THE EARLIEST SOCKETED AXES IN SOUTHEASTERN EUROPE: TRACKING THE SPREAD OF A BRONZE AGE TECHNOLOGICAL INNOVATION

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Abstract: Although their early evolution is largely obscure, socketed axes are among the most numerous artefacts of the Southeastern European Late Bronze Age. They seem to appear at once in a horizon of hoards conventionally parallelized with the Central European B2 D phase. Some researchers have tried to explain this sudden occurrence as the result of a local development which began with Early Bronze Age socketed chisels. Others seek their origin in the Seima-Turbino metalwork horizon (in which socketed axes are already attested to in the first quarter of the 2nd millennium BC). Starting from there, a complex pattern of transmission through different cultural milieus is suggested until their arrival in the Carpathian Basin around 1300 BC. The present contribution sets out to clarify some aspects of the invention and spread of this Bronze Age innovation.

Keywords: Southeastern Europe, socketed axes, Seima-Turbino Horizon, innovation

Introduction

Socketed axes are among the most characteristic artefacts of the Late Bronze Age (LBA) in Southeastern Europe. Compared to the characteristics of older axe types, they are a major technological innovation. Not only were fewer raw materials needed in the casting of a socketed axe head (Kibbert 1984, 118; Wanzek 1989, 153-154), but a comparable impact force could be generated through the weight of the wooden shaft. The insertion of the shaft directly into the axe head would solve one of the major problems of other axe forms; in this way, the axe head would no longer be pushed deeper into the shaft with every blow until the wood finally splits (Dietrich 2010b). Furthermore, the shaft would not have required refashioning in order to change between the functionalities of axe and adze; the simple turn of the axe head and re-fastening would have sufficed (Fischer 1999, 42).

Socketed axes made a sudden appearance in Southeastern Europe in a hoard horizon conventionally parallelized with Reinecke’s Bronze Period D (Dietrich 2010c), usually thought to have started around 1300 BC. As with all innovations, the how and when of this phenomenon are of central interest and a topic of debate. While some researchers propose a local development of the socketed axe in the metal-rich Carpathian Basin on the basis of socketed chisels (which are attested there from the Early Bronze Age onwards (comp. Dietrich 2010c), others tend to seek their origin further to the east (Bočkarev 2002, Uşurelu 2010, 46-52).

Setting the scene: the Seima-Turbino Horizon

The exponents of the theory of an eastern origin for the socketed axe take their starting point in the metalwork of the so-called Seima-Turbino Horizon (STH; for the discussion below see map in Figure 1). This generic name covers an EBA metalwork horizon characterized by socketed axes, looped spearheads and knives with zoomorphic handles that spread over a vast area of Eurasia between the Jenissej in the east and the Baltic Sea in the west (Chernykh and Kuzminikh 1987; Parzinger 1997, 224, Fig. 1). To the southeast, the distribution area of typical metalwork reaches the middle course of the Volga, while one outlier (the famous hoard from Borodino with Seima-Turbinotype spearheads) reached as far as the Black Sea area (Kaiser 1997, 67-91).

The STH has long been dated by means of the typological comparison of objects from the Borodino hoard with 16th and 15th centuries BC Mycenaean finds (Kaiser 1997, 23-24 with bibliography). However, four radiocarbon dates seem to support a much earlier date roughly between 2000 and 1600 calBC (Chernykh 2008, 86-87; Hanks et al. 2007, 359, Fig. 3; Yungner and Karpelan 2005 ). Though still few

1 This judgment has been challenged. Kibbert (1984, 118) has argued that the functionality of an axe head is determined by its weight; Fischer (1999, 36) and Wanzek (1989, 152-153) think that socketed axes are not functional for heavy woodworking for the same reason. Socketed axes weigh mostly less than 500g (Fischer 1999, 40). However, this is also the weight range exhibited by Copper Age flint and ground stone in Southeastern Europe (e.g. Klimscha 2011, 367, Fig. 7) and the latter encompassed complex functionalities including woodworking (Klimscha 2011, 367-368). A simple equation of axe head weight with functionality is, thus, impossible. One must also take into account the weight of the shaft. Sleeves are attested to in the shafting of socketed axes, a practice which would have added centrifugal mass to the axe (Dietrich 2010a). Another possibility is the production of shafts with a considerably thickened upper part (e.g. Dietrich 2010a: Fig. 2/3). Experimental work supports the possibility of cutting wood with socketed axes (Roberts and Ottaway 2003, 125).

