Chapter 10
Conflict at Europe's Crossroads: Analysing the Social Life of Metal Weaponry in the Bronze Age Balkans

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Introduction

A remarkable fossil of prehistoric social worlds occurs in the form of bronze weapons. This is because many of these survive today in almost the precise condition they were in when they were deposited in prehistory, save for some tarnishing. This allows us to examine the subtle traces of craftwork and the scars of routine use, providing insights into diverse social practices that are rarely possible with later iron weapons. This paper will explore bronze weaponry from the Central and Western Balkans, because this was an important cultural crossroad in Europe where quite different traditions collided and were made manifest in bronze weapons. The region is very well connected, being transected by major rivers and lying between the Black, Aegean, and Adriatic Seas, thereby creating a physical link between very diverse societies of south-eastern Europe (Fig. 10.1). This therefore provides an interesting context to explore how different influences were mediated in the development of making and using weapons in Bronze Age Europe.

To assess the social roles of this body of material culture, it is important to consider how people engaged with weapons when making them, using them and eventually disposing of. From this perspective, each object can play a different role in a variety of social venues, each of which was important for shaping societal structures. We may, in this sense, consider objects to have distinct and recognisable biographies or life histories that were intertwined, at various stages, with different people (Appadurai 1986; Fontijn 2008; Gosden and Marshall 1999; Hahn and Weiss 2013; Kopytoff 1986; Molloy 2011). It is fortunate for us that many of the steps in this life history cycle can be systematically analysed and compared independently so that, from an analytical perspective, each object can contribute to our understanding of

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A. Dolfini et al. (eds.), *Prehistoric Warfare and Violence*,
Quantitative Methods in the Humanities and Social Sciences,
https://doi.org/10.1007/978-3-319-78828-9_10

Fig. 10.1 Map of sites and geographical features mentioned in the text: *MG* Markovac-Grunjac, *ON* Olmo di Nogara, *DL* Donja Luge, *A* Aleksinac, *T* Tetovo, *I* Iglarevo, *Myc* Mycenae, *D* Dodona, *Ot* Otok, *HK* Hajdukovo and Kevi-Csiker, *GHP* Great Hungarian Plain

various fields of social activity. Weaponry is a particularly interesting category of material culture in this regard. This is because during most steps of their lifecycle, weapons were handled, worn or otherwise engaged with directly by people, many of which leave material traces. They were therefore integral to, and indeed enabled, people to participate in social activities. A broad range of people including traders, smiths, warriors and social leaders or religious intermediaries were potentially involved in the social life of metal objects. Therefore, weapons must be seen as interlocutors between people with quite different identities, many of whom played a role in controlling power relations in society.

Analysing the distinct markers from different stages in the lifecycle of weaponry provides a biographic perspective on the social environment in which such markers were created. It is not necessary to isolate and assess each marker on each object, but more generally this biographic perspective allows us to find meaning in the unpredictable aspects of the lifecycle of objects in a comparative manner. Differences in how objects were made and used, for example, can provide insights into connectivity between workshops and/or regions and in turn allow us to identify deviations from the norm, such as different ways of using similar-looking objects. Archaeology has a range of analytical methods suited to measuring relevant features, often quite precisely (Armbruster 2011; Dolfini and Crellin 2016). This can include analysis of alloy composition, craft traces, functional qualities, use traces, removal/destruction (revealing, for example, a socially mediated 'death') or activities taking place when objects were finally deposited. This is essentially close to a *chaîne opératoire* approach which identifies and evaluates typical steps in the life cycle of particular categories of objects. However, in the approach taken in this study, we are primarily concerned with identifying different patterns of using a particular category of object during particular steps in their general/expected life cycle. This is achieved by evaluating individual biographic markers resulting from human-object (and material) and object-environment interactions in different social and/or physical contexts. Fundamentally, the methodology seeks to balance biographic analyses of the life story of specific objects with life cycle analyses of patterns of consumption of categories of object at different stages of their social life.

Breathing Life into Tools of Death

We could broadly define the expected life path of all weapons as beginning with the decision to make it in a certain shape, embodied by the creation of a stone mould or a wooden template for pressing into a moist clay to form a mould (Fig. 10.2). The choices made prior to doing this are predicated on the knowledge of the mould maker about how an object *should* appear and function, possibly influenced through direct discourse with the warriors who would use the finished weapons. This was an important dialogue, whether direct or indirect, because the living traditions of

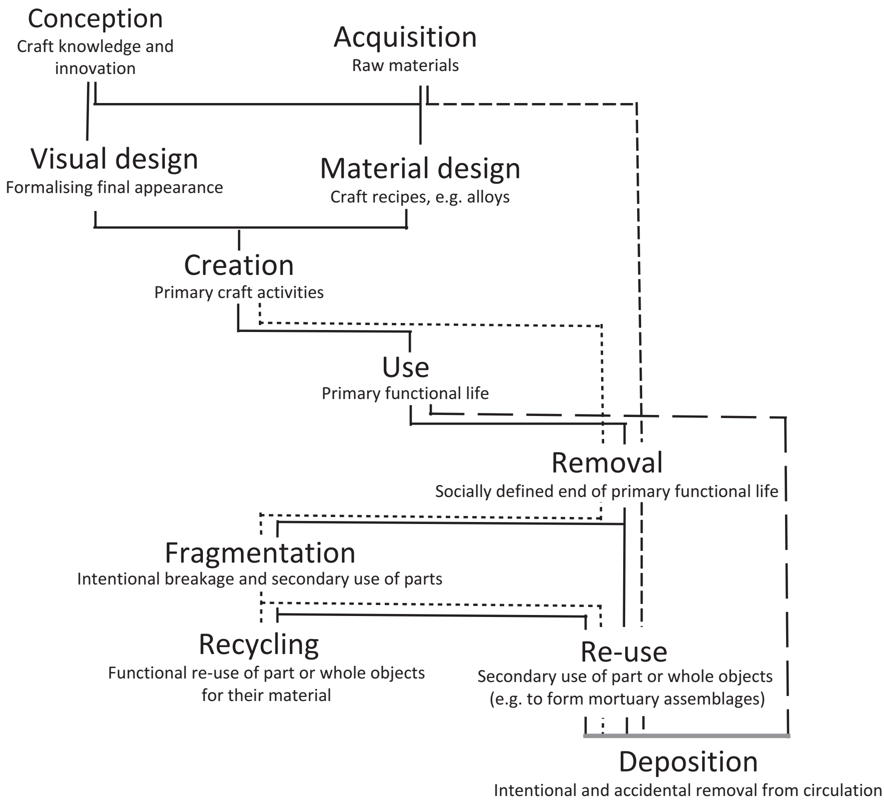

Fig. 10.2 Schematic representation of potential metalwork biographies. (Drawing by author)

martial art practices which weapons shaped, and were shaped by, came together with the skills and knowledge of the smiths in the design and development of material culture. Functional properties were thus embedded at the point of creation into objects that were to define combat practices. In this, we find overlap between two quite different fields of social activity. It is salient that weaponry, from long swords to thin shields, was often at the frontier of the capabilities of smiths and potentially pushing at this frontier at times, thereby linking evolving technical skills and societal developments. As part of this dialogue, designs could be derived from established cultural traditions, the innovative ideas of smiths or warriors, the emulation of the form and/or function of foreign weapons that had been encountered or a blend of all these.

Once the idea was set and the moulds made, the alloy was decided upon and prepared; the metals were melted and then poured into the mould to create the object. The product that emerged was cleaned up and then mechanically manipulated by cold working the edges and then annealing them, often in cycles (Bridgford 1998). This led to a hard edge suited to cutting resistant media supported by a slightly more forgiving body of a weapon that could absorb impacts without breaking (Notis 2014: 58). Following the steps to manipulate the material properties of the metal during casting and post-casting treatment, the weapon would then be cleaned or polished. At that point organic components could be added as desired to complete it, be they the plates of a sword hilt or the haft of an axe.

The smiths making a weapon may well have been cognisant of the factors that could lead to fatigue and failure of objects. Taking this into consideration, presumably in somewhat different terms that we would today, efforts to mitigate the risks of damage and failure would emerge through overall design (metric features), alloy choice, cold working and annealing. Once completed, the object would then be used, presumably for display, training and in some cases for combat. In most cases, this social life of weapons constituted the longest duration during which they were engaged with by ancient users and thereby embedded in social relations. Following the use and presuming it was not lost, decisions were made to remove an object from circulation. The biography of some items may have led to special treatment, whereby they were deposited whole or intentionally damaged, while most appear to have been fragmented into parts for reuse through recycling or incorporation into larger bodies of metalwork (e.g. hoards), thus losing their identity as individual objects and becoming a form of raw material.

Taking Up Arms

It may be helpful to initially mix up the linear trajectory of the life cycle of weapons by looking at the earliest phase of conception of shapes together with the middle phase in which these shapes determined modes of use. These superficial features are traditionally considered in relation to typological categories (Armbruster 2011), although here we incorporate a morphometric approach that addresses the relationship between metric features and functional qualities. We will consider swords first

Fig. 10.3 Selection of swords from the Balkans (Photographs by author); (**a**) Type Apa from Kevi-Csiker, (**b**) Type Indjija from Hajdukovo, (**c**) Type Vatin from Vatin, (**d**) Type Sombor from the Hajdukovo region, (**e**) Type C from Tetovo, (**f**) Type C from Aleksinac, (**g**) Sword from Donje Luge, (**h**) Type Stätzling from Sisak, (**i**) Type Manaccora from Montenegro, (**j**) Type Naue IIA/Reutlingen with faux midrib from Lakavica, (**k**) Type Schwaig from Kovin, (**l**) Type Erlach from Kovin

because they only had minor (now lost) organic elements and so are typically a weapon type that survives virtually complete. They are also perhaps the most intensively studied bronze artefacts from prehistory (Gener 2011; Harding 1995; Jung et al. 2008; Jung and Mehofer 2009; Kilian-Dirlmeier 1993; Kristiansen 2002; Kristiansen and Suchowska-Ducke 2015; Matthews 2011; Molloy 2007, 2008, 2010; Peroni 1970).

