CREATIVITY IN THE BRONZE AGE

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CREATIVITY IN THE BRONZE AGE

UNDERSTANDING INNOVATION IN POTTERY, TEXTILE, AND METALWORK PRODUCTION

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The important role of creativity in human expression and in underpinning cultural changes through time, means that understanding why and how it works poses an important challenge for archaeology. Such insights also have bearing on understanding creativity in other contexts, including the present. Through a focus on the interconnections between materials, practices, and objects, CinBA aimed at explicit analytical engagement, thus moving the study of creativity beyond intuitive responses which have hitherto made it difficult to clearly argue why some things are considered creative and others not.

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INTRODUCTION

Marie Louise Stig Sørensen, Joanna Sofær, and Lise Bender Jørgensen

Creativity is an integral part of human history. Yet the study of creativity usually focuses on the modern era, leaving unresolved questions about the formative role it has played in the longue durée. Creativity is closely related to changes in material culture, to how it sits behind innovations directing responses to the new and unfamiliar, and to how it results in changes to familiar things and practices. Creativity thus underwrites archaeological notions of cultural entities and periodisation, whether or not this is acknowledged. In this volume we aim to explore this connection taking the European Bronze Age as our focus. During the Bronze Age key shifts in the nature of society and in its material expressions can be seen. This includes innovations such as the development of full metallurgy and the emergence of woollen textiles. It is also an era characterised by intense networks of contacts and long-distance trade (Kristiansen and Larsson 2005), substantial changes in ritual life, and strong indications of the formalisation of cosmology (Kaul 2004a): all shifts which may have inspired people to search for new material expressions. These key changes were accompanied by a remarkable flowering of craft activities with a distinctive emphasis on a pleasing aesthetic through intricately elaborated objects and decorations, but also, apparently, with a singular focus on a few materials, in particular metal as well as textiles and ceramics. These changes have previously been analysed primarily in social or economic terms; here we
argue that to approach the newness and novelty of the material world of the Bronze Age without reference to creativity is to neutralise its complexity.

A focus on creativity allows us to explore a range of human actions, practices, perceptions, expressions, and motivations that sit behind the changes in what kind of things are made and how they are made. During the Early Bronze Age new materials came into use and new procedures were developed for making things. As they became established parts of the cultural repertoire they were further utilised, resulting in the range of new forms and changed practices seen through the Middle and Late Bronze Age. In particular, the emergence of woolly sheep through breeding resulted in a novel raw material for textiles, which soon provided a basis for new forms and practices. Similarly, after standardised recipes for copper alloys and more efficient casting methods had been invented, the basis for the making of bronze objects was altered and we see an explosion of forms. Within these two materials we observe innovations as well as subsequent adjustment of practices. Other materials, such as pottery, which already had a long history, continued to be used. Their exploration is therefore not linked to innovations and changes of practices but seems rather to reflect experimentation and novelties that arose from local or regional explorations of the craft, at times showing the importance of imitations and influences between materials and groups. In addition, many objects from the Bronze Age also reveal substantial attention towards their appearance, as seen in the exploration of shape, colour, pattern, texture, and motifs. The surfaces of objects were frequently used as canvasses for elaborate designs suggesting that the appearance of things mattered and that creativity may take place both at the scale of the invention of new forms and procedures, and at the level of the development of new design principles. It is, however, important to note that this does not refer to all objects and that there were also regional differences in terms of not just how, but also whether, objects were decorated at all. The extensive use of decoration on Middle Bronze Age pottery in the Carpathian Basin contrasts, for example, with the plain ware used at the same time in northern Europe. Such observations suggest that creativity may at any time be guided towards certain materials, expressions, and forms, rather than simply being a highly individualistic expression. We shall return to this question of the relationship between the individual and the collective in terms of creativity below.

Responding to these broad issues, this volume explores the nature of creativity in the Bronze Age by looking at three themes. The first is the exploitation of, and reactions to, the potentials and limitations imposed by bronze, textile fibres, and clay. The second is the production processes for objects made of these materials. The third considers the range of effects that could
be reached through manipulation of the surface appearance of the finished objects. Creativity is often, and most easily, linked to the phenomenon of innovation. These two notions are, however, by no means synonymous. Innovations are recognised through outcomes that change existing conditions and norms. They represent a leap in how things are conceptualised and made. This is familiar archaeological territory. But creativity is a wider phenomenon than innovation. It encompasses the novel exploration, reconfiguration, and development of established expressions and practices; it is these that we wish to focus on.

FRAMEWORKS FOR UNDERSTANDING CREATIVITY

The exploration of creativity in the European Bronze Age is a challenging task, not least because there is no single theoretical understanding of creativity that can be readily applied. In this volume we explore and argue for creativity as a particular quality associated with the making of objects and the outcome of this making. The quality that we refer to is intimately linked to, indeed we argue it arises from, a particular kind of entanglement of people and objects. It is, however, an entanglement that involves ideas and knowledge with the latter being accumulated through experiences and experimentation as well as comparisons as makers draw their inspiration from the world around them.

Creativity takes its inspiration from a number of fields as well as materials, including religious ideas, notions of the cosmos, and reflections of life, but it is also based in the everyday and may arise from attempts at problem solving (Runco 1994). Creativity is the realisation of ideas or ambitions through a particular material in the form of a specific set of practical actions. The form of creativity we are interested in is, moreover, related to change – whether through new forms or through elaborations and alterations of existing objects. Understood like this, creativity is a quality rather than simply a condition. It has frequently been regarded as intangible, although its results are tangible – it goes beyond language and seems to be neither a verb nor a noun, or even an adjective, but a combination of these. Through the discussions and essays in this volume we therefore aim to focus closer on these aspects, attempting to capture them. We explore the conditions for creativity and how is it constituted. We suggest we should be satisfied with this rather open understanding instead of attempting a restricted and deterministic definition of creativity. The position we take is close to some of the main approaches currently argued within debates on creativity, but differs from others.

We differ, for instance, from approaches to creativity that see it as something magical, astonishing or god-like (Boden 1990, 1998; Goldenberg and...
Mazursky 2002). While creativity itself may seem intangible, its articulation and outcomes are material – otherwise we should not experience creativity. Our philosophical standpoint is that a thing cannot be separated from the actions that made it. We argue throughout the volume for a praxis-orientated exploration of creativity. Moreover, rather than accepting creativity as part of some mystical process we focus on the creative practices involved in reaching outcomes. The underlying premise of this volume is therefore that **creativity is an outcome as well as an intention and a process**.

This focus on making processes raises questions about the relationship between the individual and the collective, a topic debated within different disciplines. Creative actions have traditionally often been linked to the existence of creative individuals (Csikszentmihalyi 1996; Jeanes 2006) assuming such individuals have special innate abilities or particular personalities. This assumption is often reproduced to explain differences in people’s performances. Insights from philosophy may be helpful here, as it has debated what range of human practices should be included within the term ‘creativity’. It has asked whether creativity is solely about artistic expressions, and if so which ones – poetry, music, art? Or does it refer to a quality that can be found within a wider range of activities? This question was intensely debated around the turn of the twentieth century when arguments about creativity being expressed within the sciences, as well as in nature, were made. Irving Singer represents a contemporary take on this topic as he argues that creativity is not limited to any single aspect of human existence. It inheres not only in art and the aesthetic but also in science, technology, moral practice, as well as ordinary daily experience (Singer 2013). Likewise, the physicist David Bohm (1996) has argued that creativity is a central feature of all aspects of human enquiry. Such views are useful in expanding the discussion of creativity beyond artistic endeavour. They suggest that creativity can exist in a range of material practices including those found in societies that existed before the development of the state and urbanism and before ‘art’ became recognised as a distinct sphere of activity, as in the Bronze Age.

Singer’s emphasis on praxis and the notion that creativity inheres in ordinary daily experiences raises the question of whether creativity is nonetheless something distinct or whether all practices are in some way creative. These questions also arise from the social anthropologist Tim Ingold’s reflections on creativity. He argues that human action is productive and thus a creative practice. He bases this on the proposition that the skills required to successfully engage with a tradition demand a process of self-development or ontogeny, so that making things is also a process of learning and therefore of human growth. The latter, he argues, is itself creative since it involves the continual
making of the person (Ingold 2010, 2013). This is an interesting position insofar as it moves away from more traditional understandings in which creativity is situated solely in the mind and instead places it in a framework of human actions and relations. Creativity is not, therefore, a matter of imposing form onto matter (a hylomorphic model of creation); rather he argues that it is generated within life-processes (Ingold 2013). This argument offers a means of connecting people and objects, but in suggesting that creativity is a process that living beings undergo as they make their ways through the world (Ingold and Hallam 2007: 11), and thus a constant feature of human life, the ability to identify creativity as a particular kind of practice and as a specific quality is lost. Creativity becomes inevitable and universally occurring. This, however, does not match human experience as the outcomes of human practices are felt to be qualitatively different. In other words, some creations— in our analyses some objects—stand out.

The qualities that sit behind this shared acknowledgement of difference are hard to pin down, but that does not mean that we should not embrace the challenge of trying to comprehend how the world is constituted. Moreover, Ingold’s argument provokes questions about whether there are qualitative differences between making an object and making a person. We suggest caution about the automatic equation between production and creativity as that appears to ignore the very different forms that production may take, ranging from mechanical production to individual creations.

By contrast, creativity has also been viewed as a means to an end (Mayes 2012). In such approaches it is considered something that can be captured and taught, and it is assumed it will take the form of an appropriate solution to a problem or a task (Howard et al. 2008). It follows that creativity tends to be considered in terms of the value of outcomes and economic contribution (NACCCE 1999; Thrift 2000). Such perspectives, with their focus on a capitalist notion of value, at first glance seem to place the study of creativity in the past out of reach. Yet, they also offer a productive challenge in terms of how to think through the relationship between objects, value, and creativity in the Bronze Age. Another understanding of value has been argued from within history of art and some types of design studies, as they propose that creativity and cultural products are valuable in themselves (Norman 2004). In terms of the specification of what that value is about, it is often argued that such products play a critical role within their social context, as they challenge established norms and provide alternative interpretations and ways of understanding the world. Similar to the approaches outlined above, such arguments raise questions about how the value of creativity is established, the extent to which it is socially and politically defined, or whether it is something that can
exist outside such boundaries. In this volume, such questions of value are not our main focus. The resolution of Bronze Age data is not sufficient to consider such questions in further depth. It should, however, be acknowledged that we tend to assume that there are some connections between our sensitivities towards objects and their various qualities, and that we make assumptions about how they were appreciated when first made and used. Thus, in this volume we assume that some of the things humans make have inherent value, and that certain perceptive qualities may be widely shared (Bohm 1996).

The outcomes of creativity are always both cultural and material. We hold that creativity is not merely about an individual mind or body imposing upon materials but rather the outcome of a more complex dynamic. We find that creativity, in the form of new solutions, may be actively pursued, but also that this is not the case at all times and in all contexts. This is why we feel that the important question is no longer about the individual versus the collective, but rather about the relationship between people and materials and of understanding the contexts and conditions under which creativity flourishes.

MATERIAL ENTANGLEMENT AND THE CONDITIONS OF CREATIVITY

Complementing our focus on practice, the idea of material entanglement is also central to our approach. This should neither be understood as material determinism nor in terms of a simplistic reference to a symmetry between humans and materials. Rather, we see material engagement as a kind of human exploration and engagement with latent properties of different materials. This is therefore a question of a dialectic, of an almost hermeneutic and phenomenological experience of engagement through which sensations are amassed and responses formed (Birgerstam 2000). This, however, is not a simple relationship as materials and humans are existentially different and play different roles when interacting. One may say that the material awaits exploration, it resists and restricts certain actions and allows others, but it does not determine actions. This is why concepts of attentiveness, rules, mimesis, and risks are helpful for understanding how creativity may take place as these concepts reconfigure the material–human relationship to include an understanding of human action in relation to materials.

Attentiveness has been argued to be an important aspect of creativity. In a study on attentiveness, the philosopher Bengt Molander (2013) recounts the Swedish guitar maker Georg Bolin’s description of listening to wood as hard work, something that took him a lifetime to learn. This reference to craftspeople ‘listening’ to the material they work with should not be misunderstood to mean that the material tells them what to do; rather the material informs them
about what can be done and how. Molander views Bolin’s attentive listening as a capacity that guides him in his selection of wood and as a necessary precursor to striving to make the best possible instrument. Molander argues that attentiveness, and the notion of ‘what leads to the best’ are important aspects of the link between knowledge and creativity. In this, ‘listening’ is a metaphor and a skill, a way of knowing things as well as knowing how to listen.

The ability to see and express connections and relationships where others have not has also been seen as a key element of creativity (Jeanes 2006; Liep 2001). If creativity is not solely about a moment of individual originality or brilliance, but more commonly emerging from alteration of existing ideas or forms, then its comprehension invites consideration of the relationship between the existing and the new in the creative process. A particular feature of creativity that we want to point to is, therefore, how it may arise in response to existing cultural forms. Typically this takes place either through breaking existing rules or different forms of mimesis. Both of these also require attentiveness.

The subversion of rules is clearly associated with creativity, with the ability to go beyond the known and familiar and to explore things from different, at times disallowed, angles and approaches. More fundamentally, this points to a constructive tension between freedom of action and the subjection of action to rules. This theme has been discussed since Antiquity. It has been argued that, ‘To the ancient Greeks, the concept of a creator and of creativity implied freedom of action, whereas the Greeks’ concept of art involved subjection to laws and rules’ (Tatarkiewicz 1980: 244). At stake in this relationship are the roles of individual imagination and inspiration in creativity, as well as the articulation of these in relation to external constraints including social expectations. In other words, creativity becomes connected to how people explore borders and boundaries. This emphasis on the negotiation of rules has also been explored by Molander (1996, 2013). Drawing on the works of Donald Schön (1987) he uses the example of a cello masterclass to emphasise attentiveness as an important aspect of the relationship between necessity and freedom, between discipline and creativity. The student practises by imitating the master, but along with this there are discussions of technique, reflections on how something was done, what other possibilities existed, and perhaps the sketching of further possibilities. Molander focuses on these additional features of learning, arguing that they serve to acquire a ‘language’ of rules and through that also a means of going beyond them. Discussions of creativity taking a similar position emphasise that creativity is not a matter of freedom and liberation from constraint but is rather about the way that worlds are produced and expressed within
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the bounds of content and communication (Friedman 2001: 60). In a rule-bound society such as might have existed in the Bronze Age, such a framework might offer a way of thinking through the ways that people made objects that were both novel but could simultaneously be integrated into the existing social milieu (c.f. Sofaer and Sørensen 2002).

Another way of responding to familiar objects is through mimesis. In this process creative responses are located in the space between the original and reproduction. This link was famously discussed by the writer and philosopher Walter Benjamin, who in turn was heavily influenced by nineteenth-century anthropological accounts of sympathetic magic (Benjamin 1933). To Benjamin, mimesis was a matter of evocation rather than of imitation and it thus becomes a basis of creativity. He, for example, suggested that material forms can mirror the structure of the cosmos in a process of ‘non-sensuous similarity’ (Stafford 2007: 81), where relationships can be creatively expressed not just between things that resemble each other but in similarities between things that are materially different, animate and inanimate, the microcosm and macrocosm. Such arguments have obvious relevance to the aspirations of this volume with regard to the ways that forms, techniques, and motifs in one material may have inspired developments in others. Archaeological discussions of skeumorphs (objects manufactured in one material imitating those produced in another) readily offer the potential to engage with this notion of creativity, as does the materialisation of cosmological narratives (e.g. Kaul 1998, 2004a and b). Here too it is necessary to exercise attentiveness to the original in order to reconfigure it in new ways.

Recent anthropological work has also explored the relationship between creativity and imitation, challenging the long-standing assumption that these are oppositions. It has, for instance, been argued that copying or imitation is not a simple process of replication or running off duplicates from a template (Ingold and Hallam 2007). Rather it involves ‘a complex and ongoing alignment of observation of the model with action in the world’ (Ingold and Hallam 2007: 5). This alignment, they argue, requires improvisation, which is a creative process distinct from the formal resemblance between copy and model that is an outcome of that process. In this view tradition has to be worked at to be maintained or ‘carried on’ (Ingold and Hallam 2007: 6). It is a matter of continual problem solving, and creativity can never fully escape social constraints if it is not to tip over into madness (Hastrup 2007). This perspective, which sees creativity as relational, offers a provocation in terms of whether or not there is a sliding scale of creativity, or whether some aspects of creativity are qualitatively and quantitatively different to others. It also leaves open the role of materials, their potential, or resistance.
In addition to rules and mimesis, risk also plays an interesting role in terms of creative practice. Pushing the boundaries or breaking rules may entail risks. The results of this may be fruitful and invigorating but it may also be disastrous or wasteful. Flirting with risk means that the outcome is not guaranteed but also that aspirations go beyond the known and familiar, beyond the standard. This pushing of boundaries takes place at many different levels from the production of single objects to a broader kind of experimentation with materials themselves, and it may therefore be identified as a mainstay of creativity at the everyday level. This kind of creative risk is illustrated by the comments made by a modern-day potter when confronted with a copy of the Skarpsalling vessel, usually considered the most beautiful and outstanding Neolithic vessel found in Denmark. In describing the vessel’s qualities she said its shape was ‘vibrating’. Asked to specify what she meant, she explained that the Neolithic potter had pushed the shape to its upmost, to just before it would collapse. Risks may also be taken in relation to social choices. The acceptability and social integration of new objects is not guaranteed, as the patent books containing many ‘failed’ inventions testify (Anderson 1994). The production of new objects therefore runs a risk of rejection, or in other words, of social failure when rules are broken or bent too far (Sofaer 2015).

So far, we have mainly tried to establish where, through what kind of encounters, and through what kind of responses creativity is found. These questions could appear to imply that creativity is a momentary reaction. It is therefore useful to briefly consider arguments that place creativity within processes, and thus re-emphasise that creativity is located in praxis.

One such argument is found, for instance, in the work of psychologist Pirjo Birgerstam (2000), who has tried to identify stages within ‘the creative process’. She describes this in terms of a hermeneutic spiral in which ‘the artist’ alternates between intuitive and rational modes of work (see Bender Jørgensen 2013a). Birgerstam argues that routines, such as a break or a contemplative rest, are applied to facilitate the release of creativity. She calls this ‘incubation’, and describes creativity as resulting from the incubation of an overall idea (Birgerstam 2000: 58–63). Such an approach, however, raises the question as to how creativity can be explored outside so-called artistic endeavour and whether it is more widely applicable. Nonetheless, Molander (2008) gives similar examples of (seemingly irrelevant) routines that allow meteorologists time to build up an ‘inner weather picture’ by looking at maps, talking to colleagues who had been working for some time, and even sitting down to have coffee. Likewise he recounts how a boat-builder appeared to be ambling aimlessly round his workshop, rummaging among his timbers, looking at irrelevant objects, lighting a cigarette and stubbing it out, in order to build up
concentration before a critical stage in the construction of a boat. This model offers a provocation to prevailing archaeological notions of the *chaîne opératoire* in terms of underlying assumptions about the logicality, inevitability, and timing of stages in the production of objects. It instates the potential importance of a pause or breaks between or within stages in the making process where decisions may take place, rather than focusing entirely upon action itself.

Recent sociological work has also focused on creative processes, in particular the connections that they generate and express. Here, the making of things is a matter of connecting existing materials and ideas to make something new. Such creative acts usually involve a social dimension, connecting people together (Gauntlett 2011). This perspective refutes what it identifies as a previous over-emphasis on end products and their classification as creative, insisting instead on the importance of creativity as a process in which thinking and making are not separate activities. It sees creativity in making things as a kind of practice-based enquiry in which people may mess around with materials, play, experiment, rearrange, discard, or manipulate the thing in question until it communicates meanings in a satisfying manner (Gauntlett 2007, 2011; see also Ingold 2013). Creativity exists as part of a wider ‘making and doing culture’ (Gauntlett 2011: 11) which is not limited to elites or ‘creative types’ or requires external verification. Creativity can be high-level and high-impact but it can also be low-level and everyday (Gauntlett 2011). In other words, not all creativity is the same.

The anthropologist James Leach goes further in pursuing a social rather than a psychological perspective. He has attempted to use a comparative approach in order to move between contexts, compare processes between them, and the conceptual worlds they express (Leach 2004). On this basis he has defined a series of elements that make up creativity. These include combination (arguing that creativity can be recognised where new combinations of ideas or things are apparent), that such combinations are deliberate and directed, and that there is novelty in form or outcome (Leach 2004). How these elements operate in different social settings is also a focus of his enquiry. He further demonstrates that notions of creativity are not universal (Leach 2004; Hirsch 2004).

An attempt to locate the origins of any particular creative output singularly within an individual may thus be unhelpful. Creativity need not be attributed to a particular person. Richard Sennett (2009) points out the importance of understanding the social context for how notions of creativity are distributed. To show this he contrasts modern injunctions for even the lowliest worker to work creatively, with the social dynamic in the Renaissance workshop that required a different set of social relations between master and assistants. Such points may be useful to bear in mind in a more general sense, rather than
limited only to workshops, especially when thinking about a society such as
the European Bronze Age. In such societies there might have been settings in
which only particular kinds of people were permitted to ‘be creative’ such as
may have resulted from closely controlled communities of practices, appren-
tice systems, or overtly ritualised production which excluded certain sectors
of society from participation. However, individual makers cannot be identified
in a straightforward manner; there are no signatures or makers’ marks that we
are able to recognise. Furthermore, the importance of household production
during the Bronze Age – and therefore the potential for creativity within such
settings – should be emphasised, as considerations of creativity tend to take
modern production contexts for granted.

CREATIVITY AND ARCHAEOLOGY: WHAT MAKES
ARCHAEOLOGY DIFFERENT?

Contemporary explorations of the concept of creativity tend to agree that
there are many different types of creativity and that they are differently mani-
fest. The various, and to some extent contradictory, frameworks for under-
standing creativity outlined above each offer something to archaeology and
the investigation of Bronze Age creativity; at least they are helpful to think
with. Many contemporary approaches have reacted against the exclusive anal-
ysis of the outcomes of creativity to focus on process, as have we. In contrast
to many contemporary studies of creativity, however, archaeology’s focus on
material culture demands that objects retain a central significance in terms of
creativity and that we learn to think with and about creativity as both process
and outcome. This requires a way of interrogating creativity as material expres-
sion. Recent anthropological and sociological perspectives have edged towards
recognition of the role of ‘things’ in tracing how creative processes unfold (see
Ingold 2007a and b, 2013; Gauntlett 2011), yet even here creativity is largely
viewed as an abstract, rather than a tangible phenomenon. It is therefore telling
that there has been relatively little consideration of creativity based on working
back from materials and objects, analysing them to trace and understand pro-
cesses through their outcomes.

This situation may be the result of a long-standing split between the abstract
and the material in analyses of creativity. It is articulated, for example, within
Lévi-Strauss’ (1966) famous discussion of the engineer and the bricoleur in
which he introduced a metaphor for two different types of creativity (Hirsch
2004); for the engineer problems are solved by creating a new abstract model
or formula, whereas the bricoleur reuses existing elements in novel combina-
tions. Both create new things but from different starting points. The former
begins with the abstract and the latter with the concrete (Hirsch 2004). A further difficulty with separating the abstract and the material is that it assumes that abstract thought is the means by which change takes place, while material conditions are static and only to be recombined. This is problematic because it becomes impossible to account for new materials and material developments if the abstract and the material are not understood to be mutually dependent.

Nonetheless, this divide between the abstract and the material has become deeply entrenched within contemporary thought. It persists, for example, in the distinction between art and craft where the production of the handmade object has long been considered as the poor relation to supposed more cerebral artistic activity (Adamson 2010; Sennett 2009). Recent work has, however, reassessed this divide (Adamson 2010) and has argued for craft as a way of ‘thinking through the hands’ (Almevik et al. 2011; Pallasmaa 2009). The hands provide an important link between knowledge, thought, and creativity where haptic understanding of the world is of central importance in imagining something new (see also Paterson 2007a and b). Objects articulate the boundary between their maker and the world such that the bodily and mental constitution of the maker become the site of the work as different creative possibilities arise through different hand and body movements (Pallasmaa 2009). Creativity is thus a matter of the whole person – body and mind. Since the crafting of things is not separate to life but is part of it, this means that meaning can exist within the act of making (Ingold 2013). In some cases, the form-giving actions of craftspeople might therefore be understood in terms of a literal making sense of the world (Sofaer 2015).

Many existing discussions about the nature of creativity focus on short time scales and take modern material conditions for granted. In other words, they focus on how people are creative with materials and the ways that they bring them together, rather than exploring creativity by investigating how some of these materials came into being and became established. It is here that archaeology’s focus on the longue durée, and the Bronze Age in particular, has the potential to offer a distinctive contribution to understanding the nature of creativity. In this period certain aspects of material culture cannot be taken for granted and materials that we now perceive as almost ‘natural’ (bronze and woollen textiles) were only coming into being. An archaeological emphasis on the material (rather than only cognitive) aspects of creativity thus allows an original understanding of how creative possibilities are generated and how their expressions change over time.

Objects and practices provide contexts for creativity to take place. Granting them a central role has clear resonance with established archaeological approaches to material culture as contextually specific in expression and use.
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(Hodder 1987). Understanding the importance of context, whether constituted by objects or wider fields of cultural actions, may also help to reveal why some situations or places might provoke qualitatively different responses or stimulate more creative reactions than others. Creativity in materials and objects is not, however, necessarily ubiquitous nor always obvious. In other words, it is a matter of place and people, as well as time. In this volume we have limited our focus to the study of the European Bronze Age (2500–500 BC) in regions forming a north–south axis across the continent: Scandinavia, central Europe, and south-east Europe (for details of local chronological schemes see Fokkens and Harding 2013).3

From an archaeological point of view contextualisation is also a matter of investigating materials as specific kinds of contexts since different kinds of materials have specific potentials, constraints, and connections to other materials, and were differently exploited in the production of objects and their uses. In this volume, we have selected three different materials and their corresponding crafts to investigate: fibres, in particular wool, and their use in textile production; metal and metalworking; and clay and pottery production. The most important differences between these materials are that wool and metal were new materials developed or invented and used in similar ways throughout Europe, whereas pottery was a well-established craft, which shows no innovations but substantial regional differences. Changes during the Bronze Age are expressed differently within each of these materials, reflecting their different properties, as well as the kinds of experimentation and decision-making processes that were embedded within their production practices. For textiles, questions of creativity arise from the emergence of a new raw material and how it was responded to including the adaptation of existing tools, the development of new weaves, patterns, and the construction and tailoring of garments. The most challenging observation for bronze is the development of deliberate alloying and recipes for the proportion of different admixtures, the innovation of casting, and the meanings and compositional principles underlying some of the elaborate decorations on objects. For pottery, it is important to explore creativity in terms of the sophisticated, complex, and varied treatment of clays, the use of distinct colour effects, and regionally distinct sometimes elaborately decorated surfaces that combined a variety of finishes and decorative techniques.