2 Evidently this complex problem cannot be thoroughly explored within the confines of this paper. Many of the issues presented below are re-addressed in detail in my PhD thesis.
and from samples for which an old wood effect cannot be excluded, these early dates find some support when linked to a series of radiocarbon data for the Abashevo and Sintashta cultures, since metalwork (and, more seldomly, pottery of the latter) was found in some Seima-Turbinon cemeteries (Chernykh 2008, 86-87). Thus, absolute dates between 2200-1600 BC for the STH do seem possible at the moment.

The early dating of the STH opens up the possibility that the socketed axes typical for this horizon are the earliest in Eurasia. A direct date is available from wood found inside the socket of an axe from one of the graves at Yur’ino; it dates with a probability of 89.9% to 1985-1747 calBC (Yungner and Karpelan 2005, 112). Based on these new dates, Bočkarev (2002) and Uşurelu (2010, 46-52) have suggested that the socketed axe was distributed westwards by groups which migrated from the STH Siberian core area. In order to assess the probability of this model, it is necessary to include a short account of the information available on the STH and the problems related to this archaeological phenomenon.

Chernykh (1992, 216) counted 422 metal objects and 30 casting moulds over the whole of the STH distribution area (representing a zone measuring around 3,000,000km²), of which the majority came from only five cemeteries. Most of these sites were unfortunately excavated and published insufficiently. In some cases, the graves were reconstructed by agglomerations of bronzes (Kaiser 1997, 77-78), as human bones were conspicuously lacking from many complexes. The grave goods (i.e. metal, bone and stone weapons as well as lamellar bone armor and jadeite ornaments) are thought to evoke the image of elite warrior identities (Chernykh 1992, 216). A few burials were identified as ‘founder’s graves’ due to casting moulds discovered within (Chernykh 1992, 218). Ceramics were generally missing from the graves, making it hard to correlate them with cultures defined on basis of pottery style. Consequently, no STH settlements are known (Chernykh 1992, 216; Parzinger 1997, 224).

Chernykh (1992, 215-216) classes this conglomerate of widely-scattered (but formally somehow unitary ⁴) bronze

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⁴ Chernykh (1992, 217-224) highlights seven distinct groups inside the Seima-Turbinon area by the regional clustering of find spots. He further brings forward arguments for a general differentiation into an eastern and a western group by metal types and differences in the alloys.

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Figure 1: Model of the proposed spread of socketed axes from east to west. At present, radiocarbon data are only available for the Seima-Turbinon axes; the other dates are just estimates (images of axes after Uşurelu 2010; base map: www.stepmap.de).
objects as ‘the Seima-Turbino-Transcultural Horizon’, a package of specialized, innovative bronze objects and technology which spread throughout Eurasia by westward-migrating Siberian groups. Other authors have been more reluctant in their interpretations as pointedly summarized by Parzinger (1997, 226-228). As most archaeological cultures in Eurasia have been defined by pottery styles, he argues that the Seima-Turbino bronzes, because they are usually not associated with ceramics simply did not fit the traditional heuristic approach to material culture. Parzinger emphasizes that the metal objects seen as typical for the STH were also common in local cultures in many cases (comp. Bočkarev 1986; Kaiser 1997, 80-81 with further bibliography) and were attributed to a distinct horizon only if their find contexts did not include pottery. According to Parzinger (1997, 226), this would be the reason for the many single finds and badly-documented grave inventories which appear among the overall body of archaeological discoveries. Ultimately, he regards Seima-Turbino metalwork as having been firmly integrated into the local Andronovo, Abashevo and Srubnaja cultures (Parzinger 1997, 228).

The STH is, thus, highly disputed. Based on the evidence available at present, the whole concept may have to be reduced to the basic statement that over a vast territory and apparently in different cultural milieus in the late 3rd and early 2nd millennium BC grave ensembles, with formally comparable rich metalwork (including socketed axes, spearheads and knives) appeared. These discoveries seem to convey the impression of steppe warrior elites who rapidly adopted new symbols of power (Anthony 2007, 446-447). The appearance of this package of elite metalwork represents the moment in which important technological innovations become visible to the archaeologist for the first time, presumably also including the socketed axe. However, the short account presented above should lead to some restraint in taking a thus far poorly understood phenomenon as the starting point for a grand historical synopsis. The arguments presented in favor of this horizon being the origin of the socketed axe in the Carpathian Basin should be carefully evaluated.

**An eastern innovation travelling westwards?**

Bočkarev (2002) has taken the early dating of the STH as the starting point in his argumentation for the spread of early socketed axes from east to west (Figure 1). In the middle of the second millennium BC, the Seima-Turbino Complex was replaced by several new cultures. Parts of these post-Seima-Turbino groups are thought to migrate westwards (bringing the socketed axe along with them) with their spread marked by the appearance of Andronovo type pottery as far west as the Dnieper. Bočkarev dates the appearance of socketed axes in the region east of the Carpathians between 1500-1300 BC. In the 13th century BC, the Noua Culture would then have brought the axes into the Carpathian Basin during its westward migration. Only at this point, the indigenous production of socketed axes would have begun followed in short shift by populations in the Danubian area (Bočkarev 2002, 118).

The last steps in this chain were discussed in particular detail by Uşurelu (2010). Starting from a chronological analysis of bronze and casting mould hoard finds from the northern Black Sea region, he highlighted four chronological horizons for depositions which contained moulds (2010, 28-34). The earliest was named after one of the characteristic finds, the ‘Golovurov Group’. For those hoards containing bronzes he describes five clusters, again understood chronologically, with the ‘Lobojkovka group’ paralleling the Golovurov group. The artefacts cited as characteristic for this horizon include several variants of two-looped socketed axes (Uşurelu 2010, 30-31).

These axes have strong typological relations with another cluster of metalwork, the so-called Derbeden Group situated at the middle course of the Volga and the southern forelands of the Urals; metal forms of both groups were found together in closed finds (Bočkarev 2002). The basic idea of Uşurelu is to use this group of metalwork as a chronological and regional bridge between the STH and the axes in the northern Black Sea area, thus constituting a chain, whose last link is the Noua Culture taking the socketed axe on its westward migration finally into the Carpathian Basin. As neither the Derbeden group nor the Lobojkovka-Golovurov groups of metalwork are dated independently, this model is based exclusively on typological links and interpretations, as well as on the paradigm that objects and innovations spread only by the migration of people. Especially the system of decoration is believed to be interconnected within the axes of all three groups, “degenerating” more and more on its way to the west (Uşurelu 2010, 45-46 with further bibliography). With secure dating for much of this presumed way missing, Chernykh (1976, 192-193) and others (cf. Uşurelu 2010, 44, note 19 with further bibliography) have – based largely on the same typological observations – proposed the Derbeden axes to derive from the Northpontic group.

Lacking the space for a detailed discussion, it is necessary nonetheless to touch upon some general problems within the typological reasoning put forward in this case. Schwarzberg (2009, 89-94) recently analyzed the Seima-Turbino socketed axes in detail. Confirming opinions earlier expressed by Chernykh (1992, 220-222), he concluded that two groups of forms are clearly distinguishable, one which was located to the east and another to the west of the Urals. The eastern group encompasses axes with the characteristic Seima-Turbino ornaments, while undecorated axes dominate the western group (Schwarzberg 2009, 93-94, 41)

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1. See also Anthony’s (2007, 444-446) regular associations of Seima-Turbino metalwork with Elamino and Krotovo cultures’ pottery in the region encompassed by the upper and middle reaches of the Irtysh and the upper Ob.
Fig. 4-7). Chernykh (1992, 224-226) has further noted that only some axes contain tin west of the Urals while the rest were made from arsenic bronze (which is typical for the local Abashevo and Srubnaja cultures). Chernykh (1992, 226) took this as evidence for the physical westward movement of ‘Seima-Turbino-type populations’, while Schwarzberg (2009, 93-94) concluded that socketed axes were traded westwards from a Siberian metallurgical center and copied locally in the East European lowlands, a process which included the loss of the original decoration system, because it had no meaning in the new cultural context.