The earliest swords in Central Europe and the northern Balkans were the Type Apa (or Hajdúsámson-Apa) and the related Type Kurzschwerter swords, dating to the later seventeenth century BC (Fig. 10.3). Five swords of this family are known from the region (Harding 1995, nos 10, 228–230 and Fig. 10.3a). They are found throughout the Carpathian Basin, and variants occur as far afield as Scandinavia (Vandkilde 2014). This indicates that when tin bronze was first being weaponised in Europe, societies in the Balkans were active participants in this process. The Type Apa sword is very distinctive due to its metal hilt and short tapering blade (around 30 cm). Experiments with replica Irish swords of similar blade geometries (Molloy 2007, 2017) suggest that these short and light blades were suited to light slicing or lacerating cuts and thrusts. By the sixteenth century BC, many other types of sword emerged (e.g. Fig. 10.3b, c) including slightly more robust short swords as well as longer ones, often dubbed rapiers; many of these types were shared in northern Italy and the Carpathian Basin (e.g. Bader 1991; Burgess and Gerloff 1981; Harding 1995; Kemenczei 1988; Peroni 1970; Schauer 1971). These swords typically had organic handles and ranged from close-quarter melee weapons to long and thin ones requiring greater space and more controlled use. This rough functional division is seen in other Bronze Age cultures of Europe (Molloy 2010, 2017).

In Crete, the first swords of Europe had been invented one or two centuries earlier than the Type Apa (Kilian Dirlmeier 1993; Molloy 2010; Georganas 2010). By the sixteenth century BC, new forms were emerging that were to reach their floruit in the fifteenth to fourteenth centuries. These had long and thin blades with midribs to strengthen them, and they occur as far north as the Central Balkans (Fig. 10.3e, f). At this time, in the Carpathian Basin and the northern Adriatic, local swords with long and thin blades emerged that could be used in a manner very similar to the Aegean pieces, called the Type(s) Sauerbrunn-Boiu (Cowen 1966; Harding 1995). The contemporary emergence of long thin swords suited to light draw-cutting and thrusting attacks (Molloy 2008) at the same time in both regions may suggest influences being shared in martial traditions, even if craftspeople were working with local aesthetic ideas. In light of this, a weapon from Tetovo in the southern Balkans is particularly instructive (Fig. 10.3e). This is a local variant of the Aegean Type C sword, the archetypal midribbed sword of this period in the Aegean, but it has a very distinctive form of incised bipartite decoration on its shoulders that is characteristic of Sauerbrunn and Boiu swords in Europe, but absent on Aegean swords. Cowen considered this to be a particularly meaningful design, citing these as "a pair of eyes … of the sword itself, or rather of the spirit within it" (Cowen 1966, 294). The Tetovo sword can be seen as an interlocutor between two traditions, demonstrating exchange of ideas even when objects may not have been moved with regularity between regions. Interaction between members of groups can lead to technical ideas and concepts of practice being shared, which can lead to selective copying of shapes and functions, or mimicry as Fahlander (2007) calls it. Given the social differences between Aegean and Balkan societies, it is unsurprising that influences were partial in their physical manifestation and that European warriors did not wholesale adopt Aegean traditions which would have looked quite alien to them. As Vandkilde (2014, 614) argued, "weapons in comparable and rival styles were not only most assuredly symbolic in terms of social power, but were also practical devices for the clear identification of particular persons and groups".

The potential for the Balkans to be a melting pot of military traditions from the European and Aegean spheres is thus set out. The grip-plate swords of the Aegean region and those of the Balkans appear to have evolved largely bilaterally in the fifteenth to thirteenth century BC, though links between Balkan and Italian metal-working traditions increase considerably. In all regions, there was nonetheless a parallel development of the functional qualities of weapons even when the visual properties in each region remained distinct. This bilateral development continues in a bias towards shorter and more robust swords by the later fourteenth century (e.g. Fig. 10.3d). This begins to change significantly in the thirteenth century BC, when the multifarious swords of both traditions began to be replaced by (or evolved into) robustly proportioned weapons (Fig. 10.3i, k) of a generic Naue II family of full-tanged swords, which continued to be popular well into the early first millennium BC. These were essentially defined by a flanged hilt cast as one with a parallel-edged blade in the region of 0.6–0.7 m length and ca. 0.4–0.7 kg (Jung and Mehofer 2009; Kristiansen and Suchowska-Ducke 2015). Some swords with bronze hilts were used alongside these in the Balkans and had similar functional qualities (e.g. Fig. 10.3l with clear combat induced damage). These were all well-suited to close-quarter collaborative styles of fighting, being short enough to change direction rapidly and robust enough to make light percussive-lacerating cuts, but long enough to strike from a slight distance.

A sword from Donje Luge in Montenegro (Fig. 10.3g) warrants specific mention to explore the often ambiguous ways in which cross-cultural exchanges of traditions may take form (Bulatović et al. 2003). This has a hilt from the general 'Naue II' tradition but a blade that tapers rapidly and has a distinct midrib. It therefore possesses a widely used thirteenth century (and later) hilt with a blade inspired by swords that had gone out of use in the palatial centres of the Aegean by that time. This in turn may suggest that Aegean-type midribbed swords remained in use longer in the Balkans than in the south. The sword illustrates the way in which regions of the Balkans were innovative melting pots of different traditions.

Farther north, local types of this grip-tongue family of swords developed and shared much with examples from the Carpathian Basin and parts of northern Italy (Bader 1991; Kemenczei 1988; Peroni 1970). Two sword fragments from Bingula-Divoš and Brodski-Varoš may hint at influences from the Aegean variant of this family of swords (Molloy in Press; Harding 1995 nos 419, 420). Other types also evolved, which have a very distinctive form of cross-section with stepped ribs, which appear to have been a purely aesthetic feature. This is Harding's (1995) Type Novigrad, which is typical to the lands around the middle Danube and its tributaries, and is particularly interesting as its characteristic ribs are also found on contemporary spearheads, constituting loosely matching fashions for these two weapon types. It is not feasible here to elaborate on each category of sword in relation to their life cycles, but the primary point is that integrated analysis of form and function can be used to differentiate between influences arising from distinct venues of interaction or engagement. This can be illustrated further looking at spearheads.

Spearheads

Since the inception of spearheads in the Balkans (Fig. 10.4), these were typically socketed weapons with broadly leaf-, flame- or teardrop-shaped blades and measured commonly in the region of 15–20 cm, but with longer examples occurring also in excess of 30 cm length (Jovanović 2010; Todorović 1971; Vasić 2015; Vinski-Gasparini 1973). The socket penetrates most of the way to the tip of the blade, which makes these weapons very robust. Most would have been versatile enough to use with two hands on a form of staff weapon, single handed for thrusting, or else they could have been thrown. While a good range of forms emerged over time, some slightly longer than others (e.g. some of Vasić's (2015) 'spearheads with curved blades' (Fig. 10.4m) and 'spearheads with short sockets' (Fig. 10.4k, n), there is a greater consistency in their functional attributes than one may see in the spears of the Aegean in the later Bronze Age (Avila 1983; Molloy 2016; Snodgrass 1974). The socket is generally around 1/3–1/2 the length of the entire spearhead, and the blades have sharp and thin edges. The very distinctive triple ridges of the Type Novigrad swords find stylistic parallels on a category of contemporary spearheads (e.g. Fig. 10.4c, d, f). Another variety of spearheads had a slight swelling in the lower (socket) side of the blade, sometimes called 'violin form', which is characteristic of this region and was to be adopted and much adapted in the Aegean region, particularly north of the Gulf of Corinth (Molloy 2016).

All spearheads were capable of penetrating in stabbing attacks, though it is notable that a distinctive type with proportionately short sockets (Vasić 2015, nos 205–211; Vinski-Gasparini 1973, Table 60.27, 87.5, 94.7, 112.4) had a rounded point (Fig. 10.4k). That this is unlikely to have been a repair to a broken point (e.g. Fig. 10.4i) is indicated by its ubiquity across this type of spearhead, as also seen on a specimen from Kefalonia in Greece (Molloy 2016, Fig. 13.8.3) and examples of the type from Pila del Brancón in Italy (Salzani 1994). The metal is quite thin here so that they could certainly penetrate flesh but would be less useful against armour. Conversely, it was less likely for the (absent) tip to break against such armour or get trapped in an organic shield. The edges of these spearheads were also well-suited to cutting attacks, particularly the longer varieties which had blades, which alone were in excess of 30 cm length. Other spearhead varieties were suited to cutting, although those with a swelling in the base of the blade (Fig. 10.4d, h, l) may have been less effective and more geared towards thrusting because of the abrupt break in the line of the edge. The proportions of most spearheads, and their full-socket design, meant that they were well designed to withstand combat use. However, the many broken pieces in hoards lacking their point and exposing the hollow socket within indicate that any damage to this area rendered a weapon unserviceable. In this sense, they were potentially less 'forgiving' than swords which could be reshaped, to an extent at least, and remain functional.

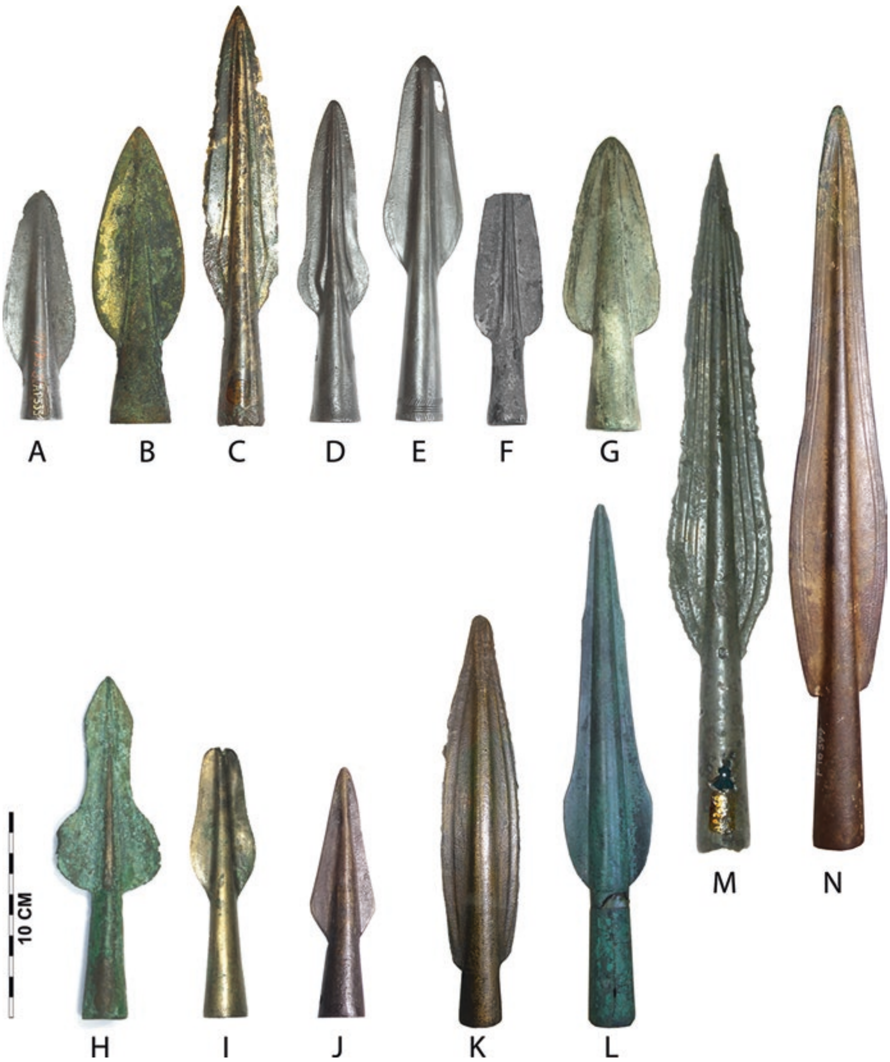

Fig. 10.4 Selection of spears from the Balkans (Photographs by author); (**a**) spearhead with bay leaf-shaped blade from Futog, (**b**) spearhead with profiled blade socket from the Banat region, (**c**) spearhead with curved blade from Hetin, (**d**) spearhead with curved blade from Futog, (**e**) spearhead with rhomboidal blade from Futog, (**f**) spearhead with profiled blade socket from Mali Žam, (**g**) spearhead with willow leaf blade from Krcedin, (**h**) spearhead of Albano-Epirote shape from Thessaly, (**i**) spearhead with rhomboidal blade from Futog, (**j**) spearhead with rhomboidal blade from Ljubljanica river, (**k**) spearhead with bay leaf blade and short socket from the Ljubljanica river, (**l**) spearhead with curved blade from the Korçë region, (**m**) spearhead with curved blade from Hetin, (**n**) spearhead with curved and incised blade from the Ljubljanica river

Fig. 10.5 Above: battle axe from Vatin; Below: Albano-Dalmatian axe from the Skadar region. (Photograph by author)

Axes

It can be debated if axes in many parts of Europe were intended for use as weapons, but in the Balkans and Central Europe, this is less of an issue. A collared shaft-hole battle axe of metal developed there by the fifteenth century BC (Gimbutas 1965: 215–217; 327; Kovács 1977: 39–41) and was in use until the thirteenth century BC or later (Fig. 10.5). These had a variety of spikes, axe bits and hammer edges that were clearly designed for interpersonal combat and not as craft tools. These tomahawk-like weapons had narrow holes and appear to have been suited to single-handed use, but we cannot rule out these being attached to longer pole arms. They are rare in the Balkan Peninsula but are found as far south as the site of Dodona in Greece, where an axe of this type was found, which was an import from further north (Bouzek 1985; Carapanos 1878). A different form of axe of Albano-Dalmatian type emerged in the region of Albania, Montenegro and southern Croatia, which appears also to have been primarily oriented towards combat, with a curved-back single-cutting edge. The far more common winged axes and socketed axes of this region are, like their counterparts in other parts of Europe, ambiguous items that were no doubt designed as tools but could have been readily used as weapons if the need arose and are perhaps best considered tool weapons (Chapman 1999).

Shields and Armour

The only evidence for defensive weaponry (Molloy 2009) occurs in a hoard from Otok, where we find fragments of Type Lommelev-Nyírtura shields (Uckelmann 2012, no. 6). This is a type of shield that was characteristic of the Carpathian Basin and the Balkans and is also known from the Nordic Bronze Age (Uckelmann 2012). The dearth of surviving evidence for shields should not be seen as evidence that they were rarely used, because the simple fact that a consistent type was found at widely dispersed sites indicates that knowledge of the form was widespread. It remains possible that organic shields like those we find in Ireland were more commonly used. The shields of metal were well-suited to combat when they were in excess of 0.7 mm thickness; it is thus probable that the Balkan shields were combat-worthy weapons (Molloy 2009, 2017; Needham et al. 2012). The existence of a Bronze Age shield with Lommelov-Nyírtura and Herzsprung influences at Delphi in Greece may indicate that the idea spread through the Balkans and into Greece.

Armour from the Balkans is related to traditions known across central and south-eastern Europe. Greaves are a form of armour used to protect the lower leg, and bronze examples come from the Balkans (Vinski-Gasparini 1973; Karavanić 2009; Mödlinger, Chap. 9, this volume). The distinctive closing mechanisms of Balkan types are shared with Central European forms, but these are all different to the closing mechanisms used for most Aegean greaves, which often otherwise look very similar. The decorative motifs on greaves from the Balkans, including chariot wheel motifs on a recently identified looted piece, are occasionally also found on Aegean pieces, such as the set from the Athenian Acropolis (Clausing 2003). This motif was used on armour, particularly helmets, in central and south-eastern Europe (Mödlinger 2013), suggesting a link between chariots and warriors. Chariot wheels from Árokalja in Hungary (Pare 1987) may support the view that such vehicles were a reality on the battlefields of the Balkans and Carpathian Basin, but this hypothesis cannot be tested.

Metallurgy

Following from these considerations of the functions of weapons as defined by their shapes, we can usefully consider how smiths took technological steps to control the mechanical properties of the metal used. The initial step in this process was deciding what alloy to use. Alloys are intentional recipes, arising from technological choices made by smiths to blend different metals with the intention of controlling material properties so that when the metal is cast into a specific shape it can perform a predetermined function. Such intentionality in alloy design can be seen by comparing the alloys of sickles, axes, swords and spearheads. Using data from published studies and my own ongoing research, Figure 10.6, 1 illustrates that sickles tend to have very low tin contents, whereas axes and (more so) spearheads have a relatively wide range of tin contents, and swords a more restricted range. As far as alloy design is concerned, it is evident that swords were the most carefully controlled of all weapons, while spearheads appear to have had little consideration, or at least standardisation, given to alloys.

In considering why these variances occur, we can return to the relationship between form and function and consider these in relation to the mechanical challenges facing objects by looking at well-published data from Slovenia (Trampuž-Orel 1996). Swords were long castings that would be subjected to a range of potential strains arising from torsional, impact, tensile and sheer (through leverage)