This focus on material is not to endorse material determinism. Rather, focusing on materials as particular kinds of contexts provides an opportunity to explore how Bronze Age people pushed the boundaries of their knowledge and of understanding creativity as a kind of praxis-based enquiry into
the world. On a practical level it also responds to the challenge of how to investigate creativity by offering a potential methodological point of departure for the study of creativity in archaeology; a ‘closeness to the object’ (Turkle and Papert 1992). It thus becomes possible to trace how people worked with materials and objects in an imaginative way as part of their curiosity about the world, and how they worked on finding solutions to practical problems. Thus, while creativity has often been seen as a ‘black box’, interrogating the making of objects can help to describe, understand, and articulate creative processes.

THIS VOLUME

Addressing creativity in this way demands a ‘revaluation of the concrete’ (Turkle and Papert 1992). At the most basic level, such an approach necessitates an initial understanding of how people understood the nature of the materials with which they worked, but it also requires an investigation of how objects were made. The three parts of this volume – Raw Materials: Creativity and the Properties of Materials (Part I), Production Practices (Part II), and Effects: Shape, Motifs, Pattern, Colour, and Texture (Part III) – represent the fundamental stages within the making of an object. We explore how creativity can be expressed at each stage from the raw material to the finishing, but also the diverse methods and variety of reasons involved.

In Part I we discuss the role of our chosen raw materials: textile fibres, metal, and clay. This brings attention to how their innate properties would guide and restrain how they could be worked. It simultaneously focuses concern on how these constraints may have been discovered, perceived, and potentially overcome, or in other words how boundaries were pushed. To bring these properties fully into our discussion each material is considered on its own. Attention is first paid to their natural properties in terms of behaviour, where they could be found, and how they were extracted or harvested. Next, each material is discussed in terms of how a natural resource is turned into a fabricated raw material ready to be used by a craftsman. For textiles this refers to the different kinds of fibres used, including the breeding of sheep to develop woolly fleeces. For metal this is about selecting different naturally occurring mineral compositions and experimenting with their behaviour. The materials of pottery refer to clay and the different tempering materials used. In the reflections at the end of Part I, we point to the different dynamics of the three materials, vividly illustrating the important contribution materials themselves make as regards practice, and through that to creativity. We argue that the contribution that materials make to creativity can be understood through how they demand
attentiveness. We also point to the repercussions of the new, how they call forth new procedures, impact society in a number of ways, and how they become part of how the world is understood. The role of experimentation and problem solving for Bronze Age creativity is suggested. We argue that creativity can result directly from an intimate engagement with the material world rather than only taking the form of an interpretation of the world.

In Part II we focus on production practices. We show how within production practices there are different pathways that can be followed and decisions to be made. We also explore how technical and normative constraints may be broken and problems solved, and we emphasise how all these aspects can generate diversity in responses. We therefore discuss some of the core characteristics of each of the materials in terms of production sequences or the chaîne opératoire (allowing us to stress the roles of selection, choices, and constraints), communities of practice (to give attention to the social contexts of creativity and inventions), consider how changes in material culture can be said to be due to development of technical skill, and examine tools (as inventions in their own right and as the linch pins in material–human entanglements). We draw out some of the shared characteristics of the conditions for creativity in production processes and through these reflect on what creativity may be when explored through this particular lens. The discussions throughout Part II explore what the ‘newness’ of wool and tin–bronze entailed, making it clear that this meant that working routines, tools, labour organisation, and social relations had to be adjusted. These developments, however, also demonstrate something about the human capacity for adaptation and reinvention as we see that practices and tools related to one material were in many instances transferred and re-adapted to new materials. Creativity is therefore just as much about rethinking existing ways of doing things as it is about inventing new procedures and forms.

Part III examines finished objects in terms of the ways that Bronze Age people explored the effects of objects. In other words, the particular material properties or affordances of things that structure perceptions and responses (see Gell 1998; Gosden 2001). The discussion in this section of the volume builds on those of Parts I and II as we consider how Bronze Age people explored different qualities of materials through production practices in order to create objects with distinctive shapes, motifs, patterns, colours, and textures. We discuss new ways of designing objects that exploited the different potentials of materials, in particular their surfaces and formal properties. We also show how aesthetic considerations were manifest in form, balance, and symmetry, and how the elaboration of objects was nested within decisions about how to find
ways of reaching certain effects or referencing specific narratives. A further important theme within this part of the volume is our examination of creativity in terms of the broader social and ideological milieu in which it took place, revealing the deeply contextual expression of Bronze Age creativity. In particular, we expose the close link between creativity and cosmological concerns, suggesting that creativity flourished in an atmosphere of cosmological richness. Motifs such as the bird, horse, boat, sun, and wheel at various levels of abstraction were widely deployed in the elaboration of objects throughout Europe from the Aegean to Scandinavia. We show how some Bronze Age objects were enlisted to create particular kinds of sensory or haptic experiences for their users that may have had particular associations with cosmological story-telling. These objects thus also provided opportunities for creative encounters through their use.

Bronze Age creativity was grounded in the human imagination. Imagination is a creative force that both enriches the material world and is enriched by it. It is the alchemy that turns technical or material knowledge into something new or novel, enabling people to augment and to transform their material world. It combines the uniqueness of personal understandings and insights with the broad sweep of collective imagination, in this case through a shared cosmology. Thus not only did Bronze Age people creatively explore and exploit the effects of objects in order to create metaphorical associations but myths and stories were imaginative and creative resources in their own right. They simultaneously inspired the making of objects and were made real through them.

The structure of the volume is further designed to open up understandings of creativity by moving from general discussion through to a series of specific case studies. Thus in Parts II and III, in addition to the more general considerations of Bronze Age objects, we discuss creativity through a series of short essays, each of which focuses upon a particular feature of Bronze Age material culture. Rather than an exhaustive or systematic discussion of the full range of Bronze Age objects made of textiles, bronze, and ceramics, these essays focus on particular often well-known items that we use as selected objects to think with. These include the female costumes from the Danish Early Bronze Age, the textiles from the Hallstatt salt mines in Austria, Bronze Age razors from Scandinavia, bronze objects decorated with bird images, and ceramics from central Europe. These objects are repeatedly referenced and explored from a number of angles to illustrate the core concerns of the three parts of the volume. We make no attempt at an exhaustive coverage of potential creative expressions. In our exploration of creativity, as Marcel Proust put it, "The real
voyage of discovery consists not in seeking new landscapes but in having new eyes’ (Proust 1932: 260).

NOTES
1 Interview with potter in Land of Legends, Lejre, Denmark, August 2013 by M. L. S. Sørensen.
2 Though he did not mention the word creativity specifically in his discussion.
3 In this volume we use local chronological schemes and terminologies relevant to each region.
PART I

RAW MATERIALS: CREATIVITY AND THE PROPERTIES OF MATERIALS
INTRODUCTION

Marie Louise Stig Sørensen, Joanna Sofær, and Lise Bender Jørgensen

All things are made from materials. This making is the most fundamental aspect of human–object relationships, but it is also complex due to the diverse properties of raw materials, the variety of desired outcomes, and the skills and abilities of makers. In Part I we aim to explore the three materials discussed in this volume: textiles, bronze, and clay. Our specific concern is locating and analysing the impact of the distinct characteristics of these materials. We investigate the development of new procedures for preparing raw materials that were either first discovered or that emerged during the Bronze Age; in other words, the development of new chaîne opératoires in response to the properties of materials. We also examine which factors might have influenced changes through time. In particular, how did various ways of working with the materials engender new understandings and material engagements? What are the implications of procedures being established, and how were they challenged, changed, improved, or innovated upon? We are concerned to address questions such as: How did the innate properties of each material inspire, guide, and restrict the production of objects? What specific knowledge, skills, and decisions were required to work with them? For example, how did textile-making practices evolve to respond to the changed properties of wool fibres, and how were different kinds of temper explored to create different clay qualities?
We are particularly interested in locating factors and conditions that may have stimulated shifts in how the materials were explored, including how they were thought about and ‘with’. Our interest in the role of materials embraces how they were used to establish, maintain, and change production traditions. This is not just a straightforward matter of charting the trajectory of developments over time but also of exploring how new materials and new procedures might disrupt existing practices. Martin Heidegger coined the term ‘present-at-hand’ to refer to how interruptions of routines affect awareness of things. ‘Things in this mode of being are objects of conscious concern; they “light up” and become something that might be thought of in an abstract manner’ (Heidegger 1962: 102 in Olsen 2010: 72). He further argues that disturbances or interruptions cause ordinary things to become ‘present-at-hand’. Malfunctions, things missing, disrupted expectations, and experiences change our awareness of things and their relationship to each other. In Part I of this volume we aim to bring this issue of ‘present-at-hand’ and Bengt Molander’s parallel argument about attentiveness (Molander 2013) to our exploration of creativity.

Different materials have different properties. According to Tim Ingold (2011: 30), properties occur rather than exist. This, however, is a human-centred approach that risks losing sight of some of the dynamics of material–human interaction, and perhaps especially some of the aspects of materials that may inspire creativity, in respect of both opportunities and restrictions. We therefore propose a distinction between material properties and material qualities. Material properties are innate physical, chemical, and kinetic characteristics that are independent of human awareness and exploitation. Material qualities, on the other hand, refer to how such properties come to exist in new ways after being recognised and manipulated; being transformed first into raw materials and then later into objects. We suggest that becoming aware of such properties for the very first time in human history, or encountering new properties as they are evolving (due to genetic changes) would provide a distinct kind of ‘lighting up’ experience as no routines would exist for channelling and guiding responses. Thus, we argue that it is already during the process of materials being turned into a raw material ready to be used that ‘the constant flow, mixing, and mutation of materials and things’ (Ingold 2011: 30) begin, rather than this dynamic being solely linked to the production and consumption of things. We do, nonetheless, also hold that the interaction with materials per se is a particular kind of engagement that has its own characteristics. Things and materials cannot be simply collapsed into each other.

The materials we investigate vary widely in their properties, providing different opportunities and challenges for makers. For instance, they
contrast in the processing needed to transform them from their natural state as raw materials to a fabricated raw material out of which objects can be made. We need to make this distinction between raw and fabricated raw materials as all of the materials discussed are extracted from sources in which they exist as natural raw materials. Subsequently, they are prepared through different processes to become materials ready for use. Fabricated raw materials are the harvested and prepared fibres, the alloyed copper, and tempered clay. For each of these, however, the processes and conceptual frameworks involved in moving from raw materials to fabricated raw materials differ. Thus bronze, as an alloy of different minerals, is different to the natural materials it is made from and is created through a bringing together and mixing of minerals. Likewise the potter’s fabricated raw material – the tempered clay – is made by bringing together materials so that when these are combined the fabricated raw material has distinct qualities. Bronze and tempered clay both differ from the wool used by textile workers, where the desired fabricated raw material is not gained primarily by mixing materials but through the selective breeding of sheep, choice of fibres from the fleece, and their processing. One fundamental difference between our materials is therefore a result of the different properties of inorganic and organic materials. In contrast to sheep, which throughout the Bronze Age show genetic modification due to breeding, the base elements that constitute bronze and potter’s clay are not altered per se by their processing. Whereas chemical reactions are in principle reversible, genetic changes are not. In the following, we shall pursue these ideas by considering how creativity may be located within each of the three materials in terms of how they were being processed to become raw materials ready for use.
FIBRES FOR BRONZE AGE TEXTILES

Lise Bender Jørgensen and Antoinette Rast-Eicher

Bronze Age weavers used a range of different fibres: flax, nettle, hemp, and a variety of bast that had been used for millennia (Rast-Eicher 2005). Sheep’s wool, however, was a novelty and the introduction of wool as an important raw material for textiles caused changes in the way textiles were produced and used. It also caused changes in animal husbandry, land use, social structures, and in the mind-set of people but most of all, the sheep themselves, and in particular their wool, were changed. Early domesticated sheep were kept for their meat and possibly skin, but they did not have wool in our sense of the word. Like other mammals they had a coat of hair that included soft downy under-wool that grew when winter was approaching and was moulted in early summer. What the early domesticated sheep did have was a potential; their fuzzy under-wool had the genetic capacity to develop into wool.

BECOMING WOOL

Shepherds must have recognised that some of their sheep had a coat with more and better under-wool than others: longer, stronger, and shinier fibres. At some point they began to encourage this by selective breeding. Eventually white wools became especially sought after as this is a prerequisite for dyeing. By the fourth millennium BC, breeding had resulted in sufficient genetic
changes for woolly sheep to have emerged in the Near East. Three morphological changes occurred to early domesticated sheep: the horn shape changed and the ewes became hornless, the tails became long and fat, and crucially the woolly fleece developed with different coloured fleeces appearing, including white (Breniquet 2008; Clutton-Brock 1989: 57; Rast-Eicher 2008: 121–2). This is testified both by archaeological sources and textual evidence from the Near East (Barber 1991: 23–5). The European Muflon still found in Corsica, Sardinia, and Cyprus are remnants of the early domesticated sheep (Scheu et al. 2012: 51) giving an impression of the changes that took place.

A piece of sheep skin with wool of different colours from the Neolithic, mid-fifth-millennium BC site of El Omari in Egypt (Mortensen 1999) has been reported as one of the earliest examples of preserved wool (Barber 1991: 25; Kemp and Vogelsang-Eastwood 2001: 34). Regrettably the piece is now lost and cannot be re-investigated (Bodil Mortensen pers. comm.). Close in date are a number of finds of wool dated to the fourth millennium BC from Turkey, Mesopotamia, Iran, and the northern Caucasus (Frangipane et al. 2009; Gleba 2012: 3643; McCorriston 1997: 521; Shishlina et al. 2003). Cuneiform texts from the Archaic period of Uruk clearly mention wool sheep (Green 1980: 4), and by the late third and early second millennium BC records from Ur III and Old Assyria specify sheep breeds whose wools were assessed according to their quality and colour. The wool of fat-tailed sheep was the best, that of ‘mountain sheep’ was of poorer quality, while a third kind, uli-gi sheep, yielded very coarse wool. Up to five different qualities of the wools were recorded. Further distinctions were made between new and old wool. As regards colours, the wool of fat-tailed sheep was recorded as black and white, while other sheep breeds appear to have yielded black, red-brown, or multi-coloured wool (Waetzoldt 1972: 3–9, 46–50).

Wool has a range of properties that makes it very well suited to use as a textile fibre (Cook 1968: 102–8; Gleba 2012; Harris 2010). Modern wools are elastic, have a good stretch and recovery, and are fairly resistant to abrasion. Wool fibres have scales that cause them to felt easily. Together with crimp, a wavy structure unique among natural fibres, this makes wool an excellent insulating material against heat as well as cold. Wool is highly absorbent and can hold moisture up to about a third of its weight before it feels wet. Wool remains warm even if damp. This is caused by the release of heat as moisture is being absorbed. The tenacity of wool is 1–1.7 g/denier when dry, 0.8–1.6 g/denier when wet, and its tensile strength 17,000–29,000 lb/square inch. Wool becomes weak and loses its softness when heated to boiling point for long periods; at 130° it decomposes and it chars at 300°. If stored carefully it hardly deteriorates, but the keratin that it consists of decomposes if subjected to strong
sunlight over long periods. Wool has a natural lustre that reflects light although the degree of this varies between sheep breeds. Significantly, wool appears in a range of natural shades – white, grey, brown, and black. Furthermore, as wool dyes easily, it offers a wide palette of potential colours. Not all of these special properties were found in the wools of wild and early domesticated sheep, but they emerged through breeding. Crimp, for example, is first attested in Iron Age wools (Rast-Eicher 2013).

In Europe, woolly sheep seem to have entered the scene more or less on the threshold of the Bronze Age in various regions. Hornless sheep turn up in Early Bronze Age finds from Switzerland (Rast-Eicher 2015, forthcoming). In central Hungary, changes in the composition of faunal assemblages, as well as slaughter patterns for sheep bones, suggest a shift after 2000 BC towards sheep being kept for their wool (Vretemark 2010: 157). Currently, the earliest examples of wool in Europe are a sprinkling of textile finds dated by relative chronology or radiocarbon dating to around 2000 BC and early in the second millennium BC from the Czech Republic, Denmark, France, Germany, Italy, Switzerland, and the UK (Bender Jørgensen and Rast-Eicher 2015). By the Middle Bronze Age, after c. 1600 BC, we find wool textiles turning up regularly, and seemingly all over Europe (Gleba 2012; Rast-Eicher 2005, 2008; Rast-Eicher and Bender Jørgensen 2013; Ryder 1990a).

The emergence of woolly sheep was only a beginning. Fibre analysis shows that the fleeces of early sheep consist of several types of fibres: fine underwool with diameters up to 25 microns, medium hairy or heterotype fibres, and kemp (i.e. coarse, brittle hair with a wide medulla) (Rast-Eicher 2008; Rast-Eicher and Bender Jørgensen 2013). These differences were explored and responded to resulting in further genetic changes. For instance, the wool of a mid-second-millennium textile from Pustopolje in Bosnia-Herzegovina proved on analysis to consist of all these fibre types; coarse kemp fibres are conspicuously sticking out of the yarn and the fabric must have been quite itchy to the touch (Figure 1.1a). Similar wool with a high proportion of coarse hair and kemp has been recorded in a number of textiles from the Lüneburg region in north-west Germany dated c. 1500–1200 BC (Bender Jørgensen and Rast-Eicher 2016). The Pustopolje and Lüneburg wools show that by the Middle Bronze Age, sheep in Europe still had fleeces whose composition was little removed from that of hairy sheep. Analysis of Scandinavian Bronze Age woolen textiles demonstrates that they were similarly mainly made from a combination of very fine fibres with a few coarse fibres and kemp, showing that the wool was from the hairy Bronze Age sheep. This type of sheep is further documented by a number of sheepskins found preserved in the salt mines of Hallstatt, Austria, offering a rare glimpse of Bronze Age fleeces. They show that
Middle Bronze Age fleeces were short, with coarse medullated fibres and fine unmedullated under-wool. The coarser fibres have natural pigmentation and would have appeared as dark, whereas the under-wool only had a low degree of pigmentation and was lightly coloured, at times even white (Rast-Eicher 2013; Rast-Eicher and Bender Jørgensen 2013). The breeding of sheep had two main aims: to produce white wool and longer fibres.

The wool from the Bronze Age textiles from Hallstatt generally corresponds with that of contemporary fleeces. A few of these Middle Bronze Age textiles are, however, made of wool that is virtually unpigmented. In other words, it is white or almost white. These wools also have a different fibre composition (Figure 1.1b). This suggests selection or breeding of sheep with more evolved wools, or, alternatively, that a very careful sorting and selection of light fibres from different animals was carried out in order to obtain white wool for specific purposes. This shows that the potential of sheep for developing wool was being exploited and their capacity for producing specific fleece types and colours was being pushed. Here it is important to emphasise that white
wool is genetically dominant, which is important for purposeful breeding as partly white sheep could have been used to produce fully white sheep (Ryder 1990b: 143).

Regina Hofmann-de Keijzer et al. (2013) have shown that several Middle Bronze Age textiles from Hallstatt as well as the Pustopolje textile were dyed. These are all made of pale or almost unpigmented wools and indicate that Bronze Age people began to use dyes as a way of enhancing the range of colours in textiles. The breeding for white sheep and the development of dyes appear to have been mutually enforcing innovations at this time.

Late Bronze Age wools are rare, due to the prevalent funeral rite of cremation that does not preserve textiles. A few exceptions do, however, exist. Margarita Gleba examined wool samples from Radfeld in Austria dated to 1100–1000 BC and found they represent a further transitional stage in the development of the fleece (Gleba 2012: 3648). In contrast, in Scandinavia by the Late Bronze Age no signs of changes have as yet been observed (Rast-Eicher and Bender Jørgensen 2013). Changes in the fleece may thus to some extent take place at regional levels as shepherds had differing access to breeding animals as well as different expertise and knowledge. Access to, and control over, sheep with wool of desired qualities may therefore have been much valued.

The development of the fleeces, and through that the types of wool used in textiles, was an on-going process. Iron Age fleeces from the Hallstatt salt mines are more varied than those of the Bronze Age. One type is almost the same as those found from the Bronze Age but with less coarse as well as less fine fibres (Rast-Eicher 2013; Rast-Eicher and Bender Jørgensen 2013). They may be understood as a reflection of the Bronze Age fleece type being in the process of development and a standard being established. The Iron Age saw a further development towards distinctive sheep breeds (Gleba 2012; Rast-Eicher 2008; Rast-Eicher and Bender Jørgensen 2013).

FLAX IN A STATE OF FLUX

Flax has been used for almost 12,000 years and was introduced in Europe at the beginning of the Neolithic. Since then it has undergone many modifications. Among the first was the transformation of the wild flax species *Linum bienne* into the domesticated *Linum usitatissimum*. Further genetic changes led to subspecies especially suited either for oil or fibre production (Karg 2015; Zohary et al. 2012: 2, 100–6).

Flax is a very strong fibre, with excellent tensile strength that becomes stronger by as much as 20% when wet. This makes it well suited for items like fishing nets, tents, or sails. Flax is a fibre that is particularly inextensible,
stretching only slightly when tension is increased. Nonetheless it is an elastic fibre that tends to return to its original length when tension is relaxed. It has a high degree of rigidity and resists bending, causing linen fabrics to crease easily. It is highly resistant to heat up to about 120°C but gradually loses strength if exposed to sunlight. Flax is a good conductor of heat, which makes linen fabrics feel cool. Working clothes for smiths, for example, used to be long linen shirts that warded off heat and sparks. Linen is also crisp and smooth, and has the ability to absorb moisture such as sweat. These aspects make flax highly suitable for clothing and for household linens. Flax fibres appear dull but become lustrous when beaten or smoothed; its natural colours vary between white, yellowish and grey (Cook 1968: 9–11; Harris 2010: 105–6). It is difficult to dye although textiles from Pharaonic Egypt show that this had already been mastered by the Old Kingdom (i.e. the third millennium BC), and was further developed during the Eighteenth Dynasty (Barber 1991: 223–5; Kemp and Vogelsang-Eastwood 2001: 152–5). Flax can be used to make fine, light, virtually transparent fabrics as well as very coarse sackcloth or tarpaulins (Cooke et al. 1991). The natural properties of flax are exploited when woven in tabby due to the density of the interlacing or binding points that make the fabric firm, strong and, if densely woven, rather stiff.

The earliest archaeobotanical evidence of flax from Europe derives from sites of the Linearbandkeramik (LBK) culture and dates to the second half of the sixth millennium BC (Zohary et al. 2012: 103). It arrived as part and parcel of Neolithisation, along with farming, domesticated animals, and pottery. Flax seeds or capsules have been found in many parts of Europe, including Austria, Britain, Germany, Italy, the Low Countries, Poland, Spain, Switzerland, and the Balkans including Greece (Karg 2011, 2015). In the Alpine area, flax cultivation started in the seventh and sixth millennium BC. Until the second half of the fourth millennium BC, winter flax was cultivated. It was accompanied by weeds deriving from the Mediterranean. Then it was replaced by a new flax type that is found along with local summer weeds (Jacomet 2013; Karg 2015). After c. 3400 BC a new flax species with smaller seeds was introduced and became the norm (Maier and Schlichtherle 2011: 571–2). The excellent preservation conditions in the Alpine lakes mean that we can connect this change in the properties of the plant with changes in flax cultivation and processing. This suggests that cultivation was explicitly aimed at enhancing the properties most important for fibre production; the new flax variety was better suited for fibre production than the earlier type with large seeds. The change to a new flax type is said to have been caused by influences from the Danubian area (Herbig and Maier 2011). At this time, preserved fibres with remains of stem fragments
attached to them become rare, suggesting that the processing becomes more meticulous. These two observations suggest a ‘flax-boom’ from around 3000 BC (Maier and Schlichtherle 2011: 571–3).

Flax appears to have been the most common fibre in Bronze Age textiles from southern and western Europe; about two thirds of all textile finds from France, Greece and Italy, all Spanish, and most of those from the UK are considered to be made of flax (Alfaro 2012; Alfaro 1984; Bazzanella and Mayr 2009; Gleba 2008a; Grömer 2007; Henshall 1950; Hedges 1973; see also the online CinBA textile database, http://cinba.net/outputs/databases/textiles/). Nonetheless, a number of these textiles were found and published as flax in the nineteenth or early twentieth century; some are now lost, and fibre identifications cannot be ascertained. It is therefore likely that the picture was more varied.

The use of flax in northern Europe is less clear. In the literature there are references to two examples of Bronze Age linen from northern Germany. One is a plaited tassel from Vaaler in Schleswig-Holstein, dated to Montelius Period II (Middle Bronze Age), and the other is a textile fragment from a Late Bronze Age grave from Schaliß in Mecklenburg (Ehlers 1998: 221, 468; Möller-Wiering 2012: 126). New fibre analyses have, however, shown that the Vaaler tassel is made of bast and the Schaliß identification is difficult to verify (Bender Jørgensen and Rast-Eicher 2016). For some reason, flax does not seem to have been much used in Scandinavia before towards the end of the Bronze Age. Archaeobotanical evidence in the form of flax seeds and capsules have been found in bogs and settlements dated to c. 800 BC (Andresen and Karg 2011: 519–20; Viklund 2011: 509–10); a single flax seed dated c. 1000 BC was found at Bjerre Enge in Denmark (Robinson et al. 1995: 14).

Neolithic flax fibres were processed much like the bast and grasses that had been used for various forms of basketry and even clothing since the Palaeolithic; as unretted strips as well as retted fibres (Rast-Eicher 2005: 119). Experiments indicate that fine Neolithic linen threads were made by stripping fibres from stems that had been field retted for up to 10–12 days. The wet fibres were then divided into finer strips and joined by rolling the fibre ends between the fingers, rolled around a spool, and left to dry. Two such yarns could then be spun into a plied yarn, for example using a drop spindle (Leuzinger and Rast-Eicher 2011: 537). Investigations of Middle Bronze Age linen samples from the salt mines of Hallstatt show that fibres at the site were also processed in this way. Late Bronze Age linens from Switzerland, however, are made from fibres that were processed more carefully; each fibre was now separated from the others, suggesting they were combed after retting, making it possible to make softer threads (Figure 1.1c) (Leuzinger and Rast-Eicher 2011: 540).
The above discussion shows that it is possible to trace changes in flax plants as well as in the processing of flax fibres throughout the prehistory of flax cultivation in Europe. Farmers and textile workers had been attentive to plants and fibres, encouraging and acting upon changes in their properties. The aim was obviously to obtain better, finer, and softer fibres that could be turned into fine yarns, increasing the range of fabrics and textures that could be produced from them.