Interesting for the question at hand is not only the start of the disappearance of the decoration system already in the area and period proposed for the STH. The western group of axes (which one would assume to have influenced the Derbeden axes) had no loops (Schwarzberg 2009, Fig. 4-5, map Fig. 6). The Derbeden axes usually had one loop, while the North Pontic Group had two (Uşurelu 2010, Pl. 1/1-4; 2/1-5; 6/18-32). This would allow for the possibility that the Derbeden axes really were a mixture of eastern (decoration) and western (loops, general form) elements in the sense suggested by Chernykh (1976, 192-193), rather than an innovation which travelled westwards.

Typological arguments seem, thus, to have reached a dead end which can only be overcome by independent absolute dating of the groups of metalwork concerned. To get beyond this line of argument, other evidence must be considered. The first step to accomplishing this is to ask what kind of innovation really travels in this case.

What innovation?

The knowledge of casting socketed implements in two-piece molds has already been attested to in Southeastern and Central Europe from the EBA onwards. Striking examples of very early socketed chisels come e.g. from the settlement of Pecica in Romania (Gogâltan 1999, 155-157, Fig. 10/1, 24/1-3, 38/2-3). The last BA occupation horizon at this site was dated by a large series of radiocarbon dates between 2000 and 1600 calBC (O’Shea et al. 2004-2005, Fig. 9). Another early socketed chisel was discovered in layer 16 of the settlement at Tőszeg in Hungary (Csányi and Tárnoki 1992, 200, Fig. 353.). This layer is attributed to the classic Nagyrév Culture, which roughly equates with Bz A2 in Central European terms (for Radiocarbon dates, see Gogâltan 1999, Pl. 7). Therefore, the casting of socketed implements was established in Southeastern Europe at approximately the same time as it was in the Eurasian Steppes. Yet another point should be stressed: it was not the way in which chisels or axes were cast that travelled.

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Seina-Turbino axes show features for pouring the molten bronze into the molds that are not found in Southeastern Europe. Most of the technological variants (‘Eingussvarianten’) which Wanzek defined as typical for Southeastern Europe (1989, 59-65, Pl. 12) include channels cut directly into the stone molds, a feature which is shared by the postulated forerunners of the Southeast European axes in the North Pontic area, as a quick survey of Bočkarev’s and Leskov’s (1980) work on this find group reveals.

The technological package that potentially came from the east would thus have to have been exclusively restricted to the idea of transferring the already well-established technique of casting socketed objects to another class of implements.

**Southeast European predecessors of LBA socketed axes**

Furthermore, the timespan in which this idea potentially travelled must be considerably shortened. There is ample evidence for Southeast European socketed axes dating from the Middle or even Early Bronze Age which mostly appear in the form of settlement finds. O. Dietrich’s list (2010a, 2010c) can be further expanded; it now comprises 19 find spots (List 1; Fig. 2). These discoveries suggest that a production of socketed axes was already well-established in Bz B (1600-1500 BC), a point in time during which their predecessors were thought to have arrived outside the Carpathian Basin. Indications of an even earlier production start come from the EBA ‘founder’s house’ at Feudvar, Serbia (list 1, no. 11). At Feudvar, a fragment of a mould for socketed axes or chisels was found (Hänsel-Medović 2004, 97). A considerable number of finds was discovered in Wietenberg Culture contexts in the Carpathian Basin (list 1, nr. 8, 14-19). This culture dates well before 1600 by both radiocarbon data and archaeological reasoning (Boroffka 1994, 288-290). It is important to stress that none of the axe forms deduced from the moulds or the shapes known from the finished product have any resemblance to Seima-Turbin axes, but rather with younger forms of the same region. The list of finds further illustrates that most of the evidence for early socketed axes comes from settlements and was fairly often preserved in the form of moulds (List 1).

The earliest socketed axes were loosely scattered throughout Southeastern Europe (Figure 2) without a particular focal point. The map seems to show just a weak reflection of what originally was a much more dense distribution pattern. Explanations for the lack of early socketed axes from the archaeological record can be found in the life-cycle of Bronze Age metalwork.

**Where have all the axes gone?**

There are two major (and interrelated) points which should be considered in addressing this question. First, the normal fate of bronze objects was to be re-melted (Fontijn 2002, 248-249, Fig. 13/1; Hansen 2011, 276-278). The possibility of casting new objects from old ones was the main advantage of using metal rather than stone (Hansen 2011, 276-277) and it should be assumed to have been widely used. Only objects that for certain reasons had been taken out of the chain of casting, use-life and re-melting will survive and be visible archaeologically (Fontijn 2002; Hansen 2011, 277-278, Fig. 2).

In the Carpathian Basin, these special reasons are restricted to hoarding. Graves are mostly devoid of metal objects or are altogether absent. For example, 85% of the Romanian socketed axes stem from hoard finds (Dietrich 2010b, 30, Fig. 3). This links their visibility to this find category with only a few pieces (especially moulds) with find locations inside of settlements. Over the last few decades, Bronze Age hoarding has been recognized as a structured, religiously-motivated phenomenon with chronologically and/or regionally different rules regarding the categories of objects included and their treatment (cf. Fontijn 2002, esp. 211-220; Geißlinger 1984; Hansen 1991; Hansen 1994; Hänsel and Hänsel 1997; Soroceanu 1995; Hansen 2005 all with references to further bibliography). The hoarding customs of the Carpathian Basin have been shown to have been especially selective (Hansen 1994). EBA and MBA hoards are almost canonically composed of representative weapons in the form of axes, swords and jewelry (e.g. David 2002; Mozsolics 1967; Soroceanu 2012; Vachta 2008). The inclusion of tools is a rare exception.

This suddenly changes at the beginning of the LBA. At that time, a wide range of tools (like sickles and socketed axes) were included in hoards. They were also included in a wide variety of types that can hardly be imagined to have developed within short time (Dietrich 2010). It seems that much of the diversity and development of metal objects during the Southeastern European EBA and MBA I has been obscured by the rules of hoarding. Whole object classes (like socketed axes) become visible to the archaeologist only in rare settlement finds and fairly often in the form of those moulds disposed of after use (cf. List 1 for the find contexts of early socketed axes). The appearance of socketed axes in hoards at the beginning of the LBA is, thus, not due to their invention, but rather to changing...

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8 Especially the beaked mouths (Dietrich 2010a, 359, Fig. 4) of many pieces are striking typical stylistic elements of later forms of the Carpathian Basin as well as earlier local socketed chisels (Dietrich 2010c).
9 A Romanian bias is due to my concentration on this area for the material studied during my PhD research.
10 For example most of the Romanian moulds for socketed axes come from settlements, which results in a spatial distribution pattern completely different from that of hoarded finished products (Dietrich 2011).
rules of hoarding, as was already presumed decades ago (by B. Hänsel 1968, 73)\textsuperscript{11}.

**Conclusion**

The axes of the so-called Seima-Turbino Horizon are the oldest objects of their kind known in Eurasia at present. At the moment, secure evidence for socketed axes in the Carpathian Basin goes back only to Bz B, though with a high probability for Bz A2 beginnings. However, the lack of evidence for early socketed axes in Southeastern Europe can be explained as a result of culture-specific formation processes of the archaeological record. While early socketed axes formed part of an 'elite warrior package' manifested in rich graves throughout the Eurasian Steppes, they did not enter this package in Southeastern Europe, where shaft hole axes and swords were the weapons of choice for representation and hoarding in the EBA/MBA. As our knowledge of metalwork during this period and region is largely based on hoards, much of the early development of metal objects seems to be obscured by selective depositional practices. However, several well-dated settlement finds of early socketed axes in Southeastern Europe considerably shorten the timespan between the supposed eastern predecessors and the earliest objects in the west. The casting of socketed objects seems to be generally attested to roughly at the same time in both regions.

Thus, the model of the spread of the socketed axe has to be significantly modified. There is little to no evidence for a slow diffusion of several forms of socketed axes through different cultural milieus from east to west by the migration of people. Casting technology, typological features and the social use of axes (prestige objects in graves/tools in settlements and hoards) clearly separate the eastern Steppes from Southeastern Europe.

The innovation possibly received from the east would thus have to have been exclusively restricted to the idea of casting socketed axes (which would have moved quite rapidly throughout Eurasia in the first quarter of the 2nd millennium BC). If the technological innovation of casting socketed objects in general should derive from the knowledge of Seima-Turbino smiths (which is improbable given the technological differences between the areas), we would have to assume an even more rapid spread of this idea throughout Eurasia around the year 2000 BC.

**List 1: Pre-BzD socketed axes in southeastern Europe**

1. **Celldömölk**, Vas megye, Hungary, fragment of a mould from a settlement (early MBA; Wanzek 1989, 204, No. 69d, Pl. 49/8b).
5. **Slovenska Bistrica**, občina Maribor, Slovenia, socketed axe from a hoard (Teržan 1983, 63-65), Bz C\textsuperscript{13}.
6. **Soltvadkert**, Bács-Kiskun megye, Hungary, hoard with moulds for socketed axes and chisels inside a settlement, MD II (Bz B1; Hänsel 1968, 73, Pl. 25/1-2, 4-5, 11-12).
7. **Szécsény**, Nógrád megye, Hungary, two socketed axes from a hoard which probably dates to the Forró Horizon (Bz C2; Mozsolics 1973, 121).
8. **Boiú**, județ Hunedoara, Romania, Wietenberg Culture settlement (EBA to MBA\textsuperscript{14}). One socketed axe, presently lost (Popescu 1956; 312, note. 37\textsuperscript{15}).
9. **Gheja**, județ Mureș, Romania, hoard of one socketed axe with a chain of five bronze rings in its loop. An early date for the find is probable by formal analogies with the axes of Kolodnoe, Otomani and Slovenska Bistrica (Petrescu-Dinboviţa 1978, 102, nr. 32, pl. 33D).
10. **Otomani**, județ Bihor, Romania, un-stratified settlement find. Hänsel has convincingly argued that none of the finds from Otomani date later than MD III (Bz B2/C1; Hänsel 1968, 73, Pl. 29/12).
11. **Feudvar**, Vojvodina, Serbia, fragment of a mould for socketed axes or chisels from the so-called ‘founder’s house’ (Hänsel and Medović 2004, 97, Fig. 8/5, 14/3-4).
12. **Veseleć**, okres Piešťany, Slovakia, mould in a MBA Tumulus Culture settlement context (Bartík 1995, 43, 46, Fig. 4).
15. **Perișor**, județ Bistrița-Năsăud, Romania, hoard with socketed axes in a Wietenberg Culture pot (Soroceanu and Retegan 1981, 207-211, Fig. 26-33).
17. **Moldovenesti**, județ Cluj, Romania, “Dealul Cetății”, socketed axe from a Wietenberg Culture settlement (Bajusz (ed.) 2005, 413, Fig. 25/146).

\textsuperscript{12}Kobal' (2000, 83, No. 62) dates the find into his Podgorjany II Horizon (Bz B). This early date is not completely certain, as two undecorated axes of type B1 after Vulpe (1970) are part of the hoard, which could date also to Bz C (Vulpe 1970, 72-73, 76). Boroffka (2003, 325) has also pointed out that two pendants (“Lanzettanhänger”) could be even later. It is possible that the hoard represents an ensemble collected over a longer period of time with an emphasis in Bz C.

\textsuperscript{13}The other objects from the hoard include an Askenofen type sword and knobbed sickles which would fit into Bz C. The only argument for a later date would be the socketed axe itself... and then only if one acts on the assumption that this find group did not appear before Bz D (Hansen 1994, 185).

\textsuperscript{14}Boroffka (1994, 288-290); 238, Tabl. 14 dates the Wietenberg Culture between Bz A2 and the beginning of Bz D.

\textsuperscript{15}Popescu’s comment is based on a communication from Nestor.
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References


Part 3: Cultural Interaction: Modes and Channels of Movement and Transmission