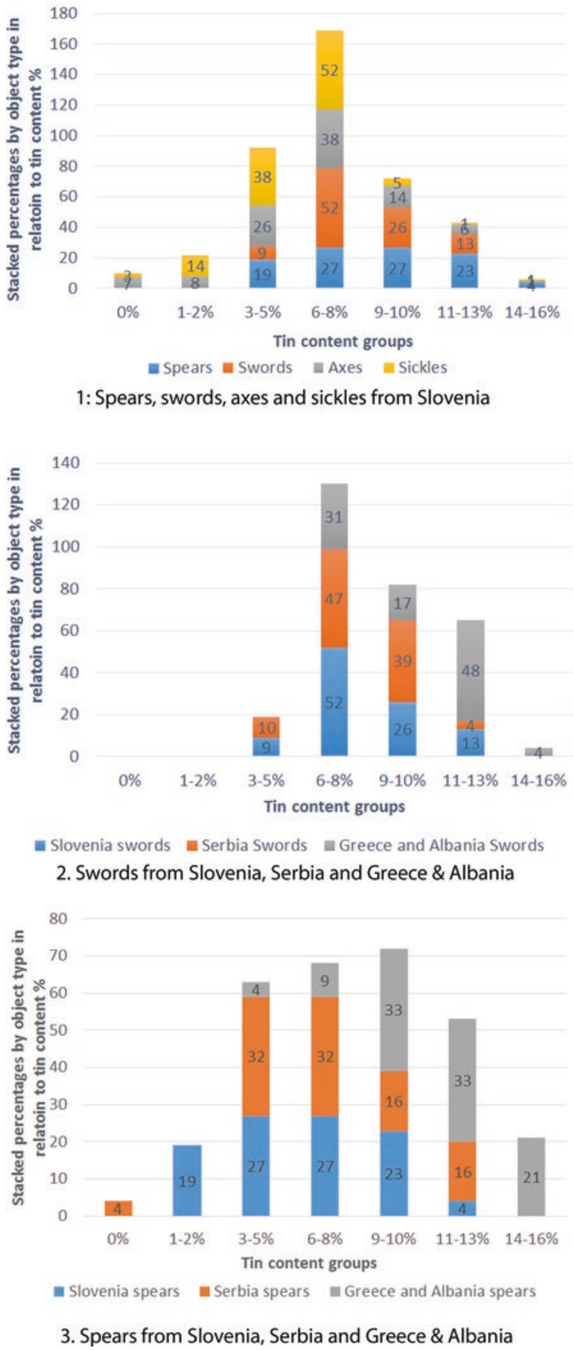

Fig. 10.6 *1* Alloys of sickles, axes, spears and swords from Slovenia (after Trampuž-Orel 1996); *2* alloys of swords from Slovenia (after Trampuž-Orel 1996), Serbia (Molloy in press), Greece (Mangou and Ioannou 1998, 1999; Koui et al. 2006) and Albania (Koui et al. 2006); *3* alloys of spears from Slovenia (after Trampuž-Orel 1996), Serbia (Molloy, in press), Greece (Mangou and Ioannou 1998, 1999; Koui et al. 2006) and Albania (Koui et al. 2006)

mechanical stresses and strains when used. They thus had to meet a balance between increased risk of bending (lower tin) and risk of breakage (higher tin), which could be culturally or even workshop contingent. The challenges faced by swords contrast with spearheads, which would primarily be subjected to impact and torsional stresses within a relatively small item. Many were short enough so that bending was less likely to occur, and even longer pieces had a flexible, tough and impact-absorbing wooden core running almost to their point, making them more or less bi-composite weapons. Sickles faced altogether different forces, having relatively predictable mechanical stresses when cutting fibrous grasses. Axes would have fulfilled a wide range of functions which their basic shapes may not indicate, so alongside cutting and shaping different types of woods, they may also have been used for butchery, skinning animals and preparing foods, for example. In all of this we can see that there were distinct challenges to be considered when making tools and weapons and that for Slovenian smiths, swords were singled out for special treatment. Figure 10.6, 2, 3 show that this same pattern for spearheads and swords is observable in a larger dataset based on analyses by the author of samples from Serbia. It is notable in this regard that only certain objects could be effectively, or at least economically, recycled to create others such that most spearheads were poorly suited to making sickles, for example. This could potentially link into now lost biographies or beliefs of appropriate life cycles for categories of objects, even following fragmentation and recycling.

It is also notable (even accepting the different analytical methods used) that there is a difference between the alloy choices made in the Aegean and European weapon smithing traditions. When Aegean, Albanian and Montenegrin smiths manufactured swords of the general European grip-tongue family, they appear to have been quite conservative in alloy recipes, choosing to use a traditional (for them) higher tin content than other European smiths in most cases (Molloy and Doonan 2015). A similar conservatism is seen in the latter tradition, because the earliest swords have tin contents very similar to the later ones, suggesting little experimentation and a tendency towards slightly lower tin contents than may be expected, with a medium tin alloy of 6–8% being particularly popular (see Fig. 10.7, caption). As well as affecting function, these alloys visibly impact on the colour of the weapons, with higher tin (in this general range) making metal more golden and lower tin increasingly looking like the brownish-orange colour of copper.

It is clear that there were technological choices made when deciding on alloys for weapons but that in cases such as spears, the perception of suitable alloys was either highly variable or there was little concern for precision. For swords, while greater care was evidently taken in selecting alloys, smiths did not use an alloy recipe that was exclusive to weapons. While we must take account of recycling affecting surviving alloys, the above issues may indicate that there were decisions made in recycling relating to the appropriate mixing of fragmented objects to make particular new ones. Steps of ca. 2% tin content are visually recognisable, with experience, when looking at clean bronze (pers. obs.). While alloys are a critical factor in weapon design, how the object is mechanically and thermally worked thereafter can influence the functionality of tools and weapons. We can evaluate this by looking at the microstructures of metals.

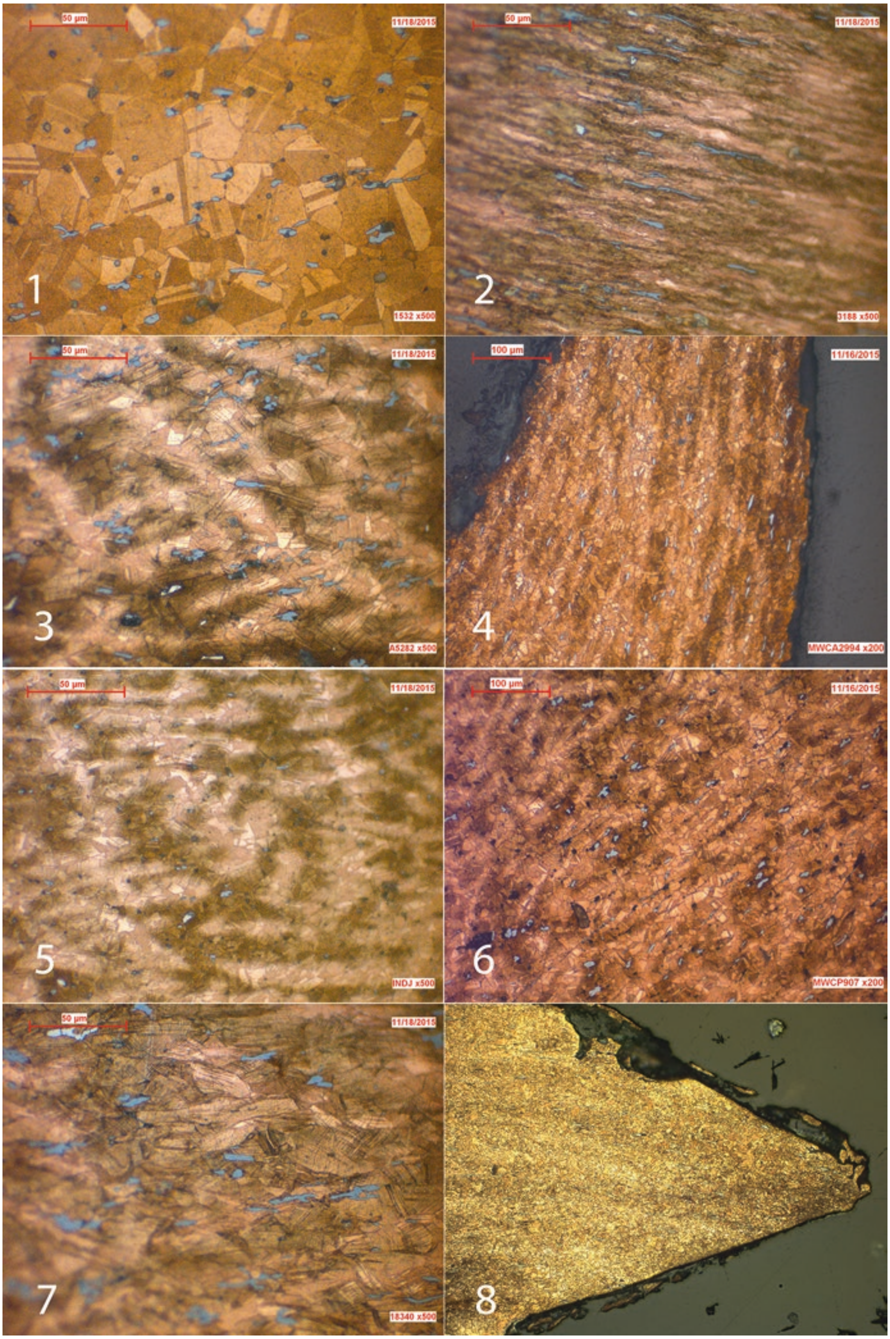

Fig. 10.7 Metallographic sections (Photographed by author and P. Northover); *1* spearhead with moderately cold-worked, well-annealed and complete recrystallised microstructure from Stari Kostolac (1532), tin content ca. 5.5% (SEM-EDX); *2* spearhead with heavily cold-worked, poorly

Microstructures

Metallography is used to examine the microstructures of metalwork, which can inform us about how smiths attempted to alter the material properties of objects made from copper alloys. It is possible to make here concise preliminary comments on the results of analyses of samples taken from 110 swords and spears in Serbia. In very general terms, it is observed that most of the weapons that can be considered to have been finished objects showed some degree of intentional modification. A notable exception is the hoard from Markovac-Grunjac, where most objects appear to be as-cast or having had very minor work done on them, which is consistent with previous studies of these finds (Jovanović 2010). Mechanical modification was most typically conducted in the form of cold forging of the edges, which was observed on both swords and spears. Spearheads were more variable in their treatments, with some receiving considerable post-cast treatment (Fig. 10.7, 1) and others having less cold working performed on them, and being less thoroughly annealed, while some were heavily cold worked but poorly annealed (Fig. 10.7, 2). Most swords have evidence of cold working and annealing from the earliest Type Apa swords down to types from the end of the Bronze Age (Fig. 10.7, 3–8); indeed, as with alloy design, there was little experimentation with this process over time in the region. Cutting across all of these periods, many swords were moderately cold worked but poorly annealed (much residual coring is commonly visible), though exceptions are known which have very skilfully manipulated microstructures (c. 10.7, 8). Overall, there is little to differentiate the technical traditions of designing and modifying the metal of seventeenth century swords from those of twelfth or eleventh centuries BC date.