FLAX AND WOOL

To a great extent wool took over from flax as the dominant raw material for textiles around the beginning of the Bronze Age. Investigating evidence of early textile production in Mesopotamia, Joy McCorriston (1997: 517) has called this change the ‘fibre revolution’, arguing that the shift from flax to wool led to changes in land tenure, social relations, labour roles, and labour specialisation. Flax production requires prime arable land as well as substantial input of labour. Cultivation of flax involves preparation, fertilisation and watering of the soil, and weeding (Valamoti 2011: 556). Flax harvesting and processing involves several different processes before the fibre can be spun: pulling, rippling, retting, breaking, drying, scutching, and heckling (Andresen and Karg 2011: 518–19). If the fibres are spliced, the procedure should be adjusted to: pulling, rippling, retting, breaking, wetting, stripping, splicing, and drying.

The production of wool does not require good arable land; sheep can be herded on marginal land. McCorriston (1997: 523) mentions the steppes and deserts of Mesopotamia as grazing grounds documented in Sumerian texts. In Europe, sheep have been (and to some extent still are) grazed in mountain pastures, heathlands and other forms of marginal land (Bender Jørgensen 2012a: 179). An increase in open lands during the last phase of the Neolithic period in the Alpine regions of Europe points to a change in animal husbandry at that point (Schibler 2008). Land requirements also differ. McCorriston (1997: 524) estimates a yield of 335 kg hackled flax fibres per hectare. By contrast, based on an estimated 4.5–8 hectares needed per sheep for grazing, there would be an average yield of 0.125–0.450 kg of wool per hectare in the steppe or desert. For Scandinavia calculations suggest 300–440 kg flax could be produced per hectare on good arable land and 1–2 kg wool per hectare of coastal heathland (Bender Jørgensen 2012a: 179). Flax has, however, a major disadvantage as it is only possible to sow it on the same ground every seventh to eighth year, whereas sheep can graze the same pastures for years if a degree of rotation is possible.
The labour invested in prehistoric fibre production is difficult to assess. McCorriston has estimated that up to 58 days of work would be needed for the production of 2 kg flax and 15–20 days of work per 2 kg of wool (McCorriston 1997: 524). Although these calculations have to be understood as guestimates, the difference may, nonetheless, explain why wool proved to be a very attractive new raw material for textile production, in addition to its many other useful properties outlined above. The properties of these two main types of fibres, in many ways, are complementary; wool never came to replace flax but rather should be seen as adding exciting new avenues for the ideas and creativity of Bronze Age textile craftspeople. The two fibre types were both used in Bronze Age Europe, with various local preferences. In the north, for example, there was a tendency for wool to be dominant.

Mixing Fibres

In most cases, raw materials are not mixed in the production of Bronze Age textiles. We do, however, have a few cases where this was done. The earliest example of a mixed textile is a find from Wiepenkaten, Kreis Stade in northern Germany. A flint dagger, complete with scabbard and wooden handle, was found by peat diggers in 1935. Textile remains, wedged between handle and flint, were identified by Walter von Stokar as partly wool, mixed with hairs from other species. Only one yarn system, ostensibly the wool weft, was preserved. The warp had consisted of vegetable fibres and had disintegrated (Cassau 1935: 205; von Stokar 1938: 103). Unfortunately, the wooden handle has been glued back on the dagger (and over the remains of the textile), making re-investigation of the fibre impossible. The presence of thick, coarse fibres does, however, indicate that von Stokar’s identification of the wool fibres was correct (Rast-Eicher 2014: 16). The Bronze Age burial at Unterteutchenthal in Sachsen-Anhalt (Schlabow 1959: 118–20; von Stokar 1938: 44–5, 105) has been mentioned as another example of mixed fibres from the Early Bronze Age. Recent re-dating has, however, shown that it is not a Bronze Age textile (Friederike Hertel pers. comm.).

Interestingly, on one of the pieces of flax textile from the site of Molina di Ledro in Italy, wool was used to sew a buttonhole and a fringe onto the long and narrow belt (Bazzanella 2012: 206). In this case, wool was applied to flax as decoration rather than mixed with it. This shows that textile makers played with the new material. Finally a woven band from Chania, Crete has been found to consist of no less than three different fibres: the warp is flax, the weft
consists of goat hair, and supplementary weft threads were made from nettle fibres (Spantidaki and Moulherat 2012: 189).

There is thus a surprising lack of mixing of the different fibres. It appears that textile makers during the Bronze Age separated their raw materials rather than exploring their shared properties and learning about new fibres by joining them with familiar ones.

FURTHER FIBRES

Further fibres that were exploited for textiles in the Bronze Age include hemp, nettle, a variety of basts, and horsehair. Some Bronze Age textiles from Europe have been claimed to be silk but have proved unable to stand up to scrutiny (Bender Jørgensen 2013b).

Hemp is stiffer and coarser than flax, it is strong and durable, and therefore well suited for making string, cord, and rope. It has also been used for coarse fabrics such as canvas or sacking. If processed with care it may, however, obtain an attractive lustre similar to that of flax, and may indeed be used for many of the same purposes as linen fabrics. Individual fibre strands may be 6 ft or more in length (Cook 1968: 17–18). Although flax and hemp are difficult to distinguish, it is thought that hemp has been identified in Middle Neolithic settlements from Latvia (Zeiere 2012: 268), and in textiles from the Eneolithic/Early Bronze Age from Italy (Bazzanella 2012: 207, 210), Spain (Alfaro 2012: 337–8), and the Ukraine (Gleba and Krupa 2012: 402). A Late Bronze Age find from St Andrews in Scotland has also been suggested to be hemp (Heckett 2012: 432). The history of the domestication of hemp is much less clear than that of flax; so far linguistic and cultural evidence suggest that it was grown in China by the mid-fifth millennium BC (Zohary et al. 2012: 106–7).

Nettle fibres are soft and pleasant to handle. They are creamy white to grey in colour, depending on how well it has been retted; strands may be up to 3 ft in length. Nettle fibres have been used to make sailcloth in Late Medieval and Early Modern Scandinavia, but have also been used for clothing, furnishing fabrics, canvas, or as twine and rope (Cook 1968: 25–6). Nettle fibres have been identified in a textile from Minoan layers in Chania, Crete (Spantidaki and Moulherat 2012: 189), and are suggested for a Late Bronze Age find from Pyotdykes in Scotland (Heckett 2012: 432). Nettle fibres were also used for the fine fabric found wrapped around the cremated bones in the Late Bronze Age burial from Lusehøj, Voldtofte in Denmark (Koie 1943). Strontium isotope analysis of the origin of this fabric has recently been suggested to be
Kärnten–Steiermark in Austria (Bergfjord et al. 2012), indicating wide-ranging trade in either fibres or finished textiles.

Bast from various species of wood such as lime (Tilia sp.), elm (Ulmus sp.), oak (Quercus sp.), juniper (Juniperus sp.), and willow (Salix sp.) have been exploited throughout history, especially for cordage and basketry but even for fine, flexible, textile-like fabrics, along with reeds and various grasses (Gramineae) (Dimbleby 1978: 45–7). Basts of these species were chosen for their combination of volume, strength, and pliability. The strength of lime bast is superior to the bast of the other species, making this the most popular. Its tensile strength is 40% that of hemp. It is particularly strong if not retted; it is 47% stronger when wet, has low water absorption, limited swelling when wet, low weight, low extensibility, and low resistance to wear, although it does not decay lightly. It also floats on water, dries quickly and – if retted – is soft to the touch (Harris 2010: 107; Myking et al. 2005: 65–70).

Bast artefacts are known from Palaeolithic, Mesolithic, and Neolithic sites in Europe (e.g. Alfaro 2012: 338; Bender Jørgensen 2013c; Médard 2012: 368; Rast-Eicher 2005; Rast-Eicher and Dietrich 2015). The best-known example is the clothing of Ötzi (or Similaun man), the ice mummy from the Alps (Bazzanella 2012: 205). In the Pre-Pottery Neolithic Near East bast cords were even used to create pots by gluing the horizontally rolled strings with asphalt (Schick 1988: pl. XIV). The use of bast continued in the Bronze Age, particularly for netting and basketry (Broholm and Hald 1940; Ehlers 1998; Rast-Eicher 2005: 127).

Horsehair is strong, stiff, lustrous, and resilient, but also coarse – especially when compared to other fibres used for textiles. Horsehair has at various times been used for interlining or stiffening for tailored garments and millinery, stuffing in mattresses, and for upholstered furniture. A fine hairnet of horsehair covered the head of the young women interred in an oak-log coffin at Skrydstrup, Denmark (Broholm and Hald 1940: 99); the find is radiocarbon dated to 1175 BC (K-3873; Jensen 1998, 191 note 25). Horsehair was also used for strings attached to a pot found with a clothed bog body radiocarbon dated to the ninth century BC from Damendorf Ruchmoor in northern Germany (Ehlers 1998: 421). A woven, tasselled ornament from Cromachs in Ireland dating to the ninth to eighth centuries BC is made of horsehair and shows that this was also a raw material that could be used for textiles. It closely resembles horse trappings depicted in Assyrian reliefs from the first half of the first millennium BC (Heckett 1998, 2012: 433–5).

The prime importance of the raw materials used for textiles is how they responded to human interaction during prehistory. By the beginning of the
Bronze Age, specific properties had emerged which were further pushed and different fibres came to co-exist making it possible for different traditions and different desired outcomes to affect production. Within textile fibres were innate properties that made them fundamentally different to the inorganic materials found in metal and potter’s clay.
What, then, are the innate properties of the material when we consider bronze and what influence did they have on human creative engagement? As bronze is now a common material it is easy to take its existence for granted, or alternatively, to assume a technological evolution from copper to bronze that posits the emergence of this alloy as a ‘natural’ response to opportunities. An alternative to either of these assumptions is to focus on bronze as a fabricated raw material, and to see it as resulting from the mixing of various minerals and resulting from experiment and experience-based discoveries of new ways to exploit the properties of various minerals.

Scientific investigations of the origin and development of bronze (archaeometallurgy) have tended to focus on the composition of various early copper alloys. They have investigated mineral sources to argue for the potential spread of metallurgical knowledge, attempting to date the earliest occurrences of specific traits and the transmission of knowledge between different regions (e.g. Roberts and Thornton 2014). There is also a substantial literature devoted more generally to the question of the development of bronze; how it might have been invented and where (e.g. Childe 1930, 1944; Muhly 1989; Sherratt 1993; Strahm and Hauptmann 2009; Taylor 1999). It has, however, been difficult to pinpoint crucial changes in space and time, and attention has turned to other aspects of metallurgy (but see Roberts and Thornton 2014). We propose
that it is rewarding to ponder these questions even if it may be impossible to provide definitive answers about origins and innovations – asking the questions help us to recognise important dimensions of the material. Examining the innovative potentials that reside in copper alloys and considering how the material that developed may be understood in terms of human engagement are thought-provoking challenges.

The stages towards ‘full metallurgy’ are in principle similar in all parts of Europe (and other regions) where primary production took place. The earliest stages date back to around 5000 BC and by the beginning of the Bronze Age different copper alloys were in use, with arsenical copper being particularly common. This changed around 1800 BC when tin alloys became dominant and widespread (often used as the definition of full metallurgy). At this stage the ‘recipe’ for making bronze became standardised. Variations in the exact proportions of the components occurred, but these were largely due to the desired qualities of the finished object rather than different understandings of the material. The intimate understanding of the material that this reveals raises fundamental questions about how this was achieved. Did people in different areas develop similar ways of working with copper ores through a community of practice that shared technological knowledge beyond a co-habiting group? Or was the similar progression towards tin-bronze due to the material qualities of copper alloys guiding practices towards similar solutions?

During the Bronze Age the development of copper alloys played an enormously significant role throughout Europe. It caused changes to many aspects of society. One was the great demand for copper and tin sources; both are scarce and only found in certain regions of Europe (Harding 2000). Extensive trading networks therefore developed to bring the different minerals together and to trade in processed metal as well as finished objects. Metal must also have affected the mentality of Bronze Age people due both to the intensity of movements and exchanges, and through new perceptions of materials including accumulated experiences of working with it. In particular, the understanding of the need for mixing fixed proportions of different materials might have enhanced the idea of absolute measurements of volumes and engendered thoughts about materials in terms of transformative qualities. In addition, increased control of material transformation through fire must have developed, accompanied by at least a practical appreciation of different degrees of heat. The minerals themselves were not altered through these practices, but their procurement led to destruction of landscapes; the desire for copper resulted in the depletion of native copper and surface deposits of copper-rich minerals, and eventually to deep mining.
WHAT IS BRONZE?

Bronze is an alloy of copper with other minerals. It is not therefore a base element. Its existence cannot be taken for granted, but must be understood as a cultural product resulting from the mixing and processing of different mineral-rich materials. The evolution from the use of naturally occurring copper-rich materials to bronze is therefore not predictable, and questions about why and how this material was invented are truly complex. The innate properties of the various minerals and alloys are part of the answer; without them the particular material could not have been made, but a phase of exploration and experimentation with the materials was also needed. Investigating the developments and innovations within metallurgy is therefore in some ways about understanding what bronze was before it became standardised and produced according to established procedures. In other words, before it gained its ‘everydayness’ (Olsen 2010: 71).

As bronze is the result of a deliberate alloying of copper with other naturally occurring elements we must assume that these qualities were sought after, experimented with, and adjusted. It is this dynamic between the possibilities inherent within inorganic minerals and the qualities emerging through their specific combinations that we want to reflect upon. We shall not review the extensive literature on Bronze Age metalworking, but focus on particular junctions in its development. Passing through hands and explored cognitively, naturally occurring materials were transformed into a cultural material with new qualities. It is this altering of the properties that may be considered a creative process. To trace the ‘finger print’ of this creative engagement we therefore need to comprehend what the materials made possible, and how this was responded to.

COPPER AND NATIVE COPPER

Copper (Cu) is a chemical base element. By itself it is a ductile, soft, and malleable material; it has lustre and is orange-red in colour, although it is rarely found in nature as pure copper. The properties and colour when found naturally depend on the amount and kinds of mineral mixture. Copper melts at approximately 1085°C and combines easily with other minerals, such as arsenic. It reacts slowly with atmospheric oxygen and through time a layer of brown-black copper oxide (patina) is formed on the surface.

In nature copper can appear as so-called native copper or as minerals such as copper sulphides (chalcopyrite and chalcocite), and copper carbonates (azurite and malachite). Native copper refers to copper that occurs in uncombined
form (in contrast to the more common occurrence of copper in oxidised states or mixed with other elements) and that has been deposited by mineral enriched groundwater. It occurs on the surface as irregular masses or as fracture fillings, and would, as other copper sources, be visually striking, having reddish, orange, and/or brownish colours on fresh surfaces. When weathered it becomes coated with a green tarnish of copper carbonate.

COPPER ALLOYS

Copper reacts slowly with atmospheric oxygen and it therefore commonly occurs in oxidised states or mixed with other elements, such as arsenic, antimony, nickel, and bismuth. It is visually distinct from its surroundings due to its striking colours, which range from deep red to iridescent green, blue, and even black. The minerals can have interesting crystalline shapes or odd surface structures, and appear as oxidised outcrops or as seams of unusual and visibly distinct materials in rocks such as seams of malachite, azurite, tenorite, tetrahedrite, and cuprite (Ottaway and Roberts 2008: tab. 4.2). Copper sources would therefore be easy to notice and collect from surface outcrops or shallow pits.

In terms of metallurgy, one of the most substantial creative changes is revealed through the increased attention to the co-mixing of copper with other minerals; this reflects an interest in the exploration and exploitation of the inherent property of the materials. This resulted in, firstly, the deliberate selection of specific ores and then, at the next stage, the development of alloying (i.e. the deliberate mixing of different ores). The technological benefit of these changes in procedure is due to how the specific mineral composition of the ores affects the qualities and properties of the material; the selection of specific ores thus reveals an awareness of these differences. This is seen particularly clearly in the use of arsenical bronze, which was preferentially selected during the earliest part of the Bronze Age. Meanwhile, deliberate alloying is most importantly reflected through the development of tin-bronze, which from around 1800 BC became the dominant alloy. These two copper alloys (arsenic and tin) are thus of specific interest for attempts to locate creative responses to the properties of the minerals.

Arsenical bronze refers to copper with a high percentage of arsenic trace elements. The natural presence of arsenic is difficult to establish, but is usually thought to vary from less than 1% to 2% (Northover 1989). There is not an agreed definition of the ratio that is needed to define a copper alloy as arsenical. Paul Budd and Barbara Ottaway (1995) use 1% of weight or above as their defining criteria. Analysis of objects suggests that prehistoric arsenical copper usually contains less than 5% arsenic. This is, for instance, the case for Tobias
Kienlin and Thomas Stöllner’s analysis of Alpine copper and Salez-type axes (2009). It is, however, clear that the presence of arsenic affects the properties of the alloy. For instance, a concentration of between just 1–2% arsenic improves casting properties, hardness potential, and ductility (e.g. Kienlin 2010). Above 4% arsenic the metal will, however, become brittle depending on working methods (Northover pers. comm.; see also Junk 2003: 22–4). Higher percentages result in colour change (Berger 2012; Lechtmann 1996; Northover 1989; Ottaway and Roberts 2008; Strahm and Hauptmann 2009), and with around 8% the cast will have a white appearance.

Whether the dominance of arsenical copper alloys during the Early Bronze Age was a result of selective collection of arsenic-rich ores or deliberate arsenic alloying has been much discussed but is difficult to prove. Meanwhile, irrespective of how arsenical alloying was reached it is clear that there was an awareness of different ore properties and the kinds of different materials that could be obtained from them (c.f. O’Brien 1999: 34). Awareness of differences between sources was possibly present already from the fifth century BC (see for example discussion in Radivojević 2015), but the selective attention towards arsenic copper reveals a stage where preferences start to be dominant practices and become shared over wide areas.

Tin-bronze is normally composed of 85–90% copper and 8–12% tin with other minor impurities. From the Early Bronze Age onwards the norm was between 5% and 11% tin (although concentrations can vary between less than 1% and greater than 20%). Tin-bronze melts at between 900 and 1000°C. When fluid it can be shaped in different forms and through subsequent hammering its hardness can be increased. Its casting temperature is 1100–1300°C and with sufficient preparation and technical expertise it can be produced in a number of installations ranging from relatively simple bonfires to furnaces (Ottaway 2001; Tylecote 1976, 1987).

THE ROLE OF EXPERIMENTS

Apart from the constitutive materials themselves, the second contribution to the development of bronze was human engagement, which must have taken the form of exploration, testing, responding to, and trying various combinations. The result was a path to innovation in which copper-alloy working went through a number of developmental stages. This does not imply a straightforward linear progression; there were probably periods of intense experimentation and accumulation of relevant experiences, and others with little change. For example, changes in the kinds of raw material used (Strahm and Hauptmann 2009), including a shift from the exploitation of oxide ore...
to sulphide ores (Muhly 1988), point to the formative role of the accumulated experiences that Bronze Age people gained from interacting with and comparing materials; experiences that were based upon encountering various raw materials in nature and on learning about them through variations in the manufacturing process.

THE FIRST STAGE TOWARDS FULL METALLURGY: NATIVE COPPER

The first stage towards the development of metallurgy in Europe lasted over several millennia of the European Neolithic, and consists of a phase during which copper was used in various haphazard as well as slightly more specialised ways. During this phase native copper, as well as various copper compound outcrops, such as malachite and azurite, were explored (Ottaway and Roberts 2008; Pernicka 1999; Radivojević et al. 2010). The difference in the appearance, and locations, of these two forms of copper may have affected prospecting and some aspects of how they were worked. Nonetheless, both were ‘harvested’ and effectively utilised in a manner similar to flint and other naturally occurring minerals and stones (e.g. Armbruster 2010). This contrasts with later deliberate mining for copper-rich ores that explored materials that were not easily available (see also Kienlin 2010: 9; Strahm and Hauptman 2009: 118); the surface metal deposits are visually striking and it is easy to appreciate why they were noticed and collected. Harding describes it as follows:

It is generally assumed that copper ore bodies would initially be noted where they appear on the earth’s surface in oxidised form, that is as ores such as malachite or azurite, which have a brightly coloured appearance … Sometimes the sulphur-bearing ores such as chalcopyrite, or the products of the enrichment zone between the oxide and sulphide ores (the best known being the Fahlerz grey ores), can appear oxidised on the surface … Although not coloured blue or green as the oxidised ores are, shiny grey or gold patches or chunks within the dull rock matrix, sometimes a centimetre or more across, indicate that the rock is of special interest.

(Harding 2000: 207)

It seems plausible that during this early stage of copper use, the attraction was the visually distinct material. That this was the case is supported by its use as this was primarily focused on display on the body, for example as beads. We therefore suggest that at this stage the interaction with the material did not aim to transform it into another kind of material or to explore other potentialities apart from the visual. Until at least the mid-fifth millennium BC the objects were made by cold- or simple hot-working of the material to shape it
(Ottaway and Roberts 2008: 206), but it was not melted. As a shaping rather than a transformative technology it is reasonable to suggest that these practices drew on knowledge and expertise that were familiar, such as the manufacturing of objects out of various kinds of stone. These influences would, in turn, have been adapted through learning about what the collected copper materials could and could not ‘do’.

In summary, the curiosity and interests underwriting the interaction and exploitation of native copper during this very long period appear to have been mainly about its colour. Most objects made are simple attachments to the body or clothing, used, for example, as a special item in jewellery (Calas et al. 2005: 984; Pare 2000: 5; Radivojević 2015). Copper, as it occurred naturally, seems to have been treated just like other source materials in terms of technological practice and, at the same time, as distinct and different due to its colours, surface, and malleability. We suggest that during this stage the creative engagement primarily took the form of a response to materials that were considered ‘interesting’.

THE SECOND STAGE TOWARDS METALLURGY: DELIBERATE MANIPULATION OF THE MATERIAL THROUGH SMELTING, MELTING, AND SELECTING

The next significant stage is the development of smelting, melting, and the deliberate selection of copper deposits with particular compositions, especially arsenic-rich copper ores. This stage can be found across diverse regions of Europe at different times. The unequal and uneven geographical appearance of deliberate manipulation suggests there were different processes behind how particular regions began to employ more sophisticated techniques and to select for arsenic-rich copper. The changes in processing suggest that people developed a more complex understanding of the materials in their environment, and began to intentionally manipulate the raw material in order to enhance certain qualities. The smelting and melting of metals were therefore very important innovations.

Smelting refers to processes through which metallic copper can be extracted from its surrounding ore matrix by breaking its chemical bonds. It is a necessary step towards the subsequent melting and casting of copper alloys for ingots and objects. The aim of smelting is to decompose the chemical combinations that are found within the copper-bearing oxide and sulphide ores. This can be done by heating the ore to a temperature at which the naturally occurring copper alloy is released from other chemical compounds. The presence of this stage within the development of metallurgy is very difficult to document. It
cannot be proven through analysis of the finished objects but relies on physical evidence of the smelting process, such as slags and furnace material (Höppner et al. 2005; Ottaway 2001). Early dates seem to have been established for finds in central and south-east Europe suggesting that copper smelting was taking place there from the fifth millennium BC (Roberts 2009: 130–2). Amongst the earliest dates for metallurgical production is material from the Serbian sites at Rudna Glava and Divostin (Radivojević et al. 2010; Radivojević 2015).

Smelting is an important technological stage as it explores the ore in ways that go beyond what was already familiar from other pyrotechnologies, like pottery firing or the use of heat in the fabrication of flint tools (e.g. Olausson and Larsson 1982). The aim is not merely to affect the material but rather to separate different components from each other to achieve a material with more desirable qualities. This seems to reveal an understanding of material properties that is more abstract and speculative than what had been seen until then within other craft activities. It probably resulted in new ways of thinking about transformative processes, manipulation, and experimentation. The development of smelting was most likely, at least partly, related to the shift in the raw materials used as deeper deposits were increasingly being explored; the ores from these required a different treatment because they had not been oxidised and the copper was therefore chemically bound more tightly to the ore.

Melting is a physical process that results in the change of a substance from a solid state to a fluid, liquid one. In archaeometallurgical discussions the term is, however, commonly used to refer specifically to the heating activities that produce copper alloys in fluid forms in preparation for casting. Evidence for early melting of copper alloys is mainly produced by the objects themselves through traces of their manufacturing, including what techniques were used for the shaping of the fluid metal. It is unfortunately difficult to separate the production evidence of smelting from that of melting, and the two processes are usually discussed together, although they had distinctly different aims. Melting of copper alloys seems to have become a regular practice from the mid-fourth millennium BC, as documented by the type of objects made. The importance of this development in terms of creativity is that it reveals a new level of control over the behaviour of the material, including the ability to shape and transform it, recycle errors or worn-out objects, create new and unique objects, and also to combine metal from different sources.

A further area of substantial creative development is revealed through the increased attention to, and awareness of, the potentialities of different ores. The composition of specific ores, in terms of the co-presence of different minerals, affects the qualities and properties of the material and thus how it will behave when worked, and its potential uses. At what we might describe as the second
stage of development towards full metallurgy, preference for certain compositions, in other words alloys, can be discerned in the archaeological evidence (Budd et al. 1992; Cattin et al. 2009; Harding 2000; Schreiner et al. 2007). It is not possible to extract the different stages, strategies, and reasons behind the increased attention towards specific copper alloys. It is also very difficult to establish when deliberate attempts to create specific alloys began and to discern whether this was intentional or a side-effect of other changes of practice at the time (Ottaway 2001; Ottaway and Roberts 2008: 208).

Nonetheless, an important change is seen in the preferential use of arsenical copper. This preference strongly suggests that even if deliberate alloying was not taking place, there was at least a deliberate selection, and thus an awareness of different ore properties (c.f. O’Brien 1999: 34). The presence of arsenic affects the characteristics of the alloy, and the prehistoric metalworker was developing familiarity and insight into these differences including the recognition that minerals from different sources would behave differently during processing. The properties of arsenical copper would appear new and different to the familiar ones of native copper; they were probably attractive, and they must have influenced the processing and working of ores, informing notions of what was desired as well as creating new possibilities (Kienlin and Pernicka 2009: 269). In this process, preferences, and therefore selective practices, developed. Standardisation in alloys that would correspond to notions of ‘recipes’ cannot, however, be observed at this stage, and the alloys explored were largely pre-given from selection amongst natural compositions found in the ore deposits. An important and challenging question is therefore when deliberate manipulation of metal composition began. One of the reasons why it is difficult to answer this question is that the amount of arsenic, and some other trace elements, will be affected by the smelting and melting processes as it is a volatile element. During heating the arsenic ‘boils’ off due to its affinity for oxygen (Bray and Pollard 2012), and the alloy of the final material will not reflect the original ore composition accurately. This makes it difficult to prove whether specific sources were looked for in the prospecting for metal ores. Moreover, the early discovery of arsenical copper could easily have happened through the accidental inclusion of arsenical ores within surface deposits of native copper (Ottaway and Roberts 2008; Taylor 1999), but there was probably also a stage when this became an attractive, sought after, and potentially deliberately created, combination.

Regardless of whether deliberate alloying did or did not take place, the increased hardness and malleability of arsenic-rich copper would have been apparent. In addition, the colour, smell, sound, and texture of differing metal compositions would have provided empirical ‘feedback’ during metalworking.
RAW MATERIALS: CREATIVITY AND MATERIALS

(Kuijpers 2014). This included, for instance, the contrast of the silvery to white appearance of objects made from arsenical copper to the redder or orange colour of native copper objects; an aesthetic quality that may have been desired and sought after (Ottaway 2001; Ottaway and Roberts 2008; Pearce 2007). Such differences might have guided metalworkers in their interaction with the material. This is where Molander’s (2013) argument for the close relationship between attentiveness and creativity becomes relevant: the properties exist but their exploitation demands attention towards differences between the sources and towards subtle changes in how the material acted when worked; metalworkers would be using various senses (for a detailed discussion of the role of perception in metalworking see Kuijpers 2014). Natural differences in the compositions of ores, together with the marked effects of just small variations in percentages of arsenic (as well as other elements), are likely to have created a volatile experimental situation as different sources would respond in slightly different ways during smelting and melting. In combination with the development of preferences this is likely to have inspired further experimentation and a search for materials that behaved in a more predictable manner. Kienlin has suggested that there was a shift in emphasis during this period from an ‘over-riding interest in shape’ to a focus on the mechanical properties of arsenical copper (Kienlin 2010: 83). We suggest this should be rephrased as a shift from an emphasis on visual effects in terms of display to an exploration of the mechanical properties of alloys driven by a desire to exercise control over the material.

During this stage, which lasted several thousand years, there were thus two significant areas of change, one relating to innovations in working methods in the form of smelting and melting technologies, the other concerning preferential copper alloys. The importance of smelting and melting techniques in terms of creative changes is that they reflect deliberate and purposeful interaction with the raw material that aims to extract and change it so it can be shaped in more complex manners. Although superficially referring to rather obvious practices, these techniques meant that working with metal ores became radically different from working in other kinds of materials. At the same time, the trend towards wanting specific metal compositions suggests selection of, and experimentation with, raw materials. This raises important questions about the links between material properties and human behaviour in terms such as prospecting, intentions, and knowledgeable action. These preferences eventually led to deliberate alloying with the aim of creating a material with specified properties.

The varied compositions of natural polymetallic ores, as well as the instability of arsenic, make this period very interesting in terms of how metalworkers
were working and how they could accumulate experience of, and control over, the material. It must have been a period of experimentation and guessing, failures and success. Expectations about outcomes as well as the unforeseen were probably integral to working with the copper minerals. This in turn may have stimulated innovation and technological developments, and in particular a desire to make the behaviour of the material more predictable. It is not surprising, therefore, that such ‘experiments’ with copper are found in areas of Europe close to ore deposits, such as central Europe and the Carpathian region (Kienlin 2010; Radivojević et al. 2010; Roberts 2009), as they might have relied on intimate familiarity with different rock surfaces and deposits and the opportunity to explore these.

THE STAGE OF FULL METALLURGY: TIN ALLOYS AS A RECIPE

The next significant stage in the development of bronze is the deliberate addition of tin (Sn) to the alloy. This contrasts with tin being accidentally present in the copper ore or used as a separate material, as seen, for example, in the making of tin objects at the Late Neolithic site at Wädenswil-Voder Au, Switzerland, and the Early Bronze Age beads from Buxheim, Germany (Primas 2002: 312). Tin-bronze refers to a copper alloy in which tin is the primary additive. The percentage of tin varies between a few percent to up to a third. The initial spread and adoption of tin-bronze was probably affected by the availability of tin sources (Bartelheim 2009: 34; Pernicka 2002: 20; Pare 2000: 6), and it probably spread along existing metal trade networks. Some, such as Ernst Pernicka, suggest that tin-bronze spread via trade and social networks to eastern, central, and western Europe from the Near East (Pernicka 1998; contra Renfrew 1969, 1973; see also Thornton 2009), whereas others argue for independent developments within specific areas of Europe (Needham 1996; Pare 2000; Roberts 2009). After its initial slow introduction in the Early Bronze Age (Pare 2000), tin-bronze rapidly became dominant within the technological repertoire of Bronze Age Europe. The concept of deliberate alloying copper with tin was firmly established by the Middle Bronze Age throughout the continent. Tin-bronze may be seen as a technical development that originated and emerged through experimentation; rather than per se being innovative it expanded on existing metallurgical knowledge to improve the quality and control over copper alloys.

This, however, does not explain why this change happened. It is often argued that the benefit of tin was not primarily that tin-bronze provided a ‘better’ product than arsenical bronze, but rather that it improved the control of the constituent parts of the alloy. In other words, it is easier to control the precise
quantities of tin added, whereas controlling the amount of arsenic, as a naturally occurring impurity within the copper ores, was highly problematic (see Duberow et al. 2009). Some also argue that an additional benefit was that adding tin (up to 13%) improves the hardening of the bronze (which takes place through hammering of the cast object), compared to what could be achieved with arsenic bronze (Ottaway and Roberts 2008: 209). This would add to the control and consistency in the production of metal objects. Focusing on this quality alone, however, represents a way of thinking about technological change that aims to explain developments through reference to rational reasons; what does it mean to be ‘better’? In terms of some of the potentially important changes that tin-bronze represents we may, for instance, have to recognise the importance of colour: tin-bronze has a more golden appearance than arsenical copper. Additionally, we may have to consider its fluid properties, which might have had increasing importance as more complex forms such as socketed spears were being explored, and how such variables may have been conceptualised through references to the ‘behaviour’ of metal, or particular kinds of metals, rather than a desire for hardness alone being the reason for change.

After the development of tin-bronze we see increased standardisation. Using different proportions of tin it was possible to produce different desired qualities in the final bronze that could be explored during the manufacture of objects. In particular, there was a distinction between alloys with properties that allowed hard edges to be produced during subsequent hammering and alloys with high malleability. We can therefore begin to speculate about whether we, at this stage, see the development of recipes as common norms for how much tin should be added to reach desired effects and thus the ability to manipulate the raw materials and the technique of alloying in order to reach specific technological and creative solutions to working with copper. Moreover, the use of recipes means that desired material qualities can be consistently reproduced. Once developed, these recipes spread quickly and widely (c.f. Pare 2000: 25–31, fig. 1.14). It is therefore possible to argue that the greatest impact of the use of tin was not a technological leap forwards, but rather increased control over the technology and in turn the ability to intentionally produce more diverse objects in terms of their physical properties. It also greatly affected social organisation and trade connections due to the limited number of exploitable tin sources in Europe.

The raw materials used for Bronze Age metalworking are inorganic minerals. Their exploitation led to the depletion of easily accessible sources and eventually to exploration and mining, altering some landscapes in dramatic manners. The important changes were thus how the inert properties were
experimented with and methods developed for working with copper alloys. The realisation of these potentials took place in stages and we propose that experimentation and sensory engagement were particularly important to the earliest stages of this development. In many ways, people’s responses to the properties found within minerals have similarities with how potters work with clay, but there are also important differences between the two materials.
POTTER’S CLAY

Joanna Sofaer

Unlike wool and bronze, clay was by no means a new material to Bronze Age craftspeople (Michelaki 2008; Sofaer 2006). Furthermore, in contrast to wool and bronze, it is not possible to describe a distinct trajectory or stages in the development of the material during the Bronze Age since both clay itself and responses to it varied throughout the continent. Clay refers to fine-grained soils defined through grain size and mineralogy. It is thus a natural, inorganic, and highly variable material; there is not one clay but many clays, each with different properties. It occurs widely in all parts of Europe, but some clay sources are better suited for the making of pottery due to, for instance, the amount and kind of impurities, and the plastic qualities of the constituent minerals.

A basic distinction can be made between primary clays, which are deposited at the place of genesis, and secondary clays that have been transported from their place of origin by wind, rivers, or ice. The former are generally of low plasticity, not highly contaminated, white in colour, coarse grained, and suited to high temperature firing while the latter are generally fine grained, highly plastic, frequently contaminated, and suited to low firing (Rice 1987). Even within a single deposit the precise qualities of the clay may be variable.

Differences between raw clays offered potters the chance to mix them in order to elicit different qualities in the clay they were working with (Hurcombe 2000; Livingstone Smith 2000). Achieving the right mix or
paste is not an easy matter but requires local knowledge of landscape and geology in order to collect the raw materials, as well as experimenting with specific clay deposits (Hurcombe 2000). Like the mixing of alloys for metal, initially this must have been a matter of experimentation that later became, as Alexandre Livingstone Smith (2000: 38) calls it, ‘a fixed habit’ with local and vessel-specific mixes and pastes produced to have consistent qualities. However, in contrast to the recipes for alloys, those for mixing clay were much more flexible. There was no single formula and similar outcomes could be achieved through different combinations of clays from different sources. Thus while clay is a natural and abundant material that was often locally available in a way that some other raw materials such as metal ores were not, its variability required a close familiarity with its qualities in order to use them most effectively. Potters had to continually evaluate their raw materials at different stages of their preparation and to find solutions in order to bring out desired qualities.

CREATING POTTER’S CLAY: PROPERTIES, TREATMENT, AND PREPARATION

The choice and manipulation of the clay affects four key physical properties of the material: plasticity, shrinkage, porosity, and response to firing. The degree of plasticity affects the clay’s handling strength, the extent to which it will retain its shape when moulded, and the extent to which the surface may split and crack when the clay is bent. Shrinkage occurs first when clay is air dried and then again upon firing. Potters therefore need to be able to anticipate a reduction in the size of the vessel, particularly if aiming for particular vessel capacities and using kilns, since shrinkage is potentially greater in kilns than in bonfire firing (Blandino 1984). In prehistoric pottery the porosity of the vessel is related to its functionality in terms of the extent to which the matrix will soak up liquid during use; in modern ceramics it is of importance in dictating the amount of glaze absorbed during decoration (Mattison 2003). Clay becomes ceramic when it is subjected to heat. Firing affects the physical and chemical characteristics of clay, irreversibly hardening the material. Although such changes are the function of duration, temperature, and the atmosphere in which the heat is applied and then allowed to dissipate (Rice 1987), the response of the clay body to these depends upon its composition. The latter affects its thermal dynamic (i.e. the expansion, shrinkage, and microstructure of a clay body) and may also affect the outcome in terms of effects such as colour. Modification of the material does not affect any one of the four physical properties of clay independently of the others; the potter’s skill lies in balancing
them out to achieve the desired qualities. During the Bronze Age these general principles underpinning the treatment of clay appear to have been well-understood. Both desired qualities and the means by which potters dealt with the principles of their material, however, varied temporally and geographically.

Since clay was only rarely used in its raw state, the range of ways in which it was transformed into potter’s clay – clay that was manipulated in order to alter, or to bring out, particular qualities of the material so that it could be worked with in desired ways or used to make a vessel with a particular function – is a matter of creativity. Raw clays were refined by processing them to remove impurities. Stones, twigs, roots, or leaves were removed by hand and dry clays may have been pounded, soaked, and levigated to obtain different textures. In the latter the clay is mixed with water and then left to stand. The coarser particles sink to the bottom while the water and any organic impurities rise to the top and can be poured off. In the middle there will be a layer of especially fine-textured clay. The extent of such clay preparation in the Bronze Age is highly variable. For example, in some cultural units, such as the Early and Middle Bronze Age Vatin Culture in the south-east of the Carpathian Basin there are some exceptionally fine clays, while many Early Bronze Age ceramics contain sand which was probably present in the clays selected (Ellison 1980: 33). In addition to this preparation of the raw clay its qualities were modified by deliberately adding a wide range of tempers including grog, small pebbles, crushed flint, granite, limestone, sand, and shell, either on their own or in combination. Compared to earlier periods there is relatively little evidence for organic tempers although they were occasionally used. Such variety suggests that perceptions of the material were not constant and were configured by practice (Hahn 2012). Tempers were wedged or kneaded into the clay to get an even mix throughout the clay body. Such temper ‘recipes’ are temporally and spatially distinct and have frequently been understood in functional terms, such as a means of enhancing the resistance of vessels to thermal shock during firing, or as a filler that improves the rigidity of the clay body enabling the construction of larger vessels without sagging (Rice 1987). The addition of temper affects the plasticity of clay such that, for example, heavily grogged clays will split and open easily while more plastic ones will bend without visible signs of cracking (Mattison 2003); the latter are more suited to more intricate forms. Different kinds of tempers also result in pots with different strengths. For instance, of the mineral tempers, sand (quartz) gives the weakest fired body, and grog the strongest (Blandino 1984), but the effect of these tempers is also related to their particle size and the quantity that is added (Rice 1987).

The treatment and preparation of clays was therefore potentially complex and highly variable. It is, however, notable that although ceramic production
was guided by the availability of local resources, potters’ decisions were not solely confined to the environment and raw materials but were also socially and culturally defined. Elsewhere this has been described in terms of a range of technological choices (Dobres 2000; Lemonnier 1992; van der Leeuw 1993), but the play between the availability of resources and the ways in which they were processed, prepared, and deployed also involved imagination and foresight in terms of the objects potters sought to produce. Furthermore, although modern ceramic studies frequently emphasise functional reasons for the addition of tempers to clays, in particular their role in modulating the thermal dynamics of vessels (Rye 1981), this does not always appear to be the case for Bronze Age vessels. For example, the deliberate inclusion of coarsely crushed granite or quartz pebbles in Early Bronze Age pottery in Denmark (Sofaer et al. 2010) risks such vessels cracking during firing. Middle Bronze Age Vatya cooking and storage vessels from Hungary are tempered with grog, but in smaller quantities than required to benefit the thermodynamics of the vessel (Kreiter 2007). Furthermore, for these vessels, pottery of the same colour and fabric as the new vessel was deliberately selected for reuse as grog suggesting that the making of pottery may have been imbued with symbolic significance (Kreiter 2007). The manipulation of materials therefore involved levels of creative play and exploration of materials that went beyond modern functional logic. This may reflect the creative confidence of potters within a well-established craft where the general behaviour of clay was already understood.

**Changes to Clay During Potting**

Modification of the qualities of clay was not confined to its preparation but also took place during other phases of the making process. While clay is an extremely stable and predictable material, its qualities are not constant throughout the making process. Clay is only plastic when hydrate. It becomes leather-hard when drying, and will reach a range of hardnesses through firing that vary from a surface that can be scratched with a fingernail to a very hard glass-like surface (PCRG 2011). At any point prior to firing the potential exists for potters to alter the clay matrix and to recycle it, or to adjust its consistency by adding water. A particular feature of clay is thus that potters can manipulate and manage the state of clay by wetting it or letting it dry, and thereby to move back and forwards between states. Potters can use this quality of clay to suspend work for a period of time; provided the clay is sufficiently protected from drying out completely (such as by being wrapped), potters can move between different stages of the potting process and other tasks. Furthermore, the speed of changes in the state of the material is influenced by the temperature and
humidity of the environment. This means that potters need to be sensitive to changes to their material caused by factors outside their control in order to both ameliorate and exploit their effects. For instance, pots need to be dried prior to firing in order to avoid them sagging in the kiln but this can only be done when environmental conditions allow. In some parts of Europe this need to control the material during potting may therefore have made it a seasonal activity.

A key aspect of creativity in the manipulation of clay as a material is therefore the management of changes to its state and movement between them. Potters’ management of the clay must be related to an understanding of how its qualities change in its different states: wet, dry, and fired. This can be anticipated and deliberately deployed within the process of making a vessel. For example, constructing large vessels such as *pithoi* of various kinds, Late Bronze Age Belegiš funerary urns from Serbia, or the enormous elaborate Late Bronze Age Gáva vessels of the eastern Hungarian Plain required that they were built in stages. To avoid vessel collapse or sagging it is necessary to let the lower parts of vessels dry before applying further clay. In order to make sure that the new clay additions adhere properly and avoid premature shrinkage it is essential to make sure that the existing parts of the vessel to which they will be added are damp (Blandino 2003). The material guides the potter as to when and how to act through changes in colour, texture (feel), and smell. Potters can use these changes in state to further alter the qualities of the clay. Burnishing, for example, needs to take place when the clay is at the leather-hard stage. The rubbing back and forth with a smooth hard object such as a pebble or bone compacts and re-orientates the fine clay particles thereby reducing the porosity of the clay and resulting in a distinctive shiny surface effect.

FIRING

Firing irreversibly changes and fixes the quality of clay by turning it into ceramic. The majority of European Bronze Age ceramics were fired at relatively low temperatures (600–800°C) (c.f. Dąbrowski 2004; Gibson 2002; Maniatis and Tite 1981; Roberts et al. 2008). Throughout Europe there was a range of firing strategies including bonfire firing, pit firing (especially for large vessels), and the use of kilns (Sofaer et al. 2013a). While the first two of these had a long history of use and remained the primary method of firing in the north of the continent and for particular vessel types (especially domestic wares), in central and south-east Europe the use of kilns was an innovation as they enabled air regulation during firing. As such they marked a departure from previous practices. The number of excavated kilns is relatively low compared
with the quantity of Bronze Age ceramics, but some kilns are known, such as those found at the sites of Basilicanova, Italy (Cattani 1997) and Herzogenburg, Austria (Neugebauer 1974–1975).

Although the inability to monitor firing by eye may have made the firing of pots inside a kiln more risky, and required great skill and knowledge of fuel and fire settings, it also offered potters the opportunity for improved control of specific aspects of the transformation of clay into ceramic. For example, the black burnished wares of the Tumulus, Terramare, and Vatya Cultures were produced through complete reduction of the clay; the consistency of this is more difficult without the use of kilns, although black vessels are found in Eneolithic, Vučedol contexts. It is notable that the Bronze Age in central and south-east Europe saw a general shift away from the selection and manipulation of raw clays in order to produce colour (as seen in the use of iron-rich clays to make the red vessels of the Neolithic in central Europe), towards the manipulation of clay through firing to obtain colour preferences. This allowed the development of shared, and therefore more widespread, colour preferences since differences in local clay sources became less important to the colour of finished objects.

This growing confidence with manipulation of physical changes to the properties of clay can also be seen in the ways that temperature regulation was used with a view to the end-use of the vessel. Thus cemetery pottery in central and south-east Europe often tends to be lower-fired (probably often in bonfires) than domestic vessels of the same type and size (see Budden 2007; Sofaer 2015). Indeed, in some cases, the cemetery material is so low-fired that its texture and hardness are reminiscent of papier maché. This practice was likely a means of conserving resources (Budden 2007), but it also reveals creativity in the sophisticated use of technologies and materials to generate specific desired outcomes.

Making and working with potter’s clay required a haptic engagement with the material and its constituent parts. In the Bronze Age, an existing sensitivity to materials was played out in new and varied ways. In contrast to wool and bronze, creativity was not primarily at the level of fundamental experimentation. Rather it was a matter of an awareness of reconfiguring existing ways of manipulating clay, and of responding to particular technical challenges emerging from it as a distinct medium, in order to create particular desired qualities.
CREATIVITY AND MATERIALS: REFLECTIONS

Lise Bender Jørgensen, Joanna Sofaer, and Marie Louise Stig Sørensen

In Part 1 of this volume we have outlined Bronze Age engagement with three of the dominant materials of the period. One important observation is the very different dynamics embedded in how people engaged with organic (wool) and inorganic materials (metal and clay). In addition, the newness of two of the materials to the Bronze Age (wool and bronze) gives rise to considerations regarding experimentation and the development of familiarity, whereas potter’s clay had a long history and mainly shows variations in terms of aims and increased control rather than innovations per se during the period.

INTENTIONALITY AND CONTROL

In the case of wool, human engagement with the material appears concerned with improving the fibre quality and changing the natural colour of the fleeces. This led to genetic modifications that took place over time, and which are in fact still on-going today. This kind of change therefore raises important questions about intentionality and control. Locating creativity within such fundamental changes in how humans interact with their animals is difficult, but also very interesting. To what extent can we argue that these were intentional changes? The observation that they happened gradually argues that at any one point people were selecting their animals for breeding based on a partial
understanding of what the selected breeding would result in and yet, within their own context of practice, having clear priorities about what they were looking for in the sheep. *Creativity may in this case be found in a very fundamental relationship between projected outcomes and how they result in specific choices.*

**ATTENTIVENESS**

Each material possesses restrictions that have to be overcome in order to make it possible to unlock their potentials. For metal this relates to the ability of copper to combine with other minerals. This meant that methods were needed both for separating copper from surrounding minerals in an ore, and for re-combining it with other minerals to create desired qualities. To reach these outcomes solutions were found in terms of recipes for their processing, in particular the techniques of smelting and melting. The creative dimension of this is found, we suggest, in the ability to recognise potentials and in finding innovative solutions to technical challenges. We therefore believe there is a substantial abstract aspect to these innovations. The strong experimental dimension which must have been involved suggests this is not merely transferring existing knowledge and procedures onto a new material; rather than ‘knowing how’ this must also have involved understanding the materials in the form of ‘knowing that’ (Ryle 1949) based upon contemplations and comparisons. Molander’s concept of attentiveness (2013) probably identifies a shared characteristic of these innovations regarding materials. It is innate qualities that are being explored, further developed, and emphasised though a growing understanding of what the material can do and what its restrictions are. This must have involved ‘attentiveness to materials’ as evidenced by, for example, the attention given to, and awareness of, colours and to the qualities in the materials at different stages of their preparation. This strongly suggests that it is indeed in the interaction with the materials, including the properties they have, that creativity arises. *Attentiveness is thus a formative aspect of creativity with regard to metallurgy.*

Attentiveness was also of importance with regard to clay. Although it was an almost ubiquitous material, clay was treated in complex and varied ways. Clay is not a singular material, nor can it be worked in a singular way. It is a natural material but it is not naturalistic since it was actively modified. The very variability and plasticity of clay promoted a wide range of responses to it. Indeed, this very variability may be a defining feature of clay as a material. How to cope with it – to work with and through its qualities – required not only familiarity with its qualities and potentials but constant attentiveness throughout the making process. On one hand, awareness of material changes may open
up or provoke new creative possibilities, but on the other the need to control these may lead to deeply rooted social, symbolic, and emotional associations that go to the heart of the constitution of local and regional traditions and the very notion of familiarity itself. As a material, clay demands constant forward thinking and prediction of how it will behave, both in the hands of the potter and how it will turn out once it is fired. In clay creativity is about responding to the variability of the material and controlling it to meet desired outcomes and ambitions.

PROBLEM SOLVING

Another important aspect is the various implications of the new materials. These are expressed at the level of new procedures, the development of tools, and the impact on society as well as the environment. With regard to new procedures and tools, we see attempts of transference of methods between materials, such as from vegetable fibres to wool or between flint and metal. In all such cases we also, however, observe work procedures becoming increasingly adjusted to the specific needs of the new material. Changes in work procedures and in materials used would also have had substantial social and environmental impact. New materials were linked to new fields of knowledge with consequential changes to labour organisation and other aspects of society including transmission of knowledge. These also spurred new demands in terms of labour commitment and how it was employed, as well as land use. For instance, as mentioned above, the production of wool demanded much less labour than the same amount of flax. The organisation of labour involved would also have been dramatically different as wool involved shepherds while flax would have been integrated into the farming regime. Similarly, metal production affected labour organisation as new kinds of knowledge were needed, both in terms of extraction and further preparation of the raw material, and in terms of its manufacture. It required trading networks to bring the different source materials together and to distribute them to metalworkers and users. All such examples of impact show how new types of knowledge and skills were central. Adjusting and experimenting, new forms of knowledge and labour organisation were all formative aspects of the creative responses we observe. We therefore suggest that solving problems is one source of creativity.

ENGAGEMENT WITH THE MATERIAL WORLD

In terms of creativity, these observations ask, ‘what drives these kinds of innovations?’ Why were new materials invented, and different ways of processing
them explored? It is extremely difficult to contemplate such questions. The answers may be deeply embedded within the human ability to question, to observe, and to make imaginative leaps. Nonetheless, a few tentative propositions can be made. One is that some of the innovations were driven by a desire to create new properties or to improve on existing ones. Wool, for instance, is a warmer and more insulating material than any of the vegetable fibres. Another is the desire to control a material, in particular by ensuring that it behaves in a predictable manner. This appears, for instance, to be a major concern behind the development of tin-bronzes, where the development of this alloy transformed a somewhat haphazard practice into a very controlled production of a metal with predictable properties. The specific aspects of creativity, which we have identified above, such as resulting from attentiveness and problem solving, may thus link to a desire within humans to improve upon the ways in which we engage with material and utilise their properties. This does not imply that such developments were part of an inevitable evolutionary trajectory. We propose that creativity can result directly from an intimate engagement with the material world.
PART II

PRODUCTION PRACTICES
INTRODUCTION

Lise Bender Jørgensen, Marie Louise Stig Sørensen, and Joanna Sofaer

Production is a collective term for the act of making things. Following on from Part I, where we discussed the qualities of materials, Part II is entirely concerned with practice. The aim is to focus on production practices and their sequences, the kinds of decisions and selections made, and to consider how creativity may be expressed within them. We are especially interested in considering how new practices developed, including those formed in response to the new materials that emerged during the Bronze Age, and in the transfer of practices between established and new crafts.

It may appear artificial to consider practice without immediately implicating the material, or in other words, linking practice to the material that is being worked with. We maintain, however, that it is not just possible, but also extremely helpful, to appreciate practice and materials as different dimensions; to understand their interconnection requires in-depth comprehension of the contributing parts. One may see this as an expression of how human practice and consciousness are dynamic reflections of, or entanglement with, the world of objects and materials. Here we therefore want to discuss and analyse the production of things through a focus on practice by putting the human response to materials at the centre. For our exploration of creativity this provides a distinct lens that allows us to be concerned about such formative aspects as decisions, selections, failures, and performance, as well as social
restrictions in contrast to material constraints. Our aim is therefore to explore the logic of individual crafts, including how they were established and new crafts were performed.

Production can be thought of as a process, or series of processes. As such, production can be analysed through the reconstruction of the stages or sequences involved in the making of a thing. For instance, critical points in a process may be used to understand how challenges are responded to, or how different ways of performing specific tasks developed. Through such analyses we can consider how and where creativity may be expressed and what may motivate creativity within this sphere. One method for analysing production practice as process is the chaîne opératoire through which production is broken into its particular individual step-by-step stages (Dobres 2000; Lemonnier 1993; Leroi-Gourhan 1965). As a methodological tool it provides a means of zooming in on particular forms of practices and of understanding them as a sequence where each step has consequences for subsequent gestures. Accordingly, it offers a means of understanding the important roles of choice and selection (Lemonnier 1993) as well as rules (Renfrew and Zubrow 1994; Schlanger 1991). In terms of the analysis of creativity it may, therefore, provide a method for identifying change in established routines, new solutions to particular challenges, or how critical points in a production process are responded to by craftspeople. It also provides a means of maintaining awareness of both technology and the social contexts that may affect practices (Bar-Yosef and van Peer 2009: 104–5; Lemonnier 1993). Within archaeology the method has been applied in lithic studies for several decades (e.g. Bourguignon et al. 2004; Pelegrin 1990; Sellet 1993), but it is also beginning to be explored for other materials and even non-technological practices, such as burials. For lithic studies, it is commonly argued that the method enables a more profound understanding of not only the actions but also the social context and cognition that accompanied the production of an object (Soressi and Geneste 2011). Others, however, consider the method an impediment to informed interpretation of behaviour. Ofer Bar-Yosef and Philip van Peer (2009) for instance, argue that scholars tend to impose their own frameworks of reference on what desired outcomes should look like and thus create perceptions of prehistoric behaviour that do not correspond to the realities of the past.

As a method the chaîne opératoire does assume a chronological ordering of the different steps of any particular production sequence, and as discussed below, it can be overly rigid in its presumption of linearity. Moreover, due to its original application to lithic production, the specific rhythm embedded in how this technology is practised has tended to affect general understanding of the method. Lithic production is a stop-start linear process in which it is not
possible to reverse actions that have already taken place. It is, however, import-
ant to recognise that the individual properties of materials affect the sequence
and rhythm of production. The three materials we discuss here are all distinctly
different from flint. Working in clay, in particular, is a very fluid and organic
practice and it is possible to re-do previous actions prior to firing. Time, in
the form of durations, temporalities, and rhythms, is therefore an important
aspect of the chaî ne opératoire and is distinct to different production sequences.
Nonetheless, properly adjusted to the particular materials and processes, the
method helps to provide frameworks for the comparison of our three different
materials and their production strategies.

In terms of the chaî ne opératoire, each material enables different kinds of reuse
or even recycling. Metal can be re-melted to be used in the production of new
objects; this was common practice during the Bronze Age. Clay is reused as
pottery fragments, for example as spindle whorls, and damaged pots often have
a long use-life. Although the clay after firing cannot be recycled as raw mater-
rial as such, crushed up it can be used as temper (grog) as is common in many
Bronze Age pottery traditions. Textiles are mainly reused by being altered, or
as scraps; recycling of the fibres is in principle possible, but rarely done, and no
evidence exists for this during the Bronze Age. In the following, such subse-
quent uses of the material will not be further discussed.

In addition to understanding the flow of production processes it is also
important to appreciate what informs how a craftsperson works. One import-
ant part of this is the role of learning. Learning is based on transmission of
existing practical knowledge, people’s socialisation into a craft, including the
development of motor habits, and the contribution from experimentation (see
Sørensen and Rebay-Salisbury 2013; Wendrich 2012). Learning a craft is of
substantial importance for the continuation of traditions, but also provides
a basis for deviations, improvements, and innovations. Recent analyses have
begun to focus more explicitly on exactly these dimensions of production
through discussion of concepts such as ‘communities of practice’. In their
pioneering work on craft learning, Jean Lave and Etienne Wenger defined a
community of practice as ‘a system of relationships between people, activities,
and the world; developing with time, and in relation to other tangential and
overlapping communities of practice’ (1991: 98). The notion of a community
of practice thus refers to relations between the group and the individual in the
production process within a craft tradition (Kohring 2013; Lave and Wenger
1991; Wendrich 2012: 5; Wenger 1998). The concept originated in response to
a lack of critical engagement with explanations for creativity and innovation,
instead placing emphasis on context, process, social interaction, material prac-
tices, ambiguity, and disagreement – in other words the performative nature of
learning (Amin and Roberts 2008: 353). Learning is thus social and arises from the embodied experience of participating in the process of making. Members of a community build relationships over time and through sustained interaction. Through these they develop a shared repertoire of resources: experiences, stories, tools, and ways of addressing recurring problems — in short a shared practice (Wenger 1998). Creativity arises on the background of, as well as in reaction to, such craft traditions and the restrictions created by communities of practice; when creative a craftsperson moves beyond common shared forms and norms.

Another significant component of production is the use of tools. Tools may be seen as extended limbs of the makers, and are integral to crafting (Sennett 2009). Sometimes the maker’s body, or parts of it, may serve as a tool, but commonly tools are specifically formed to enable the interaction between the craftsperson and the material in terms of desired effects. Our studies show how tools frequently developed through novel ways of working with existing materials or through the advent of new materials. Adaptation of existing tools can also be seen in some of the items used in metalworking, which borrowed from flint working. Tools, however, are not just about objects, but also involve notions of their proper use, how they may constitute a tool kit in which different objects ‘work together’, and are developed in relation to the worldview of a community. It is within such tool kits and their linked motor habits and rhythms that we may begin to identify the logic of a craft, and how new tools and practices may also be linked to wider community concerns (e.g. Bender Jørgensen 2012b, 2013a; Høgseth 2012, 2013).

Reflecting on these aspects of production with regard to our three materials makes it clear that creativity, in the sense of adjustments, changes, innovations, as well as development of production in terms of desired outcomes and control, may be found at different levels. Bronze Age data provokes additional questions about conservatism in practices, about whether creativity and innovations at times are rejected, and how we distinguish between skilled and creative work (or whether there are overlaps between these). Importantly, it is also clear that working with textiles, metal, and ceramics offered different conditions for innovations and creative responses due to variations in the production sequence.
In textile production makers had to deal with a new raw material: wool. At a very coarse level wool is processed through the same three basic stages as flax and other vegetable fibres: i) harvesting, processing, and preparing the fibres, ii) spinning them into yarn, and iii) weaving. Nonetheless, at each of these stages wool makes different demands and the processing had to be rethought and adjusted to suit the new material and its distinct properties. Tools, textiles, dress types, and the ways clothing was fastened changed (Rast-Eicher 2005: 129). These rapid developments are seen at several levels of production practices. For example, there were attempts at adapting existing tools used in the production of textiles of plant fibres to the production of wool textiles (Grömer 2010: 86–90, 112–16; Rast-Eicher 2005: 127). Such examples suggest both a transfer of existing practices and an element of experimentation behind the development of new processes.

Making a textile requires a long series of decisions by the maker, or makers. To a great extent the decisions depend on the intended use of the textile, but the available raw materials, tools, and techniques also play important roles, as do the skills of the maker and the cultural norms and conventions in society. The sequence of decisions also depends on whether the whole process was being carried out by one person, or if several people with different tasks and/or skills were involved. As textile production involves a wide range of
From the harvesting and processing of fibres to finishing processes, such as dyeing, wetting, teaseling, brushing, or fulling of the finished cloth, it is most likely that many people were involved.

The chaîne opératoire of textile production starts with the procurement of fibres (Figure 2.1); this differs widely depending on whether these are vegetable fibres extracted from plants (by retting before their further preparation), or wool that can be processed without further ado. Nonetheless, regardless of what fibre is used, selecting the raw material is the first important decision in the making of any textile. The next stage is the preparation of fibres and thereafter turning them into yarn suitable for the intended fabric. This requires extensive knowledge of the properties of fibres and how they are affected by processing. Then the yarn is used to weave the textile. Various types of yarn perform differently when used as warp or weft and applied to different types of weaves, sets, and densities. The size of the planned web is also of importance as different dimensions require different designs and properties. Other features including edges (types of transverse borders and side selvedges) are also closely connected to the dimensions of the fabric and to the type of loom that is to be
used. Further choices may be made regarding colour or colours, and any form of woven or applied decoration.

TOOLS

Spindles and looms are the main tools for pre-industrial textile production. In addition, tools such as sacks, other containers, and perhaps string are needed for the harvesting and clubs, combs and other tools for the processing of fibres. For the spinning and weaving, wool baskets, distaffs, pin beaters, weaving combs, or weaving swords may be used. In further processing, vats for dyeing and fulling, teasels and brushes for further finishing, and knives and needles for cutting, sewing, and decorating the finished fabrics are employed. Each of these tools may take many forms, and very likely did so in the Bronze Age. Spindles, for example, may consist of just a rod – straight or crooked – with or without a notch or hook; a spindle whorl may be added at the top, middle, or lower end of the spindle, but is optional. Spinning can even be carried out by the hands alone. Spindles are usually held vertically, as drop spindles or supported spindles, but may also be held horizontally. The spinning process is further facilitated by using another rod – a distaff – to hold prepared fibres in place (Gleba and Mannering 2012: 9). If we look further afield, spinners from ancient Mesopotamia and Anatolia appear to have carried out their craft sitting, while those of Pharaonic Egypt mainly did it standing but sometimes sitting. Spinners from Classical Greece worked standing (Barber 1991: 41–76). This also seems to have been the case during the Early Iron Age in central Europe, as illustrated by the depictions of textile workers on an urn from Sopron in Hungary (Barber 1991, fig. 2.15). A further illustration of a woman engaged in spinning derives from a tintinnabulum from Bologna, dated to the late seventh century BC (Grömer 2012: 54, 57).

Completely preserved Neolithic spindles had whorls placed at the lower end of the spindle, as demonstrated by an example from Arbon Bleiche 3 (Switzerland) where yarn made from lime bast is still in place (Grömer 2010: 87; Leuzinger 2002). Whorls are generally discoid, but also appear in forms that may be called bell-shaped (Grömer 2010: 88). Bronze Age spindle whorls from central Europe are not well known (Grömer 2010: 87–8). They are mainly biconical in shape and smaller than those of the Late Neolithic. As lighter and more compact whorls have faster rotation, Antoinette Rast-Eicher (2005: 127, 2012a: 383) has argued that they are better suited to short wool fibres. By the Late Bronze Age, spindle whorls reappear in great numbers and variety (Grömer 2012: 41). In many areas, however, there is little or no
evidence for spindle whorls despite textiles being found. For instance, spindle whorls are largely missing from the archaeological record of Scandinavia before the Roman period despite the strong textile evidence (Bender Jørgensen 1986: 135, 344, 1992: 118). This suggests that other spindle types without whorls were commonly employed.

The weight of spindle whorls varies considerably, potentially indicating differences in work procedures or desired outcome. Experiments by Karina Grömer have shown that using a supported spindle (resting on the thigh of the spinner or in a bowl or cup) and light spindle whorls (10–25 g) produce wool yarns with diameters between 0.2 and 1 mm, whereas spindles with heavy whorls (more than 100 g) result in thicker yarns, from 0.5 mm to more than 2 mm. If the spindle was suspended as a drop spindle, the range of diameters would be narrower. For plant fibres, heavier spindles may be used even for fine yarns (Grömer 2005, 2006a: 183, 2010: 90–7). It is therefore of interest when standardisation of spindle whorls can be seen as this suggests a common control of outcome.

Looms too may take many forms. Although difficult to prove definitively, it is thought that warp-weighted looms, vertical two-beam looms, and, perhaps, horizontal ground looms were used in prehistoric Europe (Barber 1991: 79–122; Ciszuk and Hammarlund 2008). In addition, a number of band looms were used (Grömer 2010: 99–112). The evidence for the warp-weighted loom is most convincing. It is depicted on Middle Bronze Age rock art from Val Camonica, Italy. It is also evidenced through loom weights, usually of fired clay. They are often found in groups; in Germany, loom weights have been found in rows that were 59 cm long at Zedau and 2 m long at Wallratz (Harding 2000: 158–60). More than 80 loom weights were found at the Early Bronze Age site of Hradčany in the Czech Republic (Barber 1991: 104). Their frequency, shapes, and weights vary chronologically as well as geographically but show that the warp-weighted loom was an important textile tool in Bronze Age Europe. The identification of other loom types is more debatable. Arguments for the vertical two-beam loom rest on technical characteristics in the preserved textiles from Scandinavia (Bender Jørgensen 1992: 118; Hald 1980: 203–18). Regardless of the type of loom, the most important innovation in Bronze Age weaving was the addition of multiple heddle shafts. This made it possible to add the weaving of twill to the plain tabbies that were the standard weave of the Neolithic and most of the Bronze Age. With the invention of twill, textile makers obtained a rich new potential for varying the texture, handle, and drape of their fabrics, emphasising the properties of wool in terms of softness and insulation. They also acquired a range of new ways of creating patterns.
COMMUNITIES OF PRACTICE

The many steps of the chaîne opératoire of textile production involved farming and livestock management, various forms of harvesting processes, as well as the preparation and processing of the resulting fibres into yarn, fabrics, and then into items of clothing or other objects. Each of these steps demanded specific knowledge and skills, but at different levels. Some tasks were carried out by groups of people while others were individual undertakings. Light work, such as the sorting and separation of fibres, might have been carried out by frail, aged people, assisted by children. Other tasks, like the mounting and warping of the loom, demanded strength and dexterity as well as knowledge, and would have been carried out by experienced adults. Textile crafts are traditionally thought of as women’s work, but this is not always the case. In some societies, spinning and/or weaving is performed by men (Crocker-Jones 1989: 23, 41, 43; Picton and Mack 1989: 19–21). Some of the heavier tasks, such as the cultivation and harvesting of flax, are usually carried out by men. Ethnographic studies of apprenticeship in pre-industrial societies indicate that children start to learn spinning at the age of five or six, weaving at about eight (Bender Jørgensen 2013a: 129). In general, children help as soon as they are old enough, learning the various aspects of the craft as they develop the necessary dexterity and skill. Examination of well-preserved Bronze Age textiles has revealed cases where skill differences suggest that two or more weavers worked together on a web (Broholm and Hald 1940: 121). Smaller items like sashes or hairnets are likely to have been made by a single person.

TEMPORALITIES

Production of textiles was seasonal as well as time consuming. The procurement of fibres was dependent on agricultural cycles of growth and harvesting, and had to be carried out when the time was right. The processing of fibres into yarn and woven cloth was presumably carried out outside the intensive periods of sowing, lambing, and harvesting. In Early Modern Europe, the spinning and weaving of wool was carried out before Christmas, while processing flax started after the Christmas holidays (Hojrup 1967: 236; Kjellberg 1943: 625; Skougaard and Hansen 1983). The labour involved in all of these tasks was considerable.

The harvesting of wool was done by rooing (plucking) or combing the fleece at the time when it was ready to moult. A range of time estimates for the rooing of one sheep have been proposed. Carol Christiansen, investigating sheep husbandry in the Shetlands, suggests it takes one or two persons on
average 15–20 minutes to roo a sheep (Christiansen 2004 and pers. comm.). Eva Andersson Strand, quoting information from the archaeological research centre at Sagnlandet Lejre, Denmark, suggests that it takes one person about 50 minutes to pluck a sheep (2012: 30). According to textual sources from Mesopotamian Ur III, Joy McCorriston has calculated that textile workers each plucked 38 sheep per day (McCorriston 1997: 523).

The time taken for the subsequent stages of wool processing is difficult to assess, but experiments suggest that a craftsperson can sort and comb c. 15 g wool per hour (Andersson Strand 2012: 31). The more meticulous the sorting, separation, and further processing, the longer the time it will take. In third-millennium BC Mesopotamia, one female textile worker could process 0.45 kg of roughly cleaned wool in four days (Waetzoldt 1972: 116). Calculations based on these data suggest that it took up to 94 days to process sufficient wool for the finest qualities of textiles (McCorriston 1997: 523). According to Hartmut Waetzoldt these textiles were normally 3.5–4 m long with approximately the same width (Waetzoldt 1972: 148).

The next stage in the chaîne opératoire of wool working is to make slivers (continuous strands of fibres) that are ready to be twisted into yarn. This process is also mentioned in cuneiform texts from Ur III, where a female textile worker is reported to be able to process 2–3 mina (c. 1–1.5 kg) of wool per day in this way (Waetzoldt 1972: 120). As regards spinning, recent experiments have shown that an experienced spinner can produce on average 35–50 m yarn per hour on a drop spindle, depending on the weight of the spindle whorl (Andersson Strand 2012: 34; see also Nørgaard 1999). The data suggest that between 50 and 80 hours of spinning would have been required for the yarn needed to make the 184 cm-long and 122 cm-wide woollen blanket from Trindhøj in Denmark (Broholm and Hald 1940: 37–9).

Making and mounting the warp is the next and crucial part of the making of a textile. This has to be done meticulously in order to secure an even tension of the warp. It is also important to create a regular spacing of the warp, and to make sure the heddles are tied correctly. A cuneiform text from Ur III mentions three women making a warp in three days for a 3.5m-long and 3.5m-wide guz-za fabric. Experiments by the Copenhagen Centre for Textile Research suggest that this is a realistic estimate (Andersson Strand and Cybulska 2013: 118–20). Mesopotamian texts mention fabrics where 25 cm were woven in a day; weavers are calculated to have inserted 20.8 wefts/hour (Waetzoldt 1972: 139). In a series of experiments on a warp-weighted loom carried out by a single weaver, on average 25 wefts/hour were inserted (Nørgaard 1999: 10). The Trindhøj blanket has 3–4 weft threads per cm; at a rate of 25 wefts per hour, it would have taken c. 25 hours to weave.
Bronze Age flax and other vegetable fibres appear to have been spliced in preparation for spinning, a process that makes the yarn look plied. We have little knowledge of how time consuming this was. As regards spinning, experiments suggest a difference between flax and wool, in that spinners were able to make 24–33 m flax yarn and 30–50 m wool yarn per hour on a drop spindle (Mårtensson et al. 2006a: 8, 2006b: 8).

Most of the work processes transforming fibres into textiles can be interrupted and resumed without any impact on the quality of the final product. This applies to the preparation of fibres, making of slivers, spinning of yarn, and weaving. Making and especially mounting a warp on the loom is another matter. An interrupted warping process results in uneven tension on the loom, and will be followed by difficulties in obtaining a good, clear shed (separation between layers of warp yarns allowing insertion of the weft), and irregularities in the web. In many traditional societies this process was therefore circumscribed by rituals and superstition (Bender Jørgensen 2013a: 131–2). Dyeing and fulling would be further processes ill-suited to interruptions, as assessment of the right temperature is essential for successful results.
THE PRODUCTION OF METAL OBJECTS

Marie Louise Stig Sørensen and Grahame Appleby

This section considers how metal objects were made: how they were designed, formed, and shaped. The chaîne opératoire for metallurgy can be presented somewhat simply in terms of the main stages of ore processing, preparation of the raw material, melting, casting and/or hammering, and final preparation. Alternatively, it may be broken into the many specific stages and decisions that sit behind a bronze object (see Figure 2.2). The latter approach, aiming to be comprehensive, risks presenting a view of practices as composed of well-defined single steps and decisions, and easily becomes so detailed and convoluted that it prevents meaningful insights into metalworking as a special kind of practice. Counter-intuitively, the usefulness of the detailed model is therefore primarily that it illustrates that metalworking can be done in different ways but it does not provide a focus for the analysis of metallurgical practice.

Objects can be made from copper alloys in a number of ways. Some of these are simple and involve little alteration of the raw material, such as objects made through hammering of native copper or drilling holes in naturally occurring copper-rich nodules to make beads. From the sixth millennium BC, hammering and the use of heat were used in the making of objects. Such shaping techniques were not distinct to copper alloys, but were also used when working other materials, such as lithics or bone. Hammering copper-rich minerals could, however, create effects that went well beyond what could be done with
other materials, as when hammering was used to stretch the metal, and through that create thin sheets or long thin rods. The use of such methods without additional manipulation of the alloys was, however, limited in its effects as the sheets become brittle and split if the metal is stretched too far and too quickly. It was only with the development of annealing, which consists of a cycle of heating to increase the metal’s ductility and malleability, that larger metal sheets could be produced. This method shared skills and techniques with gold working and is found before the fifth millennium BC in eastern and central Europe. Sheet-bronze working and annealing continued to be used throughout the Bronze Age and became a well-established practice. Through time the complexity of objects made of sheet bronze increased, with innovative and elaborate objects such as body armour being produced during the Late Bronze Age. Whether this elaboration is a reflection of creativity or merely
the result of highly skilled crafting is not, however, entirely clear. Items made of sheet bronze, such as shields and helmets (Lehoerff 2015; Mödlinger 2013), are clearly technically demanding, demonstrating a mastery and control over the properties of metal. Nonetheless, in terms of a production technique they were not really innovative, but rather the result of stretching long-standing existing practices and executing them very well. The production of bronze objects cast in moulds was, however, an innovative technique. Mould casting can be interpreted as a creative solution to the challenge of how to shape metal by exploring its ability to become fluid. The following discussion of the chaîne opératoire for metal will, therefore, concentrate on the process involved in casting bronze objects.

Using the Nordic Bronze Age razors as our example, the following stages in production can be identified: First, the ore has to be procured. In northern Europe, where local metal sources were not explored during prehistory, procuring metal would have been done through trade. This contrasts with the metal-producing areas, where people were engaged in prospecting and collecting metal-rich ores and processing them to extract the metal. Producing a razor would have involved the preparation for the casting, which was primarily about the making and control of heat: fuel, furnace, bellows, and crucibles. It would have been very important to control the temperature, both of the furnace and of the moulds (which benefit from being preheated); if the furnace is too hot parts of the minerals will burn off, if too low the metal will not flow. Casting would also have involved some kind of model for the object to be cast. For the razors this is likely to have been either a negative impression in a two-piece mould, or a positive wax model of the object. The latter is most likely the method used for those razors with elaborate decorations on the blade as this was probably engraved on the surface of the wax model. The wax model was used in cire-perdue (lost-wax) production. Finally, the razors emerging from the mould would have needed some finishing. The edge would have been hammered to become hard and thinner, and it would have been sharpened using a whetstone or similar. It would also have been polished using an abrasive substance, such as sand. On a few razors additional decorations seem to have been punched or incised on the finished object, a procedure common for many objects.

All of these stages, as further discussed below, would have been informed by knowledge about, and familiarity with, how to work with the different materials used (wood, clay, metal, stone etc.), and the restrictions imposed by these. Both general tools and others specifically designed to enable production, were also essential. Furthermore, the production practices would have been deeply influenced by cultural norms about labour division, cosmological concerns,
tradition, and aesthetics; some of these influences are easy to discern whereas others are less obvious.

TOOLS

Generalised and specialised tools are used in metalworking. The former refers to tools such as hammers, mallets, picks, and baskets that were used in many different production practices, and which were used as needed at different stages in the production of bronze objects without the tool being adapted to specific requirements. The latter refers to tools that were developed in response to the particularities of metalworking including melting and casting, as well as further refinement and finishing. The evidence for metalworking tools is very uneven. For specific stages, such as the procurement of metal ores, and from particular sites, such as the Great Orme copper mines in Wales, there is plenty of evidence. In the Great Orme mines we have, for instance, thousands of stone and bone hammers and picks (Budd et al. 1992). The tools from such sites were similar to those used in mining other materials. For other parts of the process, such as the means of decoration, we have hardly any tools and it is not possible to ascertain whether the tools that exist represent tool kits generally or are the personal belongings of a specialised craftsman. Moreover, as such specialised tools are usually found in graves, with very little evidence coming from settlement contexts or production sites, it is tempting to think of them as personal tool kits rather than common tools. The limited number of specialised tools means that the evidence provided by traces on the metal objects themselves constitute an important supplementary source.

It is with regard to the casting and the further preparation of the cast object that we find new tool types, and through them evidence of new production techniques. In addition to the use of generalised tools such as bellows, simple furnaces, and clamps, which were probably similar to tools already being used in other pyrotechnologies such as pottery making, casting also needed specialised tools such as crucibles and moulds. Crucibles were used for the melting and pouring of the metal. They were made of coarse clay, often tempered with organic materials, such as chaff, and roughly prepared with little attention to their appearance. It was clearly the crucible’s mechanical properties that were of concern, such as the ability to withstand heat, or the ability to add to the oxidation of the copper as air could move through its coarse-grained porous sides. These qualities, however, mean that fragmented crucibles can be difficult to recognise during excavation as the pieces appear similar to remnants of burnt daub or ovens. We therefore lack knowledge of whether different crucible techniques developed, the extent to which there were local norms,
and whether different pre-existing experiences of working with clay (such as pottery or house-building traditions) influenced their development as standard tools within metalworking.

The other important specialised tool was the mould. It developed in order to control the shape of the molten metal as it cooled and hardened. Our knowledge of moulds is affected by similar problems to that of crucibles, although the use of stone and bronze moulds means that there is a better recovery rate. Their invention was of great importance, making possible the production of elaborate and complex objects during the Bronze Age. They also dramatically influenced the casting method itself, introducing a means of standardisation and potentially affecting labour division. The high point of metalwork produced in this way is the bronze lurs found in northern Europe dating from the Middle and Late Bronze Age. These were large musical instruments cast in the form of twisted tubes. The lurs were tuned to be played in pairs and are incredibly sophisticated objects; modern bronze casters copying lurs using traditional techniques say they are extremely difficult to make and express the greatest admiration for the skill of the Bronze Age craftsperson (Holger Lonze pers. comm.). The forms and aesthetic possibilities that casting allowed probably contributed to bronze becoming very valuable socially from early in the Bronze Age.

COMMUNITIES OF PRACTICE

A classic topic within Bronze Age studies has been the question of who produced metal objects, and whether they were specialist or not (see Kuijpers 2013 for a detailed discussion). With accumulated knowledge of the objects, and awareness of social and cultural conditions, it now seems most convincing to argue that a fixed concept of bronze smiths is not sufficient; in a recent analysis of the production of Early Bronze Age axes from the north Alpine region, Maikel Kuijpers suggests that there were four levels of skill present (Kuijpers 2014). It is possible that such a differentiation of skill became even more diverse during the Bronze Age as more complex objects were being produced. Irrespective of the degree of differentiation in skill, metalworking must have involved a process of learning. Who did they learn from, and what repercussions did the innovations of individual craftspeople have for others? It is with regard to such concerns that the concept of ‘community of practice’ is interesting to reflect on. Across Europe, there are clearly many striking similarities in metalworking practices but this seems to be at a level that does not seem to correspond to the concept of communities of practice. Such similarities result in a clear sense of fashions or trends within metalworking. Yet
at the same time there were other idiosyncratic practices particular to a local region, a workshop, or a person. For metalworkers their community of practice could be part of local knowledge communities but they could also be part of wide-ranging networks reaching beyond their immediate social and economic surroundings.

TEMPORALITY

The investment and importance of time are extremely difficult to access with regard to metalworking. In contrast to textile production, for example, it is less easy to establish particular production ‘pathways’ that all metalworkers would use. The degree of variability of time used in the making of core aspects of the production is also a substantial challenge when trying to establish what kind of time commitment metalworking represents. For instance, the material used for making the mould has considerable impact on the time needed to make a finished object. Quanyu Wang and Barbara Ottaway have conducted systematic experiments comparing casting in bronze, clay, and sand moulds (2004). They concluded that bronze moulds required less labour to prepare a finished object, but making the mould itself was time consuming. In contrast, sand moulds were easy and quick to make, but much more time would be needed to finish the object.

Some parts of the process, moreover, although long lasting, could be interrupted and resumed at any time, just as with spinning and weaving. Other stages, however, could not be interrupted and were of very short duration. Pouring the molten metal, for instance, has to be done within seconds or the material begins to change state. The rhythm of metalworking is therefore discontinuous with long periods working steadily on building up the temperature, while other stages are fixed with short windows of opportunity. For instance, excess material can be removed with a short sharp movement seconds after an object comes out of the mould but if done later it will be a time-consuming task. Within metalworking there are thus parts of the process that take time, and other aspects that demand timing; for the latter, success in production rests on the ability to assess when the moment is right. In contrast to textile production, which in part is tied in with the annual cycle of sheep and plants, there is little to suggest that metalworking was seasonal.
THE PRODUCTION OF POTTERY

Joanna Sofaer

Pottery making was clearly a well-established craft before the Bronze Age. Its study does not therefore illustrate important changes in the trajectory of pottery production in terms of the chaîne opératoire or tool kits. Furthermore, although tools may be used, the body is consistently the potter’s most important tool because clay is worked directly with the hands (c.f. Mauss 1979; Sofaer 2015). Instead, an exploration of ceramics throws light on the continuous changes within this medium and how the making of objects in clay drew on a basic chaîne opératoire in a flexible and dynamic manner. The plasticity and potential variability of clay means that there is no inevitability in either the size or shape of clay objects, or in how they are formed. It is possible to make simple and complex, small, and large objects. Nonetheless, working with clay is not necessarily limited to hand techniques specific to clay such as coiling or thumbing out. For example, it is possible to use tools to cut, trim, or chisel out clay as in the ‘kerbschnitt’ technique originating from woodworking. Clay bowls decorated by chiselling out the clay to create spirals and zigzag motifs in relief in the same way as they might be made out of wood are found at the Middle Bronze Age site of Suciu de Sus in north-west Romania (see Kacsó 2011). The chisel marks are clearly visible in the interstices between the elements of the motifs and form part of the visual effect of the vessel, making the woodworking technique used to decorate them obvious to the viewer. Likewise,
metalworking techniques, such as riveting or beating, may also be applied to clay. Early Bronze Age Nagyrév vessels from Hungary have handles attached by piercing two holes in the vessel wall and inserting clay pegs pinched from the handle through them. The pegs may then be flattened against the vessel wall or opened in a manner resembling a modern split pin (Sofaer 2006). The flexibility of the chaîne opératoire of working with clay, which derives from its particularly plastic properties, thus seems to lend itself to cross-craft influences and to local experimentation in production processes.

Given this variability it would be a mistake to describe the chaîne opératoire of pottery production in the Bronze Age in anything but the most general terms. Not only are there local differences in material resources (such as clays, tempers, and fuel for firing), vessel-building techniques, and decoration, but each of these may also vary within cultural groups according to site and vessel type. The potential resolution of the ceramic chaîne opératoire can be increased through a focus on individual vessels (see for example De La Fuente’s (2011) identification of 59 stages in the production of an undecorated bowl). As with metalworking this, however, introduces a level of complexity that is difficult to utilise on a wider analytical level. The basic stages of pottery production can be identified as digging clay, cleaning and purifying the raw clay, mixing it with temper (filler), wedging (kneading) the clay, shaping the vessel, air-drying it to a leather-hard state, decorating and adding handles (if required), firing, allowing to cool, and removal from heat (Brysbaert et al. 2012; Rice 1987). Each of these stages offers different possibilities for creative intervention. Pre-planning in the preparation of the raw material is required in relation to the intended function or aesthetic of the finished vessel. In this case creativity is a matter of manipulating and anticipating the future effects of clay recipes. Creativity can also arise as a result of the direct physical interaction of the potter with the plasticity of clay, allowing for a degree of immediacy in creative improvisation and for correcting mistakes in vessel forming and decoration that goes beyond that possible in the production of textiles or bronze. In this regard, specific technical gestures (hand or body actions) lie behind generalised description of stages in the production process (see Schlanger 1994). Decoration, for example, is notoriously variable. This emphasis on the actions of the potter highlights the manner of execution, which may lend insights into creative practices.

The chaîne opératoire of pottery manufacture is not a single linear set of sequential activities but is rather a series of potentially parallel activities requiring co-ordination, with suites of cyclical repeated actions embedded within some of these (Brysbaert 2011; Brysbaert et al. 2012) (Figure 2.3). For instance, clay collection and processing can take place alongside the collection and preparation of temper and fuel for firing. Examples of cyclical actions may
include rolling and adding coils during vessel building. Potting is a matter of repeated additive or subtractive actions, such as kneading or trampling required to mix tempers, building up a vessel whether by coiling, pinching, paddle and anvil, or any other technique, scraping a vessel, or turning it during the repeated action of incision or impression in decoration. A particular feature of

Figure 2.3 The chaîne opératoire of pottery production.
fine ware vessels from several Middle and Late Bronze Age cultural groups in central Europe is symmetry in decoration around the pot. The production of such symmetry requires the deliberate repetition of a specific counted number of actions by the potter.

The production process of pots offers particular room for creativity as, while there is potentially a large number of stages in the chaîne opératoire of pottery production, relatively few of these are absolutely necessary in order to make a pot. Some of the stages may be left out, added to, or carried out more or less thoroughly, depending on access to resources and the desired outcome. For example, Gabbroic clay found in Cornwall in the south-west of England is naturally very plastic and, if desired, due to the feldspars in the clay can be used with relatively little preparation or temper, as seems to have been the case in the Bronze Age (Harrad 2004; Helen Marton pers. comm.). By contrast, clay can also be developed as a material by mixing or adding temper to modify its qualities. Temper may be homogeneous or mixed, and on a spectrum from well sorted to poorly sorted. For example, Middle Bronze Age Deverel-Rimbury vessels from England show a continuum from fine to very coarse (Seager Thomas 2008: 31). Likewise, decoration of vessels was by no means ubiquitous in the Bronze Age. While there are some very elaborate vessels, others are undecorated or lack any form of surface finish, while the quality of decoration may also vary. Creativity within ceramic production is not therefore simply a matter of singular decisions at individual points along the chaîne opératoire. Instead, it requires conceptualising ceramic production as a multi-dimensional process where the potential for creativity lies in decisions with regard to the presence or absence of specific production activities, how often they should be repeated in the making process, their means and thoroughness of execution. It is at these levels, and their combination, that creative practices may be detected in specific contexts. In short, creativity in ceramic production not only requires an understanding of the production sequence, but of the potential for variability within it. For pottery, there is a range of potential methods (and gestures) used within a given stage within the chaîne opératoire to achieve an outcome; the identification of stages in ceramic production is not therefore synonymous with any one way of doing things, resulting in an extraordinary potential for creativity in this medium.

COMMUNITIES OF PRACTICE

There is tremendous variability in pottery production both diachronically over the course of the Bronze Age and between regions. Different objects were made using similar techniques, and similar objects were made using different
techniques. For example, in Hungarian Middle Bronze Age Vatya pottery, a restricted number of vessel-forming techniques were deployed in expedient combinations depending on vessel size and shape (Budden and Sofær 2009); the bodies of both thin-walled fine wares and thick-walled cooking vessels were made by coiling. In other settings, however, specific vessel types were made using particular forming techniques. For instance, at Middle–Late Bronze Age Gârla Mare sites in Romania straight-sided bowls were made by coiling, urns by slab-building, and everted rim bowls with exaggerated and angular profiles (so-called porringers) were thumbed out despite their large size, presumably in order to be able to control the complex shape when building up the vessel (Sofær 2015). By contrast, in northern Poland throughout much of the Bronze Age vessel-forming techniques appear to have been locally specific and vessels of the same type were made according to different local traditions (Dąbrowski 2004). Clay as a material therefore offers a range of solutions to forming objects but in each case the techniques used were closely linked to understandings of the material and culturally described ‘ways of doing’. The investment in ceramics also differs over time and space. Some areas, such as northern Europe, invested little in pottery production with plain but perfectly serviceable pots being produced. By contrast, central Europe saw a proliferation of shapes and decorative schemes.

Such differences in forming techniques and decoration reveal that some communities of practice were conservative, whereas others were open towards experimentation with some, or all, of the constituent elements of their pots. Nonetheless, even in contexts where it is possible to observe considerable variability in pottery manufacture and decoration, creativity does not seem to conform to modern Western notions of individualistic expression. Creativity appears to be constrained by the adherence to established ideals.

TEMPORALITIES

Critical to the making of pottery is not simply the sequence of actions but the potential to go back and forwards between different stages in the making process depending on clay’s hydration. More specifically, a central aspect of ceramic production is manipulation and management of the state of clay. Potters can wet it or let it dry and thus move between points in the chaîne opératoire; of our three materials, making pottery from clay has the least linear production sequence.

Such changes in the material can be anticipated and deliberately deployed when making a vessel. In this sense, breaks within the production process, such as waiting for material to dry, are also critical to making pots. This has
previously been described in terms of primary and secondary forming techniques (Rice 1987; Rye 1981; Sinopoli 1991). During the application of primary techniques, one part of the vessel is usually shaped until it reflects its final form, and dried until it develops a leather-hard state; for hand-built pots such as those made during the Bronze Age this includes coiling, slab-building, pinching, drawing, or moulding. The remaining part of the vessel is completed when the first part has dried enough to enable joining the two sections. Early Bronze Age Nagyrév jugs were made in sections like this. The application of secondary forming techniques takes place when the shape of the vessel is defined and completed. This includes turning, scraping, paddle and anvil, knife-trimming, and smoothing. They are used to finally establish the relative proportions of the different parts of the vessel (Berg 2011; De La Fuente 2011).

Direct physical interaction between potter and clay directs and guides the potter in assessing both time and timing in decision-making processes. Working with clay is thus a matter of understanding how to actively follow the material by remaining alert to sensory clues (Ingold 2011). This is a matter of using the senses, observing when the clay changes colour, feels dry, and its smell has changed. An essential part of the potter’s craft is to know when the clay is ready to resume work. This in turn demands of the potter an awareness of temporality – of the way that the forming of objects is related to ‘material flows’ by which objects unfold (Ingold 2011). In other words, an understanding of the ways that objects are made over time and of timing actions in relation to a particular material state. What appears to the observer to be a linear series of steps, is thus ‘a complex reciprocal process for the practitioner’ (Keller 2001: 37). Such an understanding of the material also requires an appreciation and, where possible, prediction of local weather conditions as these will impact on the clay; the waiting time between stages, or the need for the potter to work faster or slower, is variable depending on these. With this in mind, it is also possible that in many parts of Europe ceramic production was a seasonal activity since pots are less likely to dry well in cold and damp conditions.

Time and timing are also critical when it comes to firing a vessel, particularly if a degree of control over colour is desired. Thus, for example, the black, highly burnished Middle–Late Bronze Age vessels of the Terramare Culture in northern Italy required complete exclusion of oxygen in order to achieve a consistent dark colour. If the kiln or pit is opened too early then the surface of a vessel will be re-oxidised resulting in a colour change. The sequence of the introduction or exclusion of oxygen can be reconstructed by looking at the broken section of a sherd (Rye 1981). In addition, in order to achieve an even colour around vessels it is important to stack them properly as this will influence the circulation of oxygen. The way that pots are
stacked in the kiln can affect the intensity of colour; the internal surfaces of Terramare sherds are generally darker than the external ones, suggesting that vessels were fired stacked in piles or upside down (Cannavò et al. 2012). Firing to obtain evenly coloured vessels thus requires an understanding of how clay will behave in relation to heat, duration, and the organisation of the firing itself, as well as the ability to successfully predict this when the material is out of sight.
INTRODUCTION

The following case studies pursue the issues discussed so far in regard to production practices. How were things made? What kinds of creative decisions or pathways were followed? What were the possible contexts of these decisions? Each essay focuses on a particular dimension of Bronze Age practice in terms of textiles, metallurgy, and pottery in order to highlight the relevance of these questions.

The first two essays focus on the use of tools including the development of new tools and how they generated new practices as well as stimulating standardisation. They are followed by three essays that in various ways reflect upon the routinisation of production and possible reasons for this, including temporal shifts, social pressures, and cosmological connotations. The essays are not intended to be comprehensive but are rather snapshots that reveal the tensions between creativity and routine practices in the Bronze Age.
CREATIVITY AND SPINDLE WHORLS
AT THE BRONZE AGE TELL OF
SZÁZHALOMBATTA-FÖLDVÁR, HUNGARY

Sophie Bergerbrant

The introduction of wool as a new raw material for textiles had many repercussions for Bronze Age societies. A key question is how it may have influenced routine practices related to textile work taking place within settlements. This is the primary concern of this essay. The focus is on textile tools, in particular the spindle whorls found on the Hungarian Bronze Age tell site of Százhalombatta-Földvár, Hungary. Do they change because a new raw material was introduced? As discussed in Part I, textiles made of plant fibres occur in the archaeological record during the Neolithic (Barber 1991: 10; Bender Jørgensen 1992: 116; Rast-Eicher 2012a: 380). The technique of making textiles of wool first arrived in central Europe with the Bronze Age, when a shift from linen to wool textiles seems to have occurred (see for example Rast-Eicher 2012a: 380–1; compare Belanová-Štolcová and Grömer 2010: 12 who regard the shift to mainly wool textiles as a short-lived development during the Middle Bronze Age). This has led to the hypothesis that with the new material a new technology appeared, one with a different type of loom and a different type of spindle (Bender Jørgensen 1992: 118; Belanová-Štolcová and Grömer 2010: 12). This raises interesting questions in terms of innovation and creativity. In this essay the everyday small-scale creativity in spinning will be discussed based on the shape and weight of the spindle whorls at Százhalombatta-Földvár. The spindle
whorls from the site will also be compared with other contemporary spindle whorls, primarily from central Europe.

SPINDLE WHORLS AND EVIDENCE FOR THE PRODUCTION OF TEXTILES AT SZÁZHALOMBATTA-FÖLDVÁR

Száhalombatta-Földvár has 3–6 m of thick, well-preserved occupation levels, covering the period c. 2300–1500/1400 BC. The site is a fortified tell settlement strategically placed on the River Danube, overlooking a bend (Earle and Kristiansen 2010; Vicze and Poroszlai 2005). Tim Earle and Kristian Kristiansen argue that it was strategically located between the Mediterranean world and central Europe (Earle and Kristiansen 2010: 24). It is therefore important for understanding the development in textile production relating to the introduction of woollen textiles, which is believed to have started in the Near East during the fourth millennium (Barber 1991: 24–5; see also Bender Jørgensen and Rast-Eicher, this volume). The majority of the textile tools in this study come from the 20 m by 20 m trench excavated by the Száhalombatta Archaeological Project since 1999 (Vicze 2013: 71). The tools studied date mainly to the Middle Bronze Age levels, although some are from the Late Bronze Age.

The archaeobotanical data from Száhalombatta-Földvár shows only a nominal quantity of flax seeds (*Linum usitatissimum*) from the Middle Bronze Age and none in the Late Bronze Age (Stika and Heiss 2013). Although the seeds may have been removed prior to the rest of the plant being brought back to the settlement (Maier and Schlichtherle 2011: 568), the very low quantity indicates that flax was not processed on the site and was an unimportant crop at the site during this period. This suggests that linens might not have been a major cloth type. In contrast, sheep dominate the zooarchaeological record from c. 2000 BC onwards. At the transition to the Middle Bronze Age the faunal material suggests a shift in husbandry practices from mainly cattle to predominantly sheep. At the same time, the demographic profile of the sheep indicates a shift from a focus on the acquisition of meat (early slaughter age of the sheep) to wool (indicated in a predominance of older sheep). Over 60% of the sheep were kept as adults. Moreover, a third of these were male. The only reason for keeping old male sheep would be for their wool (Vretemark 2010: 164–6). Unfortunately, archaeobotanical analysis has not yet been possible for the Early Bronze Age layers of Száhalombatta as the excavation is on-going; this could assist in illuminating whether the increase in sheep happened at the expense of flax.

Although other parts of Hungary have supplied us with more substantial remains of Bronze Age textiles (see the CinBA textile database http://cinba.net/outputs/databases/textiles/), only a single thread has been preserved
CASE STUDY: CREATIVITY AND SPINDLE WHORLS

from Százhalombatta–Földvár, offering limited insight into how the introduction of wool affected textile makers at Százhalombatta–Földvár. Their tools, therefore, remain our most abundant source of knowledge. Textile tools can be entirely or partly made of organic material or may be made of more enduring materials such as stone, ceramics, bone, amber, or metal (Barber 1991: 42–3, 79–125). A thread may be spun using a rock or stick (Barber 1991: 42), in other words materials that are not usually preserved in the archaeological record, or which are so basic they may be difficult to recognise as tools. It is even possible to spin perfectly good yarn by the hands alone, without any tool (Crowfoot 1931: 9; Grömer 2006a: fig. 3). This, of course, would not leave any trace at all except for the thread. Neither would the harvesting of wool by hand, plucking or rooing the ready-to-moult wool off the animals. At Százhalombatta–Földvár, however, there are a number of identifiable spindle whorls.

This study examines 38 complete or broken spindle whorls from the site; remains of three further whorls were too fragmented to allow classification or weight estimates, and are therefore excluded from the discussion below. The spindle whorls were divided into three different types and a fourth category termed ‘unknown type’. Types 1 and 2 were found in Middle Bronze Age layers. All examples of Type 3 come from the upper layer of the excavation, suggesting a Late Bronze Age date. Most of the incomplete spindle whorls were broken in half (only one half is preserved), although some represent other breakage patterns. The spindle whorls were weighed; broken specimens were studied and the weight of the lost part added to estimate the original weight of the whorl.

Type 1 are purpose-made, undecorated whorls of discoid shape, weights ranging from 2 g to 132 g. There are 19 examples of this type.

Type 2 are spindle whorls made of broken decorated or undecorated ceramic sherds. They are also of discoid shape. Some are not finished and cannot have functioned as spindle whorls, but it is evident that someone started to drill a hole in a sherd that had been cut to a circular shape. They weigh from 12 g to 125 g. There are 12 examples of this type.

Type 3 are purpose-made biconical, conical or globular whorls which means that the ratio between diameter and height differs significantly from Types 1 and 2. They range in weight between 7 g and 48 g. Five examples are preserved in their entirety. Two further specimens were excluded as their weights could not be calculated.

Type 4 are of unknown type represented by examples of whorls that originally would have belonged either to Type 1 or Type 2, but are too badly preserved to attribute to type. They weigh c. 42 g.
Seven of the whole or broken spindle whorls of Type 1 have visible damage on the edges deriving from use. A further five have possible edge damage, while seven bear no signs of this kind of wear. The damage on what is interpreted as the lower side of the spindle whorl indicates that they had been part of a drop spindle, most likely a low-whorl spindle. In a low-whorl spindle the spindle whorl is placed near the lower end of the shaft of the spindle (Barber 1991: 52). This form of spindle has been suggested to be the main one used in prehistoric Europe (Gleba and Mannering 2012: 9). Barber (1991: 53–5), however, argues that this is difficult to say with certainty for the Neolithic and Bronze Age.

The shape of the spindle whorls does not have a significant bearing on the yarn, but the ratio between the diameter and the height will have an effect on the speed of the rotation of the spindle. Discoid or lenticular-shaped spindle whorls rotate for a longer time but more slowly than spindles with a lower ratio between the diameter and the height (Grömer 2005; Gleba and Mannering 2012: 9–10; see also Verhecken 2010). This indicates that a shift from flat discoid-shaped to biconical spindle whorls would have affected how the spindle works and, therefore, how the handler would interact with it. At Százhalombatta-Földvár, discoid spindle whorls seem to be the main form of spindle whorl throughout the Middle Bronze Age. The form only changed at the transition to the Late Bronze Age when new forms (Type 3) were explored.

In a European perspective, none of the types of spindle whorls found at Százhalombatta-Földvár were new. Swiss spindle whorls from the Early Bronze Age are mainly biconical, while the flat discoid type that was common in the Neolithic becomes rare. Antoinette Rast-Eicher (2012a: 383) has interpreted this change as connected to the shift from textiles made predominantly of plant fibres to those of wool. In Austria, Early Bronze Age spindle whorls are rare; the few that are recorded are globular as well as biconical (Grömer 2010: 88). Early Bronze Age spindle whorls from the lake settlements at Lago di Ledra in northern Italy are globular as well as discoid (Bazzanella 2012), with the majority of textile fragments from the region being made of flax. Based on the palaeobotanical and zooarchaeological evidence from Bronze Age Százhalombatta-Földvár it seems unlikely that the discoid spindle whorls on this site were related to linen production rather than wool. This is evidenced by the low abundance of flax remains in relation to the striking dominance of sheep, and the relatively large proportion of discoid-shaped spindle whorls in this study: in total they make up 84% of the total sample (32 examples).
SPINNING PRACTICES AND CREATIVITY

Spinning is practical knowledge, a craft that stays with you once it has been acquired. Ethnographic studies (e.g. Crowfoot 1931; see also Bender Jørgensen 2013a) show that there are cultural differences in spinning and that tools are used in different ways. This is also evident from iconographic and other archaeological sources. For example, representations of spinning from the ancient Near East and prehistoric Europe mainly show women doing the spinning (Barber 1991: 45, 48, 55–9, 70, 72, 76), but there are depictions from ancient Egypt with male spinners (Rooijakkers 2005: 8–9). Such representations also show different body positions while spinning, from sitting to standing. This suggests that spinning is a learnt activity and is thus culturally determined. The earliest representation we have of a woman spinning in central Europe is on the famous urn from a Hallstatt period burial in Sopron, Hungary, which shows a standing woman spinning with a drop spindle (Barber 1991: 55; Grömer 2012: 57). The edge damage on the Százhalombatta–Földvár spindles of Type 1, and their tendency to break into halves may indicate that this way of spinning was already established in the Bronze Age in this region. Bengt Molander (1996: 58–62) uses the phrase ‘living knowledge’ (in Swedish levande kunskap) to describe this kind of culturally specific embodied practice. Analogous terms currently used in Archaeology are ‘body knowledge’ or ‘embodied knowledge’ (Sørensen and Rebay-Salisbury 2013; Wendrich 2012). It is, however, challenging to study this in prehistoric societies as we must rely on tracking its traces. We are unable to observe a prehistoric crafts-person or to discuss his or her choices. We have to work backwards from the finished, discarded, or partly preserved objects. The choices made by spinners must be deduced from what remains from their tools and products.

Different skills and different crafts are learnt in different ways. One common trait is that many crafts are learnt by observing and imitating before mastering a skill. This is often done while the student and teacher are discussing the process (Molander 1996), although examples are known of teaching with a focus on observation rather than oral learning. The latter can be seen in the teaching of potters in some ethnic groups from Cameroon. In these groups the trainee is only allowed to observe – no questions are allowed during the early stages of learning. The moves of the apprentice during potting have to be an exact copy of those of the teacher, and the final product also has to be an exact replica of the master’s; only culturally accepted pots are allowed (Wallaert-Pêtre 2001; Wallaert 2012: 29, 35).

At Százhalombatta–Földvár it has been shown that Bronze Age potters made more technical errors making simpler forms, such as cups, than in the more
complex fine ware. This indicates that it was probably the more experienced and skilled potters who made the fine ware whereas the simple forms are likely to have been produced by apprentices (Sofaer and Budden 2012). This may be relevant in terms of the Százhalombatta-Földvár spindle whorls. It is possible that purpose-made whorls and those made through the secondary use of sherds were created by two different groups of people, perhaps with different kinds or levels of expertise. In addition, spindle shafts were made of wood. Hence, the making of whorls and spinning do not merely rely on one craft alone, but two, or perhaps three.

As the earlier periods at Százhalombatta-Földvár have not been excavated yet, it is difficult to say for certain what the earlier spindle whorls looked like. Nevertheless, it seems reasonable to assume that they were discoid-shaped, as were Neolithic and Early Bronze Age examples of spindle whorls from the surrounding regions (Rast-Eicher 2012a: 383; Belanová-Štolicová and Grömer 2010: 11). It seems likely that the people in Százhalombatta-Földvár continued using the same tools for their spinning, perhaps adjusting their body technique in order to adapt to the new material. It is first in the Late Bronze Age that the people at the site started to be creative in making, and to accept, new shapes of spindle whorls.

Nonetheless, the spindle whorls from Százhalombatta-Földvár display a wider range of weights than can be seen in many other Bronze Age European settings; at Százhalombatta-Földvár the range of weights of the spindle whorls varies from 2 g to 132 g. In Switzerland spindle whorls weigh between 5 g and 70 g (Rast-Eicher 2012a: 383), in Italy 3 g to 64 g (Bazzanella 2012: 210). In Minoan contexts they weigh between 3 g and 100 g, with an average weight of 24 g; of the over 1,000 spindle whorls only very few weighed over 50 g (Burke 2010: 114–16, 130–50). Several spindle whorls weighing between 10 g and 70 g have been recovered from Late Bronze Age site of Zug-Sumpf in Switzerland (Rast-Eicher 2005: 128). At the Hallstatt period site of Smolenice-Molpir in Slovakia, which has over 2,200 spindle whorls, the whorls weigh from 1 g to more than 63 g, with the majority in a range from 6 g to 25 g (Belanová-Štolicová and Grömer 2010: 13). It is noteworthy that heavy and very heavy weights seem to be rare, although some are known from the Late Neolithic/Chalcolithic Jevišovice Culture and the Chamer Culture, weighing between 50 g and 120 g (Belanová-Štolicová and Grömer 2010: 11). Although the number of spindle whorls at Százhalombatta-Földvár is limited, the scale of variation indicated by the sample suggests the possibility that the community at the site may have been producing fabric for more than local use, perhaps even for exchange across a larger area.
The spindle whorls from Százhalombatta-Földvár can be divided into different categories of weight. The majority are in the range 7 g to 20 g and 40 g to 50 g, with a few around 70 g to 80 g and 90 g to 100 g, and some around 130 g. As can be seen in Figure 2.4, the limited weight range of the Late Bronze Age Type 3 spindle whorls is more in accordance with the weight range in Switzerland and Italy. The widest range of weights occurs in the purpose-made Type 1 whorls, indicating that this variety was intended. The spindle whorls made of broken ceramics have a slightly more limited weight range. Experiments exploring the relationship between the weight of spindle whorls and yarn thickness suggest that whorls with a low weight are used to spin fine thread, whereas the heavier spindle whorls are generally used for coarser yarn or plying yarn (Andersson 2007: 22; Gleba 2008a: 106; Mårtensson et al. 2006b).

Thus, with spindles whorls in these weight classes, spinners at Százhalombatta-Földvár would have been able to spin a very broad range of yarn using a drop spindle, from thin thread to thick thread. They would also be able to ply yarn.

The maximum weight of a spindle whorl has been estimated between 140 g and 150 g (Barber 1991: 52). As mentioned above, heavy spindle whorls are found in Late Neolithic cultures in central Europe (Belanová-Štolcová and Grömer 2010: 11), but are rare in Bronze Age contexts. The wide range of weights of spindle whorls at Százhalombatta-Földvár, and the fact that there are only a few extremely heavy examples, indicates that the people at the site wanted to create different types of yarn, and hence probably different types of textiles, rather than attempting to experiment with new shapes of spindle whorls per se. The site has the widest range of weight of spindle whorls found.

Figure 2.4 Weight categories for spindle whorls from Százhalombatta-Földvár.
in a Bronze Age context available in the literature. For example, in the period 2300–1600 BC the city of Ebla in the Near East had spindle whorls varying in weight between 1 g and 55 g (Peyronel 2007: 29). The variation in spindle whorls seen at Százhalombatta-Földvár therefore suggests a distinctive creativity when it comes to the production of yarn in the Middle Bronze Age. It is proposed that this creativity was intentional and planned based on the fact that the weight of the spindle can affect yarn quality and, through that, cloth quality; some whorls are then better suited than others for the spinning of yarn of a particular type.

In this essay it has been argued that the change in production at Százhalombatta-Földvár from textiles made of plant fibres to wool did not cause a complete overhaul of the practices and of the textile tool kit. Instead, it seems likely that the familiar tool types continued in use in the Middle Bronze Age. As a new material, the different way that wool fibre behaved compared to flax and other plant fibres (see Bender Jørgensen and Rast-Eicher, this volume), must nonetheless have necessitated problem solving in the beginning, to get the tools and the traditional ways of handling them to work with the new material. This process may subsequently have generated further possibilities for creative innovation in textile crafts with expansion of the range of yarn produced.
This essay discusses the making of objects out of bronze during the Bronze Age. Bronze objects are essentially made in two ways: hammering or casting. As a method of production, hammering works with the existing material to shape it by stretching it. Casting is different, however, and the innovation that the development of casting represents is the focus here. At the time when casting developed, no other material was transformed in this way. Casting can therefore be interpreted as a response to the challenge of establishing working methods that resulted from, indeed were integral to, the invention of methods for melting copper alloys. The aim was to ensure that melting was not just a way of separating minerals from the surrounding ore, but could also be used to shape the final product. Casting is therefore vital to a particular productive engagement with copper alloys. Without the invention of casting technology, the use of metals by prehistoric communities would have been very different. In particular, it enabled the production of a wider range of objects and more elaborate forms than was possible through the hammering of sheet metal. It also represents distinct skills and knowledge in terms of both the properties of different copper alloys and pyrotechnology (Ottaway 2001: 100). The complexity of the procedure suggests that metalworking involved various forms of transmission of knowledge, including apprenticeships, as well as cooperation around associated activities such as fuel and mould making.
Distinct from other contemporary techniques, casting copper alloys explored the metal’s ability to change state. This technological innovation can be seen as a creative response to the properties and possibilities of metal after its initial processing. Casting represents a way of increasing control over the shaping of the material and of overcoming some of its mechanical shortcomings. It represents a dramatic change from previous ways of working with copper alloys (and other materials); it is a unique solution distinctly adapted to what copper alloys can and cannot do. In particular, it responds to the metal’s ability to become fluid, which simultaneously causes the need for controlling and containing it, as well as the possibility of shaping it prior to it cooling and becoming hard again. The invention of the mould thus reflects an intimate knowledge of the material in terms of its behaviour. We imagine this knowledge resulted from a dynamic interconnection between practice, problem solving, accumulation of experiences, and imaginative solutions aiming to master a task better in terms of more predictable outcomes.

THE MAKING OF A MOLD

The particular challenge, and through that the innovative developments, that the different kinds of casting technologies reflect was to control the shape in which the metal would cool and through which one could therefore control its final form. The solution to this challenge was found in the development of moulds. They can be made in many different ways and in different materials. During the Bronze Age they were made in clay, stone, or even out of bronze. In terms of casting procedure, it seems that different kinds of moulds were developed from the beginning: one-piece moulds, one-piece moulds with lids, two-piece moulds, and bivalve moulds. As discussed below, it thus seems that the development of control over alloys, whether through deliberate mixing or due to selection of specific naturally occurring ones, very quickly led to innovations regarding how the metal could be shaped, as well as different methods of doing this.

A mould is a container with a cavity into which the melted metal can be poured, and which ensures that the metal after cooling will retain the shape of the cavity. It has been argued that prior to the development of proper moulds, copper alloys were cast in different kinds of hollows. For instance, Ottaway argues that from around 5000 BC, sand hollows were used for simple casting (Ottaway 2001). The introduction of specifically manufactured moulds does, however, introduce much greater control over the shape of the finished objects.

Casting in a mould is distinctly different for one- and two-piece moulds. The one-piece mould involves shaping a negative impression of the object to be made in the mould material. The metal is melted in a crucible and then
poured onto the mould filling the hollowed-out negative shape. After cooling it is broken free and removed from the mould and then subsequently refined or finished through, for example, hot and cold hammering to remove excess metal, and edge-hardening and polishing to produce smooth and shiny surfaces. One-piece moulds were used throughout the Bronze Age, as discussed further below, and were used to cast flat axes, simple pins, awls, and small discs: all objects that are of relatively modest size, with little complexity in terms of shape and surface contours. Such objects do not, for example, have inner cavities (as socketed axes do), or ridges on both sides (as palstaves do), and the one surface will always be flat, which means that elaborate symmetries cannot be produced.

For a two-piece or bivalve mould a similar procedure can be used with the two pieces tied tightly together during the pouring. The moulds may have notches and holes to help them bind better. There were further complex aspects of moulds, such as vents and inlets needed to ensure that the negative form was properly filled as the metal flowed through and solidified, and to ensure that the metal could push out the air. Having manufactured the mould, the two halves would be bound together and probably heated to a relatively high temperature prior to the metal being poured, in order to reduce the risk of thermal shock when the liquid metal was poured into it. This implies that substantial experience of temperature control was needed in order to avoid failures. It was not sufficient that the metal had been melted; the mould also had to be correctly prepared. The use of the two-piece mould represents a distinct technological development in casting methods. The benefit of the technique is obvious and is illustrated in developments in novel complex shapes, in particular from the second millennium BC onwards. It also introduced the potential for using patterns and existing objects in the shaping of the mould. Wooden patterns for making moulds have, for example, been found in Ireland (Hodges 1954). Prototypes and standardisation therefore became influential both in the conceptualisation and production of objects (Flohr Sørensen 2013).

For more complex pieces, however, such as socket axes which have an inner cavity, methods such as *cire-perdue* (the lost-wax method), or other techniques that enabled the suspension of an inner core using tappers developed. This method was also used for complex solid items such as the Trundholm sun chariot or the Scandinavian Late Bronze Age belt boxes. The *cire-perdue* method involves making a wax model of the desired object and forming the clay mould around it. During heating the wax is melted and drained away leaving a hollow impression into which the melted copper alloy is poured (Rønne and Bredsdorff 2011). The technique is documented in the Levant by the mid-fourth millennium BC (Tadmor *et al.* 1995), and in eastern and
central Europe from the Early Bronze Age onwards. It is, for example, argued to have been used in the metalworking workshop at Feudvar, Serbia (Kienlin 2010, 114), and may have been used in the manufacture of some of the Danish Late Neolithic/Early Bronze Age axes with geometric patterns and solid hilt daggers (Rønne 1989; Vandkilde 1996). This technique provided a distinct advantage over other forms of casting in terms of the ability to make complex objects. It may also have afforded greater opportunity for elaborate decoration as patterns were incised into the wax, a much easier procedure than adding it later to the surface of the cast objects. This added a degree of precision and uniformity to metalworking and thus made possible standardisation in design and production (c.f. Rønne 1989: 126). Although the principles behind the cire-perdue method are relatively easy to understand, the preparation and construction of the moulds required a number of complex steps (Davey 2009).

These aspects of bronze production, together with the great social significance of the objects produced, probably influenced Bronze Age epistemology profoundly. The epistemological impact of mould production would, amongst others, arise from new types of abstract thinking, including how objects had to be imagined during production and the outcomes predicted and planned ahead. The two-piece mould is particularly demanding. Firstly, the object is cast out of sight so to speak, as it is formed within the closed mould, and it is only through imagination and experience that one can ‘visualise’ how the object is made. Secondly, the two parts of the mould will each have a negative image of one side of the object and it is only through the casting that the whole object emerges as the two parts are joined. Whereas understanding ceramic technology might have provided a framework for the early development of refractory technology, the two-piece mould method can be interpreted as a development driven by desires about the qualities of the objects produced. Cire-perdue probably developed as a technical solution to the wish to create complex or large objects that could not be cast in a two-piece mould.

THE SEQUENCE TOWARDS MOULDS

Discerning the chronological development that lead to these innovations is challenging. Mould technology of the Early Bronze Age is evidenced by two sources: pieces of moulds and the metal objects themselves. Mould fragments dating from the Early Bronze Age onwards are found across Europe, but compared to the metalwork itself they are underrepresented in the archaeological record (Harding 2000; Ottaway 2001; Ottaway and Roberts 2008). The lack of detailed archaeological evidence for types of moulds and their contexts of use leads to substantial gaps in our ability to reconstruct the history of their
invention. We lack data on both the general progression in mould technology and details about aspects of casting. There is, for example, much discussion of whether decorations were added to the mould before casting or during the post-cast finishing of the objects (e.g. Rønne 1989, 1991). An additional source of evidence is, therefore, analysis of the finished object and metalworking debris which provide some insight into casting methods, albeit moving from the object backwards to how it was produced. In addition, the metal objects are an important source of information about the speed with which mould technology developed across Europe. Insights into the technology have also been validated through experimental casting (e.g. Wang and Ottaway 2004).

**Evidence from Mould Remains**

The moulds themselves provide rather random evidence for casting processes and there is no systematic recording or synthesis of them in the literature. This is partly because moulds, if made of clay, are friable and not easily recognised, and partly because they have not been granted as much significance in discussion of metalworking as the objects themselves (Ottaway 2001; Ottaway and Roberts 2008, 212; Wang and Ottaway 2004). It is therefore difficult to establish a clear account of developments in casting methods based on the moulds themselves. The earliest date for one-piece moulds in Europe is, for instance, still being investigated. So far, moulds for casting axes dating from c. 3600–2800 BC found at Saloš, Donja Vrba, Croatia are among the earliest evidence (Lozuk 1995). The relationship between stone and clay moulds is not clear. The reason for using stone for the production of moulds is primarily that it enables repeated castings using the same mould. Some have therefore suggested that stone moulds were a response to increasing ‘demand’ and also a means of obtaining greater standardisation of production (c.f. Harding 2000; Kuijpers 2008); this would suggest that stone moulds came into use when metalworking was well established. It may, however, also have been the case that the geological environment influenced choice of materials used in the making of moulds, as suggested by the relatively high frequency of stone moulds in Scotland and Sweden. As sand moulds do not leave any discernible physical traces it is not possible to use direct evidence (i.e. the moulds themselves) to place them within a hypothetical chronology of moulds.

**Evidence from Metal Objects**

The evidence from metal objects themselves is very complex. Firstly, early metal objects have not been systematically analysed to ascertain how they
were cast, meaning we lack a detailed chronological framework for the discussion of casting methods. Secondly, cultural development in Europe during the Neolithic and Chalcolithic was geographically very uneven, with some areas having close connections (including technological inspirations) with the Near East and others not. Thirdly, rather than mould technology following a clear evolutionary trajectory from simple to more complex, it seems that regionally there were bursts of innovations which resulted in simultaneous development of different methods of casting.

The copper shaft-hole axes of the Vinča culture of south-east Europe represent some of the earliest evidence of mould casting in Europe, but surprisingly analysis has shown they were cast in a closed-bivalve mould (Kienlin and Pernicka 2009). Flat axes in the fourth millennium BC in the north Alpine region also appear to have been produced in such moulds (Kienlin et al. 2006). Nonetheless, flat axes were not consistently cast in this kind of mould throughout the continent. For example, both in the south Alpine region and in the eastern Alpine and Balkan regions, open moulds appear to have been used contemporaneously to produce similar objects (Pearce 2007); (Lozuk 1995; Mlekuž et al. 2012; Velušček and Greif 1998). This data makes two important points. One is that we see developed mould technology very early; it must have emerged in close connection with experimentation with various copper alloys. The other point is that it shows that casting methods had strong regional characteristics, suggesting that these innovations in metalworking practices were local developments and may reveal different regional preferences. Both of these observations point to creativity within regional communities of practice who were undergoing an accelerated period of the accumulation of experiences as they experimented with a new material. It is also noteworthy that during the fourth millennium BC the objects produced using these techniques were predominantly axes. The continued use of one-piece moulds during the Bronze Age can be inferred from the appearance of simply cast items such as daggers, flat axes, pins, rings, and Ösenhalningen: objects that had become common and are found across Europe during the Únětice and other Early Bronze Age cultures (Butler 2002; Sherratt 1997). During the Late Bronze Age one-piece moulds were used for the production of objects such as sickles.

The making of complex moulds, as well as wax models and clay cones, added further demands and different skills to the process. As they were fabricated from other materials it is not given that they were made by metalworkers. Their most important requirements were, however, how they would react to heat and whether they could facilitate the oxidation of the molten metal. The essential demand on moulds is that they can be heated to the right temperature to allow metal to flow well. It therefore seems likely that the moulds
were produced by people closely associated with metalworking who had the requisite knowledge.

CASTING AND CREATIVITY

These different forms of moulds suggest an initial phase during which new techniques were being tried out and experimented with. The specific concern must have been how to determine the shape and form of the object while the metal was molten and therefore extremely plastic. After the invention of the method of casting copper alloys in simple hollows, we suggest that a significant next step was the development of the two-piece or bivalve mould as this involved a considerable amount of abstract thinking and technical expertise. This development in mould technology was neither a simple linear progression nor a process of replacement or adaptation of previous practices. Earlier metalworking skills and knowledge did not become redundant. In particular, sheet working continued and flourished, and one-piece moulds were not simply replaced by more complex ones. Rather, the two-piece mould and the technique of *cire-perdue* added new techniques and ways of conceptualising metalworking which enabled metalworkers to select different working procedures (including tools) depending on what objects they aimed to produce.

This brief reflection on the development of mould technology has not aimed to provide dates or locations; the small number of early sites, the unsystematically collected data, and the problems of the survivability of the moulds themselves make this unrealistic. Our understanding of the complexity and speed at which metalworking was adopted in different regions is constantly being refined. Nonetheless, it is clear that ‘emergent knowledge of casting’ was established in south-east Europe in the Late Neolithic (Kienlin 2010: 10).

The technology of the mould was a distinct response to the discovery of the ability to melt copper alloy. Experimentation and development of different forms suited to different outcomes characterise the ensuing metalworking practices. During the Bronze Age the implications of these were increased standardisation, new methods of decorating the objects in elaborate ways, and increasingly sophisticated forms, both in terms of size and intricacy. These developments were the results of technical innovations as well as aesthetic and social explorations of new forms and visual effects. Through the development of more moulds a further complexity was introduced into the manufacturing of metal objects, both in terms of its abstract dimensions and in the degree of ‘mechanical reproduction’ that it offered. These must have influenced both production practices and the ways in which metal objects were used to think with.
VARIABILITY IN THE CHAÎNE OPÉRATOIRE: THE CASE OF BELEGIŠ CREMATION VESSELS

Sarah Coxon

Belegiš cremation vessels are a particularly diverse form of pottery. They are stylistically varied, especially when it comes to their decoration. No two vessels are replicated exactly. Despite these differences, detailed analysis of the chaîne opératoire reveals embedded rules of manufacture that speak of a shared ceramic tradition that can be understood in terms of an established pattern of practice (c.f. Ingold and Hallam 2007: 9). Although the production of these urns was dynamic in the sense of allowing variability, makers used traditional methods as a platform for reworking decoration. Belegiš cremation vessels therefore form a useful case study for thinking through the production sequence in terms of where, and how, decisive decisions were made. They also raise important questions about how variation may be expressed within established manufacturing procedures. In particular, given that clear socio-technical rules of manufacture are apparent, Belegiš cremation vessels provoke reflection on the role that creativity may have had in contributing to the diversity present within the assemblage.

The following discussion centres on the manufacturing sequence of cremation vessels of Belegiš type from the site of Surčin in the Serbian Danube basin. The assemblage consists of 75 reconstructed vessels that are united both by geographical location and evidence for continuity in social practice; the site was used as a cemetery from the beginning of the Middle Bronze Age to
the end of the Late Bronze Age (c. 1400–1000 BC) (Tasić 2002). I argue that although one cannot necessarily pinpoint creativity in the sense of distinct novelties within the Surčin assemblage, other forms of creativity are present including divergence and recombination (see Erez and Nouri 2010; Guildford 1965; Runco 2004). Creativity, as the on-going engagement between people and material (Ingold and Hallam 2007), is an advantageous axis from which to discuss how individuals reworked technological tradition and negotiated within predetermined technological and stylistic ideals.

**BELEGIŠ CREMATION VESSELS FROM SURČIN, SERBIA**

The cemetery at Surčin lies 15 km west of Belgrade. Ceramic cremation vessels and cups were recovered from the site in the late nineteenth century but no archaeological excavation subsequently took place. Surčin is one of several contemporary sites in the region, which forms the core of the Belegiš phenomenon (e.g. see Petrović 2006; Todorović 1977; Vranić 2002). Belegiš sites are also found eastwards into Romania, westwards into Croatia, and also northwards, although the full extent of their distribution has yet to be established.

The typology and cultural significance of these vessels was previously studied by Vinski-Gasparini (1973) and included an initial attempt to deal with the diversity of the assemblage. This did not, however, include an extensive study of manufacture. Variation was instead seen to purely reflect chronological developments. The earliest vessels, known as Belegiš Ia–c type (Tasić 2002), are round-bellied vessels with four tunnel handles, cylindrical necks, and everted rims. These are often decorated with incised decoration or cord impressions. Belegiš IIa–b urns are also round-bellied vessels with tunnel handles, but towards the end of Belegiš IIc vessels have a tendency to be more angular in shape and decoration consists primarily of fluting and applied bosses (Figure 2.5). Due to noticeable differences between the earliest and latest Belegiš vessels, it has been suggested that they represent two separate cultural groups (Garašanin 1973, 1983a). The continuity demonstrated in the stratigraphy of the Belegiš settlement site of Gomolava, in north-east Serbia, however, seems to argue against this (Tasić 2004). Belegiš I and II are now commonly agreed to represent a chronological sequence within the same cultural group.

Study of the Belegiš *chaîne opératoire* enables us to go beyond descriptions of stylistic variation to examine the technological decisions that underpin material difference. Through analysis of the production sequence of each vessel, including the preparation of clay, vessel-forming methods, decoration, surface finish, and firing, methods of manufacture were identified and explored. This
reveals that some areas of the chaîne opératoire demonstrate more variation than others.

The preparation of clay attests to the underlying importance of, and adherence to, technological tradition for these vessels. The clay types and temper used for all of the vessels were relatively standardised. All of the vessels were made from well-prepared clay that was tempered with grog. An advantage of using temper such as grog is that it strengthens the clay. This aids in the formation of the vessel and additionally improves its thermodynamics, decreasing the possibility of a vessel exploding during firing (Gibson 2002; Rice 1987; Schiffer and Skibo 1997). Variations on this method of clay preparation were used for Belegiš vessels over the span of 400 years, such technical knowledge being passed down from generation to generation. The fabric of the vessels examined can be classified into four grog-based fabric types (Figure 2.6). The most frequent fabric used for Belegiš I vessels was Gr1, whereas during the late phase of Belegiš II fabric Gr3 was the most used. The latter, a coarser and stronger clay recipe coincides with the crafting of larger, thicker-walled vessels. Although only small changes to the recipe for fabrics were made, this slight shift may indicate problem-solving processes inherent in the decision to use the quantity of temper that gave additional strength in the formation of larger vessels.

Analysis of formation techniques revealed that all of the vessels were slab-built, a technique that joins rolled out smooth and even slabs of clay together. Similar methods of manufacture have been noted in Bronze Age Hungary (Kreiter 2007). Belegiš I vessels have tripartite morphologies and were made out of three separately constructed pieces, whereas the latest Belegiš II urns
(Belegiš IIc) display bipartite formations (Figure 2.5). Variation did not therefore occur in the use of the overall manufacturing technique but in the implementation of it. Slab-building formed the foundation for the manufacture of tripartite and bipartite formations and the changes in formation techniques that took place over the span of 400 years were minimal.

Although vessel-building methods remained relatively unchanged, variation in shape over time with the move from tripartite to bipartite vessels also extended to other aspects of vessel geometry. The most noticeable contrast in vessel shape is between the earliest Belegiš I and latest Belegiš II vessels; the early vessels tend to have cylindrical necks, well-defined neck to shoulder distinctions, and rounded bellies (Figure 2.5). Later urns, particularly Belegiš IIc, are more angular, suggesting a change in technical gestures that became integral to potting tradition during the later phase. Despite this shift, the placement of handles at quarter points around the vessel remained the same. Earlier Belegiš potting practice was used as a platform from which to develop new shapes that creatively combined existing practices.

A transformation of decorative technique occurred alongside the crafting of more angular Belegiš II vessels. Decoration was clearly an integral part of the production sequence. Those crafting Belegiš I urns favoured two-dimensional

Figure 2.6 The prevalence of fabric groups for Belegiš vessels at Surčin.
decoration, whereas Belegiš II vessels demonstrate the use of three-dimensional ornamentation. Two-dimensional decoration synonymous with early Belegiš urns shows subtle variation within the following key categories of decorative choice: the spatial layout of the decoration, the type of motif or decorative unit articulated, its configuration, and the technique used to apply it. Yet decoration was also executed within a set of rules. As an example, specific zones of the vessel (Figure 2.7a and b) were always decorated with particular motifs;

Figure 2.7 Layout of decoration on Belegiš vessels. a) Decorative zones; b) Examples of Belegiš decoration; c) Variations on the stem motif.
the stem motif shown in Figure 2.7c is only ever executed directly above each of the four handles. Likewise, horizontal bands are only ever placed on the vessel neck.

The range of motifs used was small. Variation occurs instead in how a motif was configured. In the case of the stem motif in Figure 2.7c, diversity presents itself in the total number of stems articulated, the addition of a horizontal stem, the addition of an arch, the curvature of the outer stems of the decorative unit, and whether or not this curved edge is at the bottom or top of the motif. It appears that this variation or divergence was intentional; the exact same configurations are replicated above or in-between each of the vessel’s four handles.

Variation also occurs in the techniques used to create these two-dimensional motifs on a vessel surface. Techniques range from impressions of lime-bast cord bundles (Grömer, Mihelić, Sofaer, and Coxon this volume), to the use of combs to produce incised lines. The number of strands of cord used ranges from two to four and the decoration is usually well executed. Cord-impressed vessels were produced earlier than the vessels with incised lines; the latter take precedence in the later part of Belegiš Ib. Interestingly, the incised decoration tends not to be very well-administered. It is ‘scratchy’ and rough from being applied when the clay had become too hard. This may represent a deterioration in decorative skill at this time or that neatness was no longer an aesthetic requirement.

Phase Belegiš Ic sees a complete shift in decorative preferences. As incised motifs give way and vertical facets appear, new procedures and tools were used. Although the type of decoration changes, the underlying conceptual rules of where to place decoration had longevity and the faceted decoration was placed above each of the vessel’s four handles in a similar fashion to decoration dating to Belegiš Ib. This continuity suggests a dynamic, developing tradition with some consistency in potting practice. Accompanying this was a shift of emphasis from two-dimensional to three-dimensional decoration that continued into Belegiš II.

Towards the end of Belegiš II (Belegiš IIc), vessel decoration becomes even more standardised, consisting of left to right diagonal fluting. This was well executed and coincided with a standardisation of vessel formation and shape. Conformity therefore presents itself not just in terms of the underlying rules of manufacture evident during the making of Belegiš I vessels, but as a standardised aesthetic preference during the crafting of Belegiš II vessels expressed through noticeably less variation in shape and decoration. Production of later Belegiš urns therefore represents a less fluid and more rigid tradition of practice than that exhibited by Belegiš I vessels.
Accompanying this preference for fluted vessels, the finish and firing of urns also shifted, again becoming a more standardised practice. Belegiš I vessels were low-fired in oxidised conditions meaning that the surface of the vessels were brown. Their consistently reduced core suggests uniform firing practices, and the vessels were lightly burnished. In Belegiš II the exterior of vessels were encased during firing to limit the supply of oxygen to the outside of the vessel creating a distinctive black surface.

For the urns from Surčin, the fluidity of potting tradition thus changed from the Middle to Late Bronze Age. During the production of Belegiš IIc vessels, uniformity in the chaîne opératoire reveals that standardisation played a more central role in the crafting of the cremation vessels. In particular, although many elements of production demonstrate continuity from early Belegiš manufacture (such as the preparation of clay and the placement of handles), vessel decoration and finish became more standardised. Emphasis was also placed on three-dimensional forms of decoration. Adopting and maintaining a standardised method of practice both requires skill and embodies a series of conscious decisions. Makers were thinking about their craft in different ways. One might argue that within the potting community there were clear ideas regarding how a vessel should look and a specific way in which to make it. New ceramic practices were quickly accepted and adopted by those making the vessels. These changes in ceramic practice, particularly those linked to pyrotechnology, were contemporary with similar tendencies elsewhere, including further north in Hungary (Coxon 2010). Throughout central Europe, pottery takes on a far more uniform feel, albeit with regional and local differences.

THE CHAÎNE OPÉRATOIRE AND THE ROLE OF CREATIVITY

In the case of the Belegiš cremation urns from Surčin, although there is diversity within the assemblage, the chaîne opératoire reveals that production of these vessels was highly rule-bound, particularly towards the end of the use of the site. It nonetheless reflects the dynamic nature of a particular ceramic tradition in terms of craft practice. This is particularly apparent in the decorative stage of the production sequence. The uniqueness of each vessel, present in subtle elaborations, displays potters’ capacities to creatively reassemble existing decorative concepts in new ways, while still adhering to a decorative tradition during the making of each individual pot. It seems that individual potters were simultaneously adding to, and taking from, a pool of potting knowledge. The result is a potting tradition that was malleable; the development of tradition was itself a creative process. The synchronic and diachronic differences between
vessels reflect the on-going engagement between potters, their tradition, and the materials they were working with.

A focus on creativity provides a means of exploring the underpinnings of how the chaîne opératoire shifts and mutates. Interpreting production practices through this lens places the responsibility for material continuity and change with the makers of the vessels rather than in an abstract typological domain. Within the Surćin assemblage, individuals engaged in vessel production did not passively transmit craft traditions but intentionally maintained or changed them. The timing of such changes was dependent on the social milieu of production; where and how such processes emerged in the Belegiş production sequence changed over time. Such observations raise new questions about the conditions for creativity that go beyond its description. They ask us to consider the nature of societies that either welcome change or, conversely, are more concerned with adhering to rules than pushing the boundaries of their craft.
THE PRODUCTION OF SCANDINAVIAN BRONZE AGE TEXTILES: SKILL AND CREATIVITY

Solvi Helene Fossøy

It has been claimed that Scandinavian Bronze Age textiles are essentially uniform and that they are not particularly advanced in their execution (Randsborg 2011: 23, 29). A close investigation of the variation in the workmanship has not, however, been conducted until recently. This essay investigates creativity through the visible variation in Scandinavian Bronze Age textiles, both in and outside more standardised cultural types. The relative abundance of Scandinavian textile material provides the opportunity to gain detailed insights into textile production, as well as into the strategies used to transmit knowledge of the craft.

THE TRANSMISSION OF CRAFT KNOWLEDGE

Anthropological studies have shown that the customs dictating the extent of variation permitted in craft production are closely linked to the strategies used to transmit craft knowledge to a new generation. Craft knowledge consists of two parts: knowledge transmitted from a master to the apprentice, and self-experienced knowledge acquired through practice (Godal 1996: 12; Rolf 1995: 21). Transmitted knowledge builds a cultural tradition that also comes with cultural norms and rules (Godal 1994: 9; Sjömar 2011: 84) that, for
example, can dictate how a material is made and used. A craftsperson cannot stand separate from his or her cultural tradition (Molander 1996: 15). Cultural norms and rules, therefore, necessarily control the craftsperson’s room for variation, and in turn affect and perhaps restrict creativity. Different apprenticeship strategies used in transmitting craft knowledge also affect these relationships (Greenfield 2000; Greenfield et al. 2003; Wallaert-Pêtre 2001; Wallaert 2012). Through studies of textile production and potters respectively, Patricia Greenfield and Hélène Wallaert-Pêtre have shown how different learning processes influence material culture in different ways. Two of the elements that seem to particularly affect the extent of variation and innovation are the level of supervision in teaching, and how much of the chaîne opératoire the student is presented with from the beginning. Craft taught with strict supervision is shown in these anthropological studies to result in reproduction of already existing types and has been labelled as the ‘culture conservative teaching method’ (Greenfield et al. 2003: 456). The apprentice is presented with the aspects of the craft in different stages and the apprentice’s work is largely organised around imitating the work of the teacher. The high level of supervision prevents the apprentice from doing any experimentation and pursuing any other creative practice. The culture conservative teaching method creates a strong tradition. Material culture continues to be produced nearly unchanged, and is centred on deeply rooted, socially accepted, cultural types (Greenfield et al. 2003: 456; Wallaert-Pêtre 2001: 485).

A radically different learning process is one based on trial and error with little supervision. This way of transmitting knowledge is more innovation-friendly and produces a very different pattern in material culture. The whole chaîne opératoire is presented to the apprentice at once, not in different stages. This more independent learning strategy results in a higher frequency of error in the apprentice’s output, but it also makes room for experimentation and innovation. The result is a learning process that produces a material culture with variation in types and little continuity (Greenfield 2000: 73–5; Greenfield et al. 2003). Craftspeople taught in this way are more willing to try new techniques and types. They perform the craft for themselves, not only to fulfil cultural expectations. Compared to the culture conservative method, this trial and error way of learning seems to motivate a craftsperson to achieve greater skill (Wallaert-Pêtre 2001: 471–91).

These trends concerning transmission of craft knowledge can also be applied to archaeological materials. The craft traditions behind objects can be anticipated as being closely linked to socially accepted expressions of creativity. Through tracking the room for variation, as well as continuity in textiles, it is possible to approach the question of how textile production knowledge was transmitted in the Scandinavian Bronze Age.
SCANDINAVIAN BRONZE AGE TEXTILES

The south Scandinavian Early Bronze Age custom of oak-log coffin burials has resulted in the preservation of an unusually large quantity of textiles (Bender Jørgensen 1986: 185–94). Best known are the whole garments from seven fully preserved oak-log coffins, four male and three female burials, dated to Montelius Periods II and III (Broholm and Hald 1940). In addition, a large collection of more fragmented textiles are also preserved, which have been studied by Lise Bender Jørgensen (1986), Inga Hägg (1995), and Solveig Ehlers (1998). This offers the opportunity to centre on this chronologically tight period in terms of the investigation of creativity in textile production.

The complete garments from the preserved oak-log coffins were examined by H.C. Broholm and Margrethe Hald. They sorted the Bronze Age textiles into two groups. The first is composed of larger tabby woven, utilitarian fabrics with single-threaded, coarse yarn made of wool that are used in the construction of all the known larger Bronze Age garments, except for the corded skirt. They form about 70% of Bronze Age textile material. The second group, approximately 30%, are smaller textiles such as braided works, sprang, tablet weaving and repp (Broholm and Hald 1940: 137–44). The latter show greater more obvious technical variation in using different textile techniques. This division between textile groups is also seen in the more fragmented textile material (Fossøy 2012). The two groups are here designated ‘generalised textiles’ and ‘specialised textiles’.

While it is nearly impossible to identify the initial function of fragmented generalised textiles due to their varied use, some of the specialised textiles can be identified as sashes, corded skirts, and hairnets (Fossøy 2012: 21, 35).

The generalised Scandinavian Bronze Age textiles, in particular, initially appear technically and visually uniform, dominated by brown, coarse tabby weaves (Broholm and Hald 1940). To find any creativity and variation can therefore be difficult. In such an apparently similar textile material creativity can, nonetheless, be explored through a series of variables (Figure 2.8). These include warp and weft twist-directions, twist angle and thread thickness, in addition to the weaving techniques used and the visual appearance of textiles. Yarn diameter is the measure of the thickness of the thread and the twist angle gives the angle of the fibres compared against the thread direction. A yarn can be twisted in either one of two directions, named s-twist or z-twist. In a weave the warp is named before the weft, making the textile s/s, s/z or z/z. Single-threaded yarn can be doubled and made into a two-ply yarn, Z2s or S2z (Bender Jørgensen 1986: 13; Hoffmann 1991: 126). Differences and similarities in yarn influence the properties of the textile (Bender Jørgensen 1986: 13). Bender Jørgensen (1986) identified a shift in the Bronze Age textiles from mostly s/z-spun in Period II to dominantly s/s-spun in Period III. This variation is linked
to the formation of craft knowledge at any one time (Wallaert-Pêtre 2001: 484–90; Greenfield 2000). The data reported in this essay arise from new analyses of 101 Danish, Norwegian, and Swedish Bronze Age textiles conducted using a digital microscope through which a textile’s final technical assessment is the mean of 10–20 measurements (Fossoy 2012). Clear differences were identified between generalised and specialised textiles, as well as within these two groups.

**Generalised Textiles**

Generalised textiles share the same homogeneous visual appearance and give the same simple impression throughout northern Europe from Schleswig-Holstein to the south–west coast of Norway, from Montelius Period II through to Montelius Period V (see also Fossoy 2012: 21–5). Nonetheless, yarn diameters in Periods II and III reveal subtle differences between the periods (Figure 2.9).
Figure 2.9 Yarn diameter in generalised textiles dated to: a) Period II and b) Period III.
Yarn diameters in Period II range from 0.7 mm to 2 mm with a mean of 1.27 mm, while in Period III the measurements range from 0.7 mm to 3.4 mm with a mean of 1.37 mm. This shows that in Period III yarns with thicker diameters were more prevalent. Such a pattern cannot, however, be seen in the twist angle. Using Irene Emery’s (1966) categories for spin angle, adjusted by Karina Grömer (2007) to suit Bronze Age textiles, 92% of the yarn fits in the category ‘medium spun’, and no clear differences can be seen between the periods. The variation in yarn diameter, especially in Period II, has little bearing on the immediate visual appearance of the generalised textiles due to their coarseness. Only when compared directly will one piece appear a bit finer or coarser than another. A tendency in the data seems to be that warp and weft have the same thread thickness, while the twist angle shows little relation to these and therefore varies more (Fossøy 2012: 22–8).

The material published by Fossøy (2012) is largely the same as that previously analysed by Lise Bender Jørgensen (1986) which showed the change in twist direction between Period II and Period III. With new methods of analysis, and with some new material, the quantity of s/s-textiles in Period III is not, however, as dominant as previously thought (Bender Jørgensen 1986: 16–17). In Period II, 87.5% of the generalised textiles have s-twisted warp and z-twisted weft (s/z), but the variation is wider in Period III, when 51% of the fabrics are s/z, 7.5% z/z, and 30% s/s. The remaining 9.4% are textiles with spin pattern, which refers to production where yarn with different twist directions is used in the same thread system (Fossoy 2012: 65–7) (Table 2.1). This variation seems to reflect a change from having strict rules on how the warp and weft threads should be twisted, to having more freedom and therefore variation. The trend to spin-patterned textiles underlines the lack of importance of twist direction in Period III.

No specific item of clothing can be linked to these variations in spin direction, neither in the fragmented textile material nor in the fully preserved

<table>
<thead>
<tr>
<th>Twist direction</th>
<th>Period II</th>
<th>Percent</th>
<th>Period III</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>s/z</td>
<td>42</td>
<td>87.5%</td>
<td>27</td>
<td>50.9%</td>
</tr>
<tr>
<td>s/s</td>
<td>4</td>
<td>8.3%</td>
<td>16</td>
<td>30.1%</td>
</tr>
<tr>
<td>z/z</td>
<td>1</td>
<td>2.1%</td>
<td>4</td>
<td>7.5%</td>
</tr>
<tr>
<td>Spin pattern</td>
<td>0</td>
<td>0.0%</td>
<td>5</td>
<td>9.4%</td>
</tr>
<tr>
<td>Unknown</td>
<td>1</td>
<td>2.1%</td>
<td>1</td>
<td>1.9%</td>
</tr>
<tr>
<td>Total</td>
<td>48</td>
<td>100%</td>
<td>53</td>
<td>100%</td>
</tr>
</tbody>
</table>

TABLE 2.1 Changes in combinations of twist directions in the generalised textiles

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The different combinations are not linked to geographical areas either, as all contexts with two or more generalised textiles show varying twist directions (Fossoy 2012: 24–5, 66–7). Both the yarn and the textile itself were probably produced without having a specific garment or piece of clothing in mind. The generalised textiles were multifunctional and not gender specific (Sørensen 2013; Fossoy 2012).

Three of the generalised textiles have a more creative aspect as the colour of the yarn used in the warp and weft is different, with one thread system made from clearly lighter fibres than the other (Figure 2.10). One example is dated to Period II, and two to Period III. The colour is still visible today and must have been noticeable and part of a conscious choice in craft production (Fossoy 2012: 31–2). The three textiles indicate that colour was a source of variation that could be used in the generalised textiles. It has long been known that colour was used in some specialised textiles for decoration, such as the brown sash with a white line in the middle found with the woman buried in Borum Eshøj grave C dated to Period II (Broholm and Hald 1940: 73–7). The use of wool of different colours was a known way of creating aesthetic...
variation in the Scandinavian Bronze Age, both in generalised and specialised textiles.

**Specialised Textiles**

The specialised textiles contrast with the generalised textiles with regard to some of the variables. Although the measurements of twist angles do not differ from those of generalised textiles, the thread thickness of specialised textiles varies considerably more and does not show a normal distribution (Fossøy 2012: 35–6). This variation indicates that the yarn was spun specifically for a certain textile with its desired properties (Table 2.2).

Visually, the specialised textiles provide an impression of being of higher quality than the generalised textiles. Generalised textiles have coarse yarns and a simple weaving technique that only demands basic craft knowledge, whereas specialised textiles appear to be made of very fine and even-looking yarn. The specialised textiles also display several more advanced techniques such as half-basket weave, and sprang. This may imply that there were different expectations of workmanship and quality for the two textile groups. A closer study of thread evenness, looking at the standard deviation of the yarn diameter, strengthens this impression. Measurements of yarn diameter on seven generalised and seven specialised textiles show a clear tendency for the latter to be made from a more even yarn (Fossøy 2012: 55–64).

Technical variation can be observed between specialised textiles made for different purposes but also between specialised textiles intended for the same function (Fossøy 2012: 73). Corded skirts, being the largest known garment not made of generalised textile, are a good example. Analysis of fragments of eight possible corded skirts (being the cords, the end-loops, or the starting border), supplemented by published records of the preserved corded skirt from Egtved, Denmark (Broholm and Hald 1940: 78–87) shows that they were constructed in two different ways. In one type the cords are constructed from the warp and in the other from the weft. The starting border of the skirts with warp-twisted cords has weft threads crossing 6–8 threads at a time, unlike a tabby where they only cross one thread at a time (Figure 2.11). This produces quite a different, more ribbed appearance than the skirts with weft-twisted cords, where the starting border is half-basket woven. Further variation is obtained by use of different thread thickness, and single or two- ply yarn. Some skirts were even decorated with bronze tubes fixed around the cords in different patterns. This gives the top border of the corded skirts several different forms of visual appearance (Fossøy and Bergerbrant 2013). Due to the detailed variation and
Table 2.2  Yarn diameter standard deviation as a measure of the yarn’s evenness

<table>
<thead>
<tr>
<th>Generalised textile</th>
<th>Montelius Period</th>
<th>Yarn diameter</th>
<th>Standard deviation</th>
<th>Specilised textiles</th>
<th>Montelius Period</th>
<th>Yarn diameter</th>
<th>Standard deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hagendrup b</td>
<td>PII</td>
<td>1.2 mm</td>
<td>0.25 mm</td>
<td>Hagendrup a I</td>
<td>PII</td>
<td>1.1 mm</td>
<td>0.13 mm</td>
</tr>
<tr>
<td>DK 086</td>
<td>PIII</td>
<td>1.4 mm</td>
<td>0.23 mm</td>
<td>Hagendrup a II</td>
<td>PII</td>
<td>0.8 mm</td>
<td>0.10 mm</td>
</tr>
<tr>
<td>DK 202a</td>
<td>PIII</td>
<td>1.6 mm</td>
<td>0.23 mm</td>
<td>DK 142</td>
<td>PIII</td>
<td>0.4 mm</td>
<td>0.04 mm</td>
</tr>
<tr>
<td>DK 033</td>
<td>PII</td>
<td>1.2 mm</td>
<td>0.25 mm</td>
<td>DK 145b</td>
<td>PIII</td>
<td>0.2 mm</td>
<td>0.04 mm</td>
</tr>
<tr>
<td>DK 128</td>
<td>PI – III</td>
<td>1.9 mm</td>
<td>0.48 mm</td>
<td>DK 145a</td>
<td>PI – III</td>
<td>1.0 mm</td>
<td>0.12 mm</td>
</tr>
<tr>
<td>DK 075b</td>
<td>PII</td>
<td>1.5 mm</td>
<td>0.29 mm</td>
<td>DK 082a II</td>
<td>PIII</td>
<td>1.1 mm</td>
<td>0.14 mm</td>
</tr>
<tr>
<td>DK 202b</td>
<td>PIII</td>
<td>3.3 mm</td>
<td>0.62 mm</td>
<td>DK 141</td>
<td>PI – III</td>
<td>1.0 mm</td>
<td>0.13 mm</td>
</tr>
</tbody>
</table>
small sample it is unfortunately not possible to investigate whether there are changes from Period II to Period III in the specialised textiles.

An interesting aspect of the specialised textiles is, however, the distribution between male and female burials. Among the graves with complete costumes, the four male burials have one to two specialised textiles each, whereas the three female burials contain two, three, and four specialised textiles respectively. Not only does the female burial costume contain more specialised textiles, but the types of specialised textiles are also more varied. The types of specialised textiles seen in the four male graves are piled caps and sashes. Within the female burials a corded skirt, different hairnets, and a braided cap were found, with each burial also having a sash. In the context of this discussion, the blouse of the Skrydstrup woman is also relevant as it is embroidered around the neckline and at the shoulders. Embroidery of this quality cannot be seen in the male costume (Broholm and Hald 1940). The specialised textiles belonging to the female costume are therefore much more diverse than those belonging to men. In addition, the same items are often made in different techniques, implying that there was more room for creativity both in the making of the textiles and in the composition of the costume. For example, the Skrydstrup woman has both a hairnet made of horsehair and a woollen braided cap (Broholm and Hald 1940: 99). This is very different from the generalised textiles which are used by both sexes, albeit as different items of clothing.
ROOM FOR VARIATION AND TRANSMISSION OF CRAFT KNOWLEDGE

Differences in the variables between generalised textiles and specialised textiles suggest how much freedom people had in textile production. Overall, the generalised textiles primarily display traits of a standardised production and type, remaining constant for a millennium throughout northern Europe. They had relatively little room for creativity, the only real exception being the three textiles with thread systems of different colours. To remain constant for such a long time this limited variation must have been maintained through a strong tradition controlling the reproduction of existing types. As discussed above, different apprenticeship strategies are essential for how crafts develop through time. The characteristics of the generalised textile would indicate a culture conservative way of teaching this aspect of textile production during the Scandinavian Bronze Age, with a strict transmission of craft knowledge, similar to the mode of knowledge transmission discussed by Patricia Greenfield (Greenfield 2000; Greenfield et al. 2003). The change in twist direction in Period III may be due to a decrease in the strictness of the teaching strategy, not demanding warp yarns always to be s-twisted and weft yarns to be z-twisted. Having no cultural norm connected to twist direction might have opened up an opportunity for free selection of twist direction, making it the craftsperson’s own choice and preference (but see Bender Jørgensen’s essay in this volume for a different explanation). Similarly, the small change in thread thickness that appears at the same time might derive from a change to a less stringent approach to learning the craft (Fossoy 2012: 71–5).

The specialised textiles were made for different uses, and the techniques applied seem to be chosen for an exact purpose, resulting in a diversity of techniques being represented within this group. There is also variation in shape and technique amongst textiles with the same function, such as sashes and corded skirts. This implies that the craftsperson had some personal freedom in the choice of yarn and technique. With room for variation in aspects that had great visual impact, the specialised textiles are much more open to creativity than the generalised textiles. As noted, it is not possible to examine changes in the specialised textiles through time, but the technical variation suggests a more independent strategy of learning.

Based on the quantity and size of the textile items deposited in oak-log coffin burials, more people must have been needed for spinning and weaving yarns of the generalised textiles than for specialised textiles. The weaving of the blanket in the Egtved grave would demand about 3.3 km of yarn. In comparison, only c. 100 m of yarn would have been needed for the sash from Borum Eshøj grave B (Fossoy 2012: 75–6). Keeping the production of
generalised textiles simple, uniform, and made only from rough yarn could have facilitated the demand for sufficiently skilled labour in textile production. That way the majority of textiles could have been made according to simple, well-established standards, by people with just basic skills in spinning as well as in weaving. This standardisation would allow almost any yarn to be used for any textile and the resulting fabric could be used for virtually all kinds of garments. The contribution of several people in the production of the generalised textile would probably also prevent them from contributing a ‘personal touch’, as could have resulted if the textiles were the product of a single craftsperson.

A skilled craftsperson can be known by his or her ability to react to deviations and introduce solutions outside the rules of the craft (Ingold and Hallam 2007: 12), but the basic techniques and strong tradition in the generalised textiles meant that there was little need for creative solutions. The higher degree of quality and specialisation in specialised textiles suggests that this was the work of skilled craftspeople. This applies both to the yarns and to the use of more complex techniques. The limited amount of yarn needed to make specialised textiles given their small size, indicate that they could be made by a single craftsperson. The craftsperson would then spin yarn of the exact quality needed for the desired textile.

The results reported here could indicate that the size of production was closely linked to the chosen strategy of transmitting the craft. We may thus envisage that a culture conservative, basic teaching method existed in spinning and weaving and that a large number of people learned the necessary skills in order to make the standardised, generalised textiles. The need for a teaching strategy that kept the textile standardised would have limited the room for creativity. Only a few received further training in making specialised textiles. They were taught within a learning strategy that demanded higher quality results, but allowed for more personal freedom and creativity.
Spindle spinning is a skill that takes time to learn. According to ethnographic studies, children start at the age of five or six (Bender Jørgensen 2013a: 129; Chantreaux 1941–42; Crowfoot 1931). Once learnt, it becomes second nature, a simple, subconscious movement, and can be carried out almost anywhere – standing, sitting, walking, while gossiping with the neighbours, or waiting for your turn at the well. As discussed by Lise Bender Jørgensen in the introduction to this part of the volume, and in the essay by Sophie Bergerbrant, spinning tools are simple, usually a spindle and, perhaps, a distaff. The latter is used to keep the prepared fibres in order and ready for use.

As described in the essay by Sølvi Helene Fossøy, yarn may be twisted in two alternate directions, clockwise or counter-clockwise; the letter z serves as a technical designation for the former, s for the latter. In Montelius Period II of the Nordic Bronze Age (c. 1500–1300 BC), most textiles found in the oak-log coffins of Scandinavia were made from s-twisted warp yarns and z-twisted weft yarns. This changed over time. By Montelius Period III, c. 1300–1100 BC, a significant proportion (30%) of the Scandinavian textiles were made solely from s-twisted yarns. This development continued in the Nordic Late Bronze Age, Montelius Periods IV to VI (1100–500 BC) (Bender Jørgensen 1986: 16, 290; Ehlers 1998: 144–7; Fossøy 2012: 65–7). It was no sudden change. A few textiles dated to Montelius I (1700–1500 BC) and II (1500–1300 BC)
PRODUCTION PRACTICES

have s-twisted yarns in warp as well as weft. The earliest of these are always from male burials; later they also appear in female burials, first in Jutland and Schleswig-Holstein. By the Pre-Roman Iron Age, s-twisted yarns had become the norm, and remained so until the second century AD when the dominant twist direction was reversed to z. About the same time as this happened, another change seems to have occurred. In finds dated after c. 200 AD spindle whorls are common. They are virtually absent from the archaeological record of Scandinavia throughout the Bronze Age and the Early Iron Age (Bender Jørgensen 1986, 1984). Why did these changes happen? Were they creative responses linked to technological changes or changes in the raw materials, or should we look elsewhere for reasons? In the essay by Fossøy, changes in the transmission of craft knowledge are suggested, but other options are possible. In order to answer these questions, it is useful to take a look at twisted items in some entirely different materials: bronze and gold.

TWISTED BRONZE AND GOLD

The fibula is a novel item in the Bronze Age in southern Scandinavia appearing from Montelius Period II. Its design is basically a metal version of a pin with a thread attached to it, in order to hold it in place when worn and prevent it from sliding out. The bow of the fibula looks twisted, as if it were imitating a thread. Some arm- and neck-rings appear twisted too, like golden cords or threads, whereas another group of arm-, finger-, ear-, or hair-rings are shaped as spirals; these are three-dimensional forms that would have appeared as twisted around a part of the wearer’s body (Figure 2.12). An examination of these ‘twisted’ artefacts shows that fibula bows are almost always twisted s, regardless where they were found, or if from a male or female grave (Aner and Kersten 1973–2011). Twisted neck-rings are mainly found in female graves. They tend to be s-twisted, but in Montelius Period III about a third are twisted z. Arm-rings are also mainly twisted s, but here a certain gender division occurs: women had mostly bronze rings, men gold rings. Spiral-shaped rings show a similar pattern of male preference for gold, but women in Jutland and Schleswig-Holstein had also access to gold spiral rings, while their sisters on the Danish Isles wore heavy spiral arm-rings of bronze. Regardless of the metal or gender, z-twisted spiral rings are more common than s-twisted ones. When found in pairs, bronze spiral rings are mostly twisted the same way, while gold spiral rings often display different twist directions.

This shows that in metal artefacts shaped like, and possibly inspired by, cords or threads, the twist direction was primarily s. The items made to look twisted z are sufficiently rare that we may consider them either as accidental or imbued
with special meaning. When it comes to spirals, the picture is less clear. Here, gender differences, regional variations, and the choice of metal – bronze or gold – all seem to have played a role. This suggests that spirals (metal twisted around parts of the body), were perceived differently to metal shaped to look twisted.

TEXTILE TWISTS

Let us go back to the twist of yarns in Early Nordic Bronze Age textiles from the same regions as the twisted metals, in other words the Danish Isles, Jutland, and Schleswig-Holstein. When split into regions and genders, the chronological change towards fabrics made solely of s-twisted yarns appears most marked on the Danish Isles, where this hardly appeared in Montelius II. While textiles made only of s-twisted yarn appear in male graves throughout the Bronze Age and later in female ones, the new ‘trend’ turns up earlier in female burials in Jutland and Schleswig-Holstein than on the Danish Isles.
Now let us take a look at warp and weft, the two yarn systems that form the basic structure of any woven fabric. The warp is the set of yarns that runs lengthwise in the loom. The weft is inserted transversely into the warp in order to create a web. The warp is held in tension, by loom weights if the loom is of the warp-weighted type, and between adjustable beams in other looms (see for example Ciