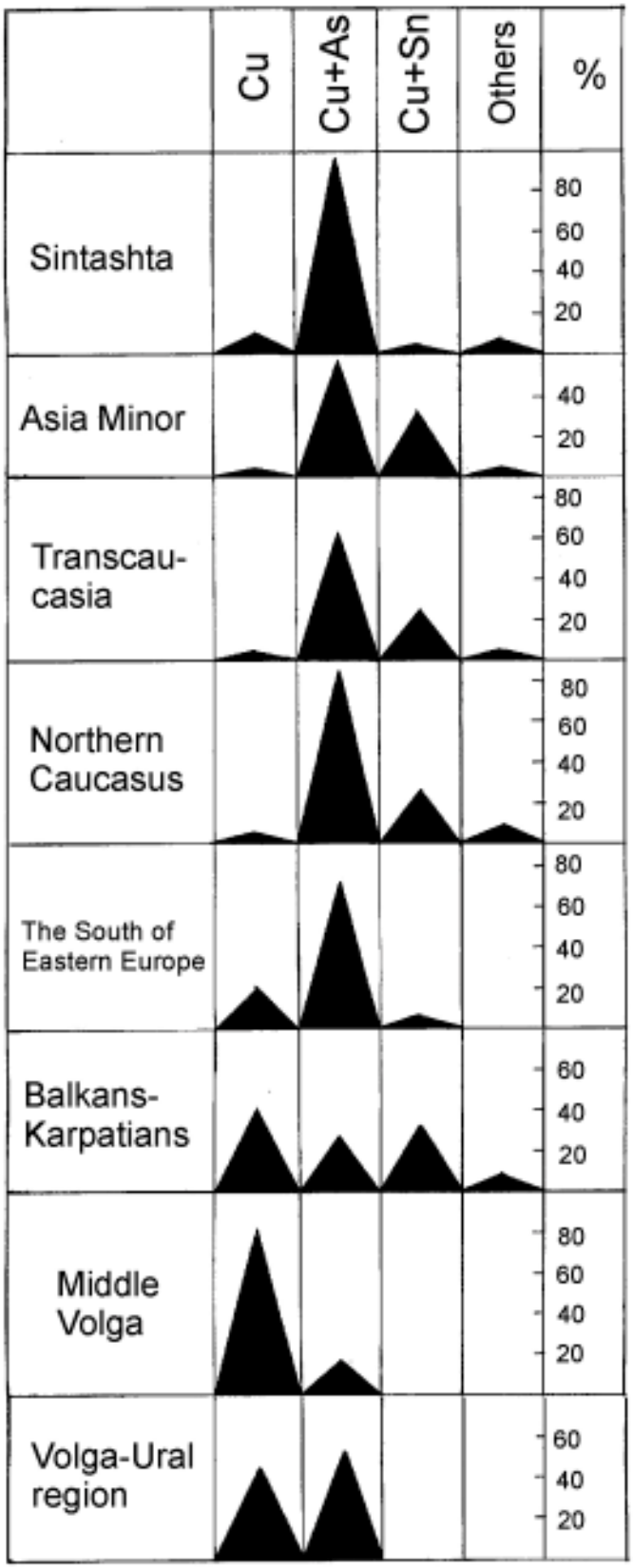

Fig. 3. Correlations of different types of alloys in northern Eurasia.

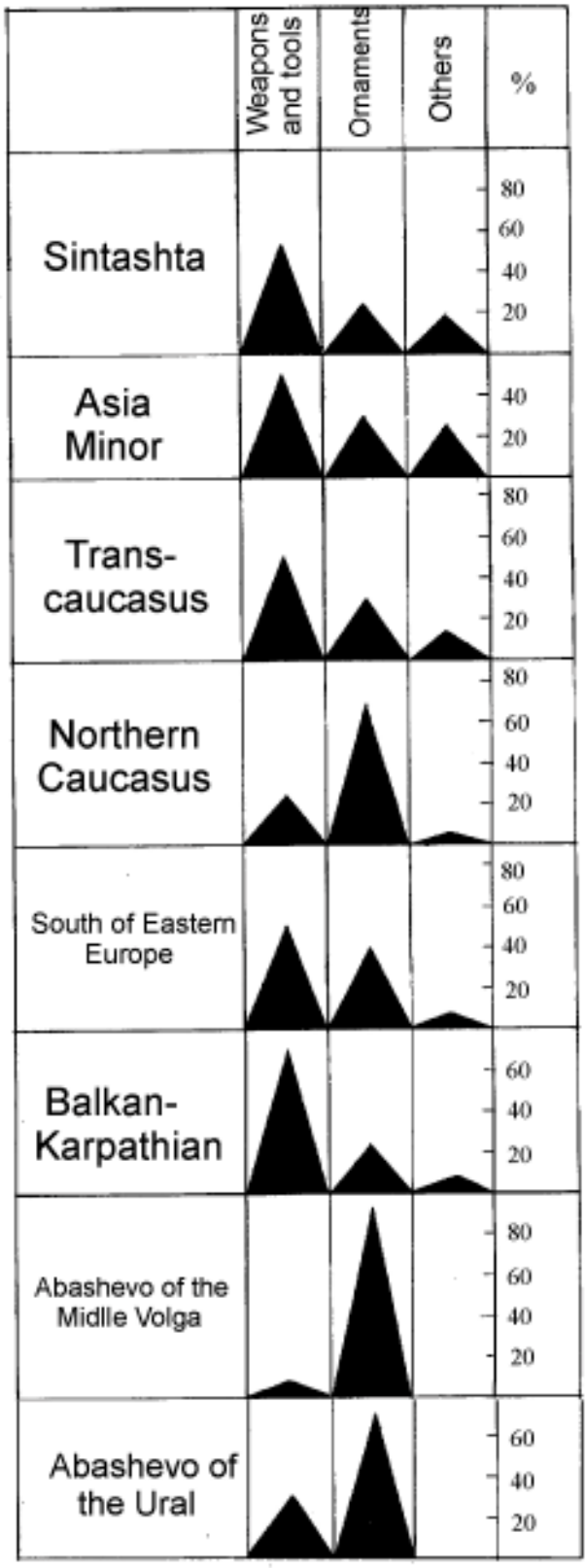

Fig. 4. Correlations of different artifact types in northern Eurasia.