The extensive analyses of swords and spears from Britain provide interesting comparisons, because Bronze Age smiths from this region also generally gave greater care to swords than spears (Bridgford 1998, 2000). As with alloy choices, this need not relate to a higher status of swords but rather to a response to the more

Fig. 10.7 (continued) annealed with substantial residual coring and minimal recrystallised microstructure from Krcedin (3188), tin content ca. 5% (SEM-EDX); *3* Type Apa sword from blade (at ancient break) with moderately cold-worked and poorly to moderately annealed with substantial coring and partial recrystallised microstructure (strain lines probably from ancient break) from Kevi-Csiker (A5282), tin content ca. 7.5% (SEM-EDX); *4* Type Indjija sword blade with highly cold-worked and moderately annealed with residual coring but high degree of recrystallised microstructure (small crystals) from Hajdukovo (A2994); tin content ca. 6% (SEM-EDX); *5* Type Indjija sword blade near shoulders with little cold-worked and moderately annealed with significant residual coring but high degree of recrystallised microstructure (small crystals) from the Sremska Mitrovica region (Indj), tin content ca. 6.5% (SEM-EDX); *6* Type Reutlingen (probable) sword blade fragment with moderately cold-worked and moderately annealed with substantial coring and high degree of recrystallised microstructure (small crystals) from Dobrinci (P907), tin content ca. 6% (SEM-EDX); *7* Type Reutlingen sword blade near point with moderate to highly cold-worked, annealed and final cycle of cold-worked (visible grain distortion, strain lines) microstructure from Pudavnica (18: 3400), tin content ca. 9% (Surface reading with portable XRF on exposed metal); *8* Type Statzling sword blade near point with substantial cold-worked, very well-annealed and completely recrystallised (small crystals) microstructure from Sisak (17272), tin content ca. 9% (SEM-EDX) diverse and greater physical pressures they would face in use. For swords and spears alike, the cold working was focussed on the edge proper, and though some of the hammered material may have been ground away during sharpening, it is clear that workers were only seeking to materially transform the very cutting edge – often covering less than 3 mm inwards from this. The manipulation of the hardness of blade edges is indicative of a need to enhance their performance for cutting. This related to a trade-off between increasing hardness to enhance cutting and maintaining toughness to withstand brittle failure through cracking or chipping. Looking to blade edges, we can find a variety of damage consistent with combat use.

Metalwork Wear Analysis

The damage to the edges of weapons can indicate aspects of how they were used (Bridgford 1997; Dolfini and Crellin 2016; Horn 2014; Molloy et al. 2016). We can, for example, quantify the general intensity of damage using numerical values, or we can describe the character and causation of instances of damage (Fig. 10.8), or a combination of both. The former option is used here, with values ranging from zero (undamaged) through to five (extreme damage). The method is complicated for this region because many items had been deliberately fragmented, and so the assessment here is to be considered as a general indicator of differences in wear patterns according to states of completeness.

Figure 10.9 shows that there is a disproportionately higher number of fragments of blades with no evident damage than we find in the other categories of 'states of completeness' for swords. The wear analysis suggests that intentional choices led to some swords being fragmented and entering collections of broken things, some of which were deposited together in hoards, while other objects were destined to retain their identity as an object and were buried intact. Spears tell a broadly similar story with the more complete examples having a higher degree of damage visible. For the

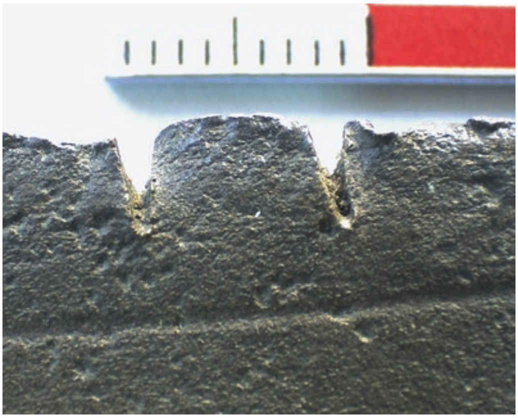

Fig. 10.8 Two sharp v-shaped nicks from blade-on-blade contact. Late Bronze Age sword from Leskovica, Serbian Banat. (Photograph by author)

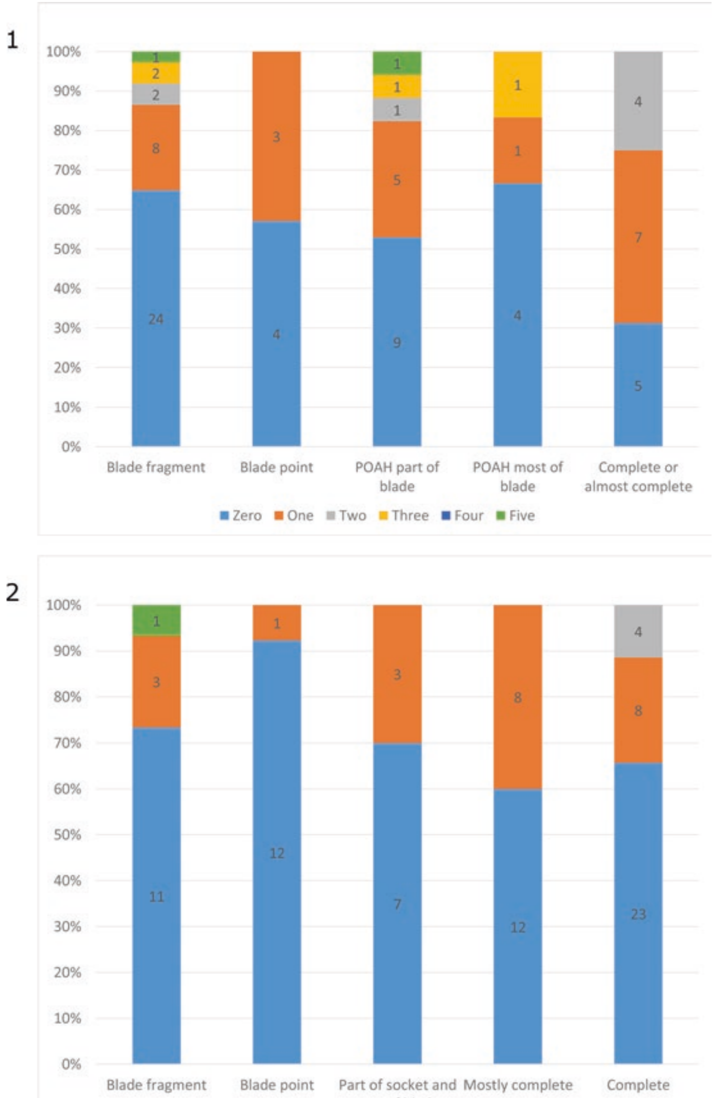

Fig. 10.9 *1* Wear analysis of combat-specific damage on a sample of swords from Serbia (*POAH* = Part or all of handle; most of blade = 50%>); *2* wear analysis of combat-specific damage on a sample of spearheads from Serbia

fragments, the actual breakage of the object was not counted in this study as an instance of wear, which it could well have been, and so these figures are probably under-representing damage caused through use.

Wear analysis is also useful for considering some specific issues. For example, despite visual similarities, swords of Aegean form found in the Balkans have a distinct breakage pattern at the hilt that is not found on pieces in the Aegean. Two

Fig. 10.10 Type Apa swords from Vajska (**a**) with faint traces of incised decoration on the handle and secondary rivets and from Kevi-Csiker (**b**) with clear incised decoration on the handle. (Photograph by author)

swords from Iglarevo and one from Aleksinac (Fig. 10.3f) have either cracking or complete fracturing where the blade meets the handle (and in two cases this was subsequently repaired by re-casting features with molten bronze), while one from Tetovo has a very distinctly bent blade (Filipović 2015; Harding 1995). It could be speculated that Balkan warriors were simply less skilled than Aegean ones, and so they broke the gracile swords that they adopted and adapted, but the fact that there is a pattern to the breakages suggests a distinct local tradition of use. These damage and repair patterns indicate that a more robust form of use was practised in this region than in the Aegean, and that it was considered worthwhile repairing weapons that had suffered catastrophic failure, perhaps hinting at biographical values being linked to these objects.

From a qualitative perspective, the Type Apa sword from Vajska (Fig. 10.10a) is of interest (Harding 1995, no. 230). This blade was bent into a U-shape, which was no doubt intentional given its extreme nature, but we can also compare it to the breakage in the middle of the blade on the same type of sword from Kevi-Csiker (Fig. 10.10b). This suggests that bending to decommission weapons was a tradition of that time to end their functional life. The decoration on the handle on the Vajska sword has been worn away through extensive handling, yet the blade has no obvious evidence for combat damage. This suggests that the present blade may have been a replacement for a damaged one. The use of a different form of rivet to repair the handle-blade join may also indicate that damage had occured and that this wear had been carefully ground away during a repair that also included repairing the handle. However, most forms of damage caused by blade-to-blade impacts consist of a mark of generally less than 2 mm depth, and so such reductive repairs (such as grinding) could only take place a limited number of times before ruining the blade. A lack of obvious use-wear may also be a product of the way the sword was used, for example, targeting soft tissue and avoiding blade-on-blade contact. When present, wear is indicative of intensity and/or character of use, but its absence can never indicate that a weapon was unused because effective striking of the flesh and bone may leave no material traces on the metal.

This metalwork wear data suggests that there was no single logical life cycle for swords or spears and that choices were made for different objects that led to different forms of depositional event. The degree of damage on objects appears to have played a negative (rejected for deposition) or positive (preferentially selected for deposition) role within this relating to contexts of deposition. The greater visibility of damage on the more complete objects may also be tenuously suggested to relate to a closer relationship with the owner or user, whereby combat use led to these weapons being woven into personal narratives and events (Kristiansen 2002). Conversely, some weapons selected for hoarding were being treated more generically, and one factor influencing this may have been that they lacked this personal or historic link.

What Broken Weapons in Hoards Tell Us About Weapon Production

Taking the well-published Slovenian dataset again, we can consider how depositional biases may relate to the ancient allocation of resources for metalwork (Turk 1996, 2001; Turk and Čerče 1996). As Dietrich (2014) makes clear, the circumstances underlying the selection of material for deposition in a hoard are social choices that need not follow a distinct universal pattern. Quantitative analyses of the different categories of objects in hoards therefore relate to choices in the act of deposition; as such, they cannot be taken as face value records of the relative proportions of objects typically in circulation. This said, we must consider how hoards were assembled. Larger items were fragmented, and many smaller items were rendered unusable, so these were not collections of objects stored for simple reuse. The hoard as we discover it was a social creation brought together with intent. The dearth of refitting pieces tells us that the hoard we find is a portion of a larger collection of broken things that had been brought together at a certain place or places. The material that was extracted to be buried for a secondary purpose was therefore a portion of a larger assemblage or assemblages that had been previously been assembled for a purpose distinct from deposition. What we find in Balkan hoards may therefore be a somewhat randomised fraction of this original assemblage. It is of course fully possible that each object was carefully selected for deposition on the basis of its lost identity as a thing in society, but the very act of fragmentation and distortion of objects when they entered into this solid stock pool of metal may be taken to imply that these identities were intentionally deconstructed (Bradley 2013; Dietrich 2014).

Thus, it could be argued that the sample of weaponry that we find in hoards could very broadly be related to the proportions of objects once in circulation by virtue of the random selection process. It must be stressed here that we are speaking of very broad parameters in this case, not specific percentages, and that different hoards were constructed for potentially different purposes and in different ways. With these caveats in mind, looking to the Slovenian hoards of the thirteenth to eleventh centuries BC (Turk and Čerče 1996), only 4.6% of objects in large hoards and 9.5% in small hoards are weapons. Looking only at those "large hoards of mixed composition" that contain any weapons (8 out of 12 of these hoards), their numbers generally constitute 3–10% of the total number of objects, but most often in the 3–5% range. An assessment of how these percentages based on numbers of objects may relate to percentages based on weight is not possible with the current data. It is suggested that these figures can constitute a rough estimate of how much metal in society went into weaponry, which would be somewhere in the region of 5–10% on the basis that weapons and fragments of weapons are heavier than many of the other categories of object counted (e.g. pins, razors, wire). This indicates that investment in military hardware was a significant, but far from dominant, aspect of bronze-using economies in the region, which appears to stand in contrast to the higher proportions of weapons seen in the deposits from Atlantic Europe, for example (Becker 2013).

Warfare

Overall, warriors and smiths of the Balkans were participants in a wider milieu of martial traditions, which encompassed Italy and the Carpathian Basin directly, and the Aegean to an extent, that increased in intensity by the thirteenth century BC. The Central Balkans also appear to have been a potential conduit through which martial practices were filtered between more densely occupied regions. The data discussed in this paper is primarily from the northern Balkans along the Sava-Danube corridor and north of this, because that is where most weapons were deposited. There is a strong degree of choice evident in the forms of weapon used in the fifteenth to thirteenth century BC, though the numbers of finds and the chronological resolution of the development of particular weapon types remain sparse. This changes notably by the thirteenth century BC, when the region is characterised by a stronger degree of uniformity in the proportions of most swords and spears, even if appearances remained diverse. Despite notable exceptions (e.g. in Fig. 10.4), the general pattern is of complementary proportions and functions of weapons between the thirteenth and eleventh centuries BC. For axes that may have been used in battle, there appears to be a wider range of choices and greater regional diversity. Although the evidence for armour is scant, the few pieces that survive, and particularly the motifs used on them, indicate that these were part of a wider tradition of armour that included much of central and south-eastern Europe as well as the Aegean. By the later Bronze Age, combat practices appear to have become increasingly conducive to cooperative fighting traditions as we would find in an organised military system, which would include lines of battle.

It is noteworthy in this context that we have a significant increase in the use of fortifications by the later Bronze Age. Substantial forts enclosing several hectares emerge as a phenomenon in Istria down through Dalmatia from the eighteenth century BC, but became more common by the thirteenth century in the surrounding areas (Hänsel et al. 2015). Defended Middle Bronze Age tell-sites in the northern Balkans were generally modest in size (Gogâltan 2008). It was only by the later Bronze Age that fortifications became much more widespread in the region (Gogâltan and Sava 2012; Kapuran 2009; Molloy et al. in press). With the spread of fortifications which had multiple lines of ditches and palisades, defended central places became an increasing challenge in warfare by the thirteenth century. This raises the logistical requirement for large bodies of men to undertake coordinated attacks on fortifications that were set within densely occupied landscapes and could contain hundreds or thousands of people, and so the potential for actual armies in the Bronze Age emerges. The fact that many fortifications were burnt down (Gogâltan and Sava 2010, 2012) suggests that violent conflict could have been focussed on these places. Whether the burning was the result of actions of combat or an act of subjugation or abasement following combat, it is clear that these forts were a focus for social and perhaps violent conflict. In the northern Balkans, these could be tens of hectares in size (the 1600+ hectare ramparted site of Corneşti-Iarcuri is worthy of special note), indicating large fighting forces (Szentmiklosi et al. 2011). In the Central Balkans, fortifications rarely exceed 1 ha by much (Kapuran 2009), indicating that broadly similar ideas were being exercised but that the expected fighting forces were notably smaller.

Discussion and Conclusion

The weapons of the Balkans were the product of relatively skilled, but rarely exceptional, craftsmanship. The smiths making them were cognisant of balancing the many material challenges that different weapon types would face. In particular, it was argued that swords had a greater degree of effort expended on them during the craft process, and greater attention to alloy contents was paid than to other tools and weapons. In general, the quality of weapons examined does not indicate that they were the product of fundamentally more advanced or elite centres of production than other metal items. A broad estimate of 5–10% of total bronze consumed being used for weapons represents a significant investment in military resources for Balkan communities. It should be mentioned here that it has not been possible to integrate osteological analyses into this overview of weapons and warfare in the Balkans due to a dearth of published material.

By briefly taking account of the scale of fortifications and the character of weaponry, it was possible to suggest that warfare had advanced to a level of organisation that enabled the assembly of what may reasonably be termed armies. These could potentially consist of amalgams of war bands with individual war leaders eliciting the support of their local population (Harding 2007). This said, the construction of fortifications of tens of hectares in some areas suggests a degree of social organisation that took military matters very seriously within specific and physically bounded, or grounded, communities. With such defences creating a requirement to be able to defend them, we must consider that military organisation had developed to a stage whereby specialists in military craft – warriors – operated alongside the other craft specialists of the Bronze Age. It would be suitable to imagine this as emerging at the behest of a chief or small power group, but unfortunately we do not have evidence to support this in terms of differentiated domestic or mortuary spaces or practices. Nonetheless, we need not subscribe to a view that such militarism emerged through egalitarian aspirations for mutual group aggrandisement (Roberts 2013), and so a level of centralisation of authority was surely at work in this region. The coeval spread of Urnfield traditions, notably channelled pottery, along the river corridors of the Balkans and the increased building of forts and growing homogeneity of combat practices are potentially politically driven and of historic importance, but these aspects could not be evaluated in this short paper. It is notable that we find increased standardisation of weaponry, in terms of proportions and craft elements, at this same time. The growing diversity of ways in which weaponry was consumed is also indicative of its importance in a range of different social venues – hoards, river deposits and burials.

It may be expected that the data presented in a paper such as this should be tested against a social framework derived largely from ethnography in order to better socialise it and deal with issues of causation, organisation and social effects. However, such a 'tyranny of ethnography' has weakened the unique contribution that archaeology can contribute to understanding conflict as a formative aspect of our past (Carman 1997; Haas and Piscetelli 2013). We are now at a methodological crossroad, whereby, taking account of the "material turn" in anthropology (Sørensen 2015), we are increasingly seeking to build our understanding of the sociality of prehistoric phenomena such as warfare directly on the basis of the material evidence, using bottom-up approaches. In this paper, we have therefore briefly explored biographic signatures of different stages of the life cycle of many weapons in order to address social practices including craft, combat, resource management and depositional practices. In part, the objective has been to test how a material-based study with no recourse to ethnography can contribute to a bottom-up approach to assessing the role of warfare in the development of European societies. It is clear that a single and robust narrative is not really possible at this point if we follow this line. This is a good thing, because the bare bones of the archaeology of conflict are revealed rather than dressed up in appealing, but ultimately borrowed, clothing – or, as Carman (1997: 221–222) put it, "perceived through the filter of anthropological assumptions". The Balkan region was shown to be very useful to test this approach because it incorporates the material traditions of distinct cultures, which allowed us to provisionally explore different responses to similar technical and social stimuli. Ultimately, to take the study of metalwork beyond a series of subfields such as typological cataloguing, archaeometallurgy, wear analysis or experimental archaeology, it can be fruitful to continue to build our evidential base to better explore social aspects of the life cycle of what were fundamentally very social artefacts – Bronze Age weapons.

Acknowledgements I am grateful to many colleagues who enabled the sampling of objects and wear analyses briefly reported on in this paper, with particular thanks to Dragan Jovanović, Marija

Ljuština and Sanjin Mihelić. The ongoing analyses of samples are being conducted in collaboration with Peter Northover, while David Dungworth and Roger Doonan have also provided considerable help in undertaking this work. I am grateful to Marianne Mödlinger and Sue Bridgford for the advice on technical matters over recent years and to Anthony Harding, Marion Uckelmann and Andrea Dolfini for the advice on this manuscript. This research was hosted at the UCD Centre for Experimental Archaeology and Material Culture with Aidan O'Sullivan and received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 655023 for a project entitled "Breaking the Mould: A cross-cultural analysis of the character of bronze smiths and craft diversity in late Bronze Age Europe (1300-800 BC)".

References

Appadurai, A. (1986). Introduction: Commodities and the politics of value. In A. Appadurai (Ed.), *The social life of things: Commodities in cultural perspective* (pp. 3–63). Cambridge: Cambridge University Press.

Armbruster, B. (2011). Approaches to metalwork: The role of technology in tradition, innovation and cultural change. In T. Moore & X. L. Armada (Eds.), *Atlantic Europe in the first millennium BC: Crossing the divide* (pp. 417–438). Oxford: Oxford University Press.

Avila, R. A. J. (1983). *Bronzene Lanzen- und Pfeilspitzen der griechischen Spätbronzezeit* (Prähistorische Bronzefunde, Vol. V.1). Munich: Beck.

Bader, T. (1991). *Die Schwerter in Rumänien* (Prähistorische Bronzefunde, Vol. IV.8). Stuttgart: Steiner.

Becker, K. (2013). Transforming identities – new approaches to Bronze Age deposition in Ireland. *Proceedings of the Prehistoric Society, 79*, 225–263.

Bouzek, J. (1985). *The Aegean, Anatolia and Europe: Cultural interrelations in the second millennium B.C.* Göteborg: Paul Áströms Förlag.

Bradley, R. (2013). Hoards and the deposition of metalwork. In A. Harding & H. Fokkens (Eds.), *The Oxford handbook of the European Bronze Age* (pp. 121–139). Oxford: Oxford University Press.

Bridgford, S. (1997). Mightier than the pen? An edgewise look at Irish Bronze Age swords. In J. Carman (Ed.), *Material harm: Archaeological studies of war and violence* (pp. 95–115). Glasgow: Cruithne Press.

Bridgford, S. (1998). British Late Bronze Age swords: The metallographic evidence. In C. Mordant, M. Pernot, & V. Rychner (Eds.), *L'Atelier du bronzier en Europe du XXe au VIIIe siècle avant notre ère* (Vol. 2, pp. 205–219). Paris: Comite des travaux historiques et scientifiques.

Bridgford, S. (2000). *Weapons, warfare and society in Britain: 1250–750BC* (Unpublished PhD.). Sheffield: University of Sheffield.

Bulatović, L., Lutovac, P., Lauko, T., Ravnik-Toman, B., Guštin, M., & Tratnik, J. (2003). *Zlatno doba Crne Gore/The golden age of Montenegro*. Podgorica: JU Muzeji i galerije.

Burgess, C., & Gerloff, S. (1981). *The dirks and rapiers of Great Britain and Ireland* (Prähistorische Bronzefunde, Vol. IV.7). Munich: Beck.

Carapanos, C. (1878). *Dodona et ses Ruines*. Paris: Librarie Hachette.

Carman, J. (1997). Introduction: Approaches to violence. In J. Carman (Ed.), *Material harm: Archaeological studies of war and violence* (pp. 1–23). Glasgow: Cruithne Press.

Chapman, J. (1999). The origins of warfare in the prehistory of Central and Eastern Europe. In J. Carman & A. Harding (Eds.), *Ancient warfare: Archaeological perspectives* (pp. 101–142). Stroud: Sutton.

Clausing, C. (2003). Geschnürte Beinschienen der späten Bronze- und älteren Eisenzeit. *Jahrbuch des Römisch-Germanischen Zentralmuseum Mainz, 49*(2002), 149–187.

Cowen, J. D. (1966). The origins of the flange-hilted sword of bronze in continental Europe. *Proceedings of the Prehistoric Society, 32*, 362–412.

Dietrich, O. (2014). Learning from "scrap" about Late Bronze Age hoarding practices: A biographical approach to individual acts of dedication in large metal hoards of the Carpathian Basin. *European Journal of Archaeology, 17*(3), 468–486.

Dolfini, A., & Crellin, R. (2016). Metalwork wear analysis: The loss of innocence. *Journal of Archaeological Science, 66*, 78–87.

Fahlander, F. (2007). Third space encounters: Hybridity, mimicry and interstitial practice. In *Encounters|materialities|confrontations archaeologies of social space and interaction* (pp. 15–41). Newcastle: Cambridge Scholars Press.

Filipović, V. (2015). Mycenaean sword from Aleksinac (Serbia). *Vesnik, 42*, 9–18.

Fontijn, D. (2008). Everything in its right place? On selective deposition, landscape and the construction of identity in later prehistory. In A. Jones (Ed.), *Prehistoric Europe* (pp. 86–106). Chichester: Wiley-Blackwell.

Gener, M. (2011). Integrating form, function and technology in ancient swords. The concept of quality. In M. Uckelmann & M. Mödlinger (Eds.), *Bronze Age Warfare: Manufacture and Use of Weaponry* (British Archaeological Reports, International Series, Vol. 2255, pp. 117–124). Oxford: Archaeopress.

Georganas, I. (2010). Weapons and warfare. In E. H. Cline (Ed.), *The Oxford handbook of the Bronze Age Aegean (ca. 3000–1000 BC)* (pp. 305–314). Oxford: Oxford University Press.

Gimbutas, M. (1965). *Bronze Age cultures in central and eastern Europe*. The Hague: Mouton.

Gogâltan, F. (2008). Fortified Bronze Age tell settlements in the Carpathian Basin: A general overview. In J. Czebreszuk, S. Kadrow, & J. Müller (Eds.), *Defensive structures from Central Europe to the Aegean in the 3rd and 2nd millennia BC* (pp. 39–56). Poznań/Bonn: Wydawnictwo Poznańskie and Habelt.

Gogâltan, F., & Sava, V. (2010). *Sântana Cetatea Veche: A Bronze Age earthwork on the lower Mures*. Arad: Complexul Muzeal Arad.

Gogâltan, F., & Sava, V. (2012). War and warriors during the Late Bronze Age within the Lower Mureş Valley. *Ziridava Studia Archaeologica, 26*(1), 61–82.

Gosden, C., & Marshall, Y. (1999). The cultural biography of objects. *World Archaeology, 31*(2), 169–178.

Haas, J., & Piscetelli, M. (2013). The prehistory of warfare: Misled by ethnography. In D. Fry (Ed.), *War, peace and human nature: The convergence of evolutionary and cultural views* (pp. 168–190). Oxford: Oxford University Press.

Hahn, H., & Weiss, H. (2013). Introduction: Biographies, travels and itineraries of things. In H. Hahn & H. Weiss (Eds.), *Mobility, meaning and the transformations of things: Shifting contexts of material culture through time and space* (pp. 1–14). Oxford: Oxbow.

Hänsel, B., Mihovilić, K., & Teržan, B. (2015). *Monkodonja 1. Forschungen zu einer protourbanen Siedlung der Bronzezeit Istriens*. Pula: Arheološki Muzej Istre.

Harding, A. (1995). *Die Schwerter im ehemaligen Jugoslawien* (Prähistorische Bronzefunde, Vol. IV.14). Stuttgart: Steiner.

Harding, A. (2007). *Warriors and weapons in Bronze Age Europe* (Archaeolingua Series Minor, Vol. 25). Budapest: Archaeolingua.

Horn, C. (2014). *Studien zu den europäischen Stabdolchen* (Universitätsforschungen zur prähistorischen Archäologie, Vol. 246). Bonn: Habelt.

Jovanović, D. (2010). *Ostave Vršačkog Gorja: Markovac-Grunjac*. Vršac: Vršac Muzej.

Jung, R., & Mehofer, M. (2009). A sword of Naue II type from Ugarit and the historical significance of Italian-type weaponry in the Eastern Mediterranean. *Aegean Archaeology, 8*(2005–2006), 111–135.

Jung, R., Moschos, I., & Mehofer, M. (2008). Fonevontas me ton idio tropo: Oi eirinekes epafes yia ton polemo metaxi dutikis Elladas kai Italias kata ti diapkeia ton opsimon Mukinaikon xronon. In *Politismiki Allilogonimopoisi Notias Italia kai Dutikis Elladas mesa apo tin istoria* (pp. 85–107). Patras: Periphereia Ditikis Ellados.

Kapuran, A. (2009). *Arhitektura iz poznog bronzanog i starijeg gvozdenog doba u basenu Južne Morave = Late Bronze and Early Iron Age architecture in the Juzina Morava basin*. Beograd: Univerzitet u Beogradu, Filozofski fakultet.

Karavanić, S. (2009). *The urnfield culture in continental Croatia*. (British Archaeological Reports, International Series, Vol. 2036). Oxford: Archaeopress.

Kemenczei, T. (1988). *Die Schwerter in Ungarn. Griffplatten-, Griffangel-, Griffzungenschwerter* (Prähistorische Bronzefunde, Vol. IV.6). Munich: Beck.

Kilian-Dirlmeier, I. (1993). *Die Schwerter in Griechenland (ausserhalb der Peloponnes), Bulgarien und Albanien* (Prähistorische Bronzefunde, Vol. IV.12). Stuttgart: Steiner.

Kopytoff, I. (1986). The cultural biography of things: Commodification as process. In A. Appadurai (Ed.), *The social life of things: Commodities in cultural perspective* (pp. 64–91). Cambridge: Cambridge University Press.

Koui, M., Papandreopoulos, P., Andreopoulou-Mangou, E., Papazoglou-Manuoudaki, L., Priftaj-Vevecka, A., & Stamati, F. (2006). Study of Bronze Age copper-based swords of Type Naue II and spearheads from Greece and Albania. *Journal of Mediterranean Archaeology and Archaeometry, 6*, 5–22.

Kovács, T. (1977). *Die Bronzezeit in Ungarn*. Budapest: Corvina.

Kristiansen, K. (2002). The tale of the sword – Swords and swordfighters in Bronze Age Europe. *Oxford Journal of Archaeology, 21*(4), 319–332.

Kristiansen, K., & Suchowska-Ducke, P. (2015). Connected histories: The dynamics of Bronze Age interaction and trade 1500–1100 BC. *Proceedings of the Prehistoric Society, 81*, 361–392.

Mangou, E., & Ioannou, P. V. (1998). On the chemical composition of prehistoric Greek copper-based Artefacts from Crete. *Annual of the British School at Athens, 93*, 91–102.

Mangou, E., & Ioannou, P. V. (1999). On the chemical composition of prehistoric Greek copper-based artefacts from Mainland Greece. *Annual of the British School at Athens, 94*, 81–101.

Matthews, S. (2011). Chelsea and Ballintober swords: Typology, chronology and use. In M. Uckelmann & M. Mödlinger (Eds.), *Bronze Age Warfare: Manufacture and Use of Weaponry (British Archaeological Reports, International Series, Vol. 2255,* pp. 85–105). Oxford: Archaeopress.

Mödlinger, M. (2013). From Greek boar tusk helmets to the first European metal helmets: New approaches on development and date. *Oxford Journal of Archaeology, 32*(4), 391–412.

Molloy, B. P. C. (2007). What's the bloody point? Swordsmanship in Bronze Age Ireland and Britain. In B. P. C. Molloy (Ed.), *The cutting edge: Studies in ancient and medieval combat* (pp. 90–111). Stroud: Tempus.

Molloy, B. P. C. (2008). Martial arts and materiality: A combat archaeology perspective on Aegean swords of the fifteenth and fourteenth centuries BC. *World Archaeology, 40*(1), 116–134.

Molloy, B. P. C. (2009). For Gods or Men? The use of European Bronze Age shields. *Antiquity, 83*(323), 1052–1064.

Molloy, B. P. C. (2010). Swords and swordsmanship in the Aegean Bronze Age. *American Journal of Archaeology, 114*(3), 403–428.

Molloy, B. P. C. (2011). Use-wear analysis and use-patterns of Bronze Age swords. In M. Uckelmann & M. Mödlinger (Eds.), *Bronze Age Warfare: Manufacture and Use of Weaponry* (British Archaeological Reports, International Series, Vol. 2255*,* pp. 67–84). Oxford: Archaeopress.

Molloy, B. P. C. (2016). Nought may endure but mutability: Intercultural encounters and material transformations in the thirteenth to eleventh century BC Southeast Europe. In B. P. C. Molloy (Ed.), *Of Odysseys and Oddities: Scales and modes of interaction in the prehistoric Aegean* (pp. 343–384). Oxford: Oxbow Books.

Molloy, B. P. C. (2017). Hunting warriors: The transformation of weapons, combat practices and society in Bronze Age Ireland. *European Journal of Archaeology, 20*(2). https://doi.org/10.1017/eaa.2016.8.

Molloy, B. P. C. (in press). In M. Korać & V. Filipović (Eds.), *Hommage a Rastko Vasić*. Belgrade: Serbian Archaeological Institute.

Molloy, B. P. C., & Doonan, R. (2015). A moving story: Some observations on the circulation of metal, metalworking and metal users in the thirteenth to eleventh century BC Balkan and Apennine peninsulas. In P. Suchowska-Ducke, S. Reiter, & H. Vandkilde (Eds.), *Forging Identities: Mobility of culture in Bronze Age Europe. Report from a Marie Curie Project 2009-2012 with Concluding Conference at Aarhus University, Moesgaard 2012* (British Archaeological Reports, International Series, S2771, pp. 235–244). Oxford: Hadrian Books.

Molloy, B. P. C., Wisnieski, M., Lynam, F., O'Neill, B., O'Sullivan, A., & Peatfield, A. (2016). Tracing edges: A consideration of the applications of 3D modelling for metalwork wear analysis on Bronze Age bladed artefacts. *Journal of Archaeological Science, 76*, 79–87.

Molloy, B. P. C., Jovanović, D., Mirković- Marić, N., Marić, M., & Mertl, P. (In Press). The fortified site of Gradište Iđjoš in the southern Great Hungarian Plane. In B. S. Heeb, A. Szentmiklosi, R. Krause, & M. Wemhoff (Eds.), *Fortifications: Rise and fall of defended sites in the Late Bronze and Early Iron Age of South-East Europe* (Berliner Beiträge zur Vor- und Frühgeschichte). Berlin.

Needham, S., Northover, P., Uckelmann, M., & Tabor, R. (2012). South Cadbury: the last of the bronze shields? *Archäologisches Korrespondenzblatt, 4*, 473–492.

Notis, M. (2014). Metals. In B.W. Roberts & C.P. Thornton (Eds.), *Archaeometallurgy in global perspective – Methods and syntheses* (pp. 47–66). New York: Springer.

Pare, C. F. E. (1987). Wheels with thickened spokes and the problem of cultural contact between the Aegean and Europe in the Late Bronze Age. *Oxford Journal of Archaeology, 6*(1), 43–61.

Peroni, V. B. (1970). *Die Schwerter in Italien* (Prähistorische Bronzefunde, Vol. IV.1). Munich: Beck.

Roberts, B.W. (2013). Britain and Ireland in the Bronze Age: Farmers in the landscape or heroes on the high seas? In A. Harding & H. Fokkens (Eds.), *The Oxford handbook of the European Bronze Age* (pp. 531–549). Oxford: Oxford University Press.

Salzani, L. (1994). Nogara. Rinvenimento di un ripostiglio di bronzi in localitá "Pila del Brancón". *Quaderni di Archeologia del Veneto, 10*, 83–94.

Schauer, P. (1971). *Die Schwerter in Süddeutschland, Österreich und der Schweiz. Griffplatten-, Griffangel- und Griffzungenschwerter* (Prähistorische Bronzefunde, Vol. IV.2). Munich: Beck.

Snodgrass, A. (1974). Metalwork as evidence for immigration in the Late Bronze Age. In R. A. Crossland & A. Birchall (Eds.), *Bronze Age migrations in the Aegean: Archaeological and linguistic problems in Greek prehistory* (pp. 209–213). Park Ridge: Noyes.

Sørensen, M. L. S. (2015). "Paradigm lost" – On the state of typology within archaeological theory. In K. Kristiansen, L. Šmejda, & J. Turek (Eds.), *Paradigm found: Archaeological theory present, past and future. Essays in honour of Evžen Neustupný* (pp. 84–94). Oxford: Oxbow.

Szentmiklosi, A., Heeb, B. S., Heeb, J., Harding, A., Krause, R., & Becker, H. (2011). Corneşti-Iarcuri – a Bronze Age town in the Romanian Banat? *Antiquity, 85*, 819–838.

Todorović, J. (1971). *Katalog praistorijskich metalnich predmeta*. Beograd: Muzej Grada Beograda

Trampuž-Orel, N. (1996). Spectrometric research of the Late Bronze Age hoard finds. In B. Teržan (Ed.), *Hoards and Individual Metal Finds from the Eneolithic and Bronze Ages in Slovenia* (Vol. 2 (Catalogi et Monographiae 30, pp. 165–242)). Ljubljana: Narodni Musej.

Turk, P. (1996). The dating of Late Bronze Age hoards. In B. Teržan (Ed.), *Hoards and Individual Metal Finds from the Eneolithic and Bronze Ages in Slovenia* (Vol. 2 (Catalogi et Monographiae 30, pp. 89–124)). Ljubljana: Narodni Musej.

Turk, P. (2001). The weight of objects in Bronze Age hoards in Slovenia and possibilities for defining weight standards. *Arheoloski Vestnik, 52*, 249–279.

Turk, P., & Čerče, P. (1996). Hoards of the Late Bronze Age – Circumstances of their discovery and the structure of the finds. In B. Teržan (Ed.), *Hoards and individual metal finds from the Eneolithic and Bronze Ages in Slovenia*, Vol. 2 (Catalogi et Monographiae 30, pp. 7–29). Ljubljana: Narodni Musej.

Uckelmann, M. (2012). *Die Schilde der Bronzezeit in Nord-, West- und Zentraleuropa* (Prähistorische Bronzefunde, Vol. III.4). Stuttgart: Steiner.

Vandkilde, H. (2014). Breakthrough of the Nordic Bronze Age: Transcultural Warriorhood and a Carpathian crossroad in the sixteenth century BC. *European Journal of Archaeology, 17*(4), 602–633.

Vasić, R. (2015). *Die Lanzen- und Pfeilspitzen im Zentralbalkan* (Prähistorische Bronzefunde, Vol. V.8). Stuttgart: Steiner.

Vinski-Gasparini, K. (1973). *Kultura polja sa žarama u sjevernoj Hrvatskoj*. Zagreb: Filozofski fakultet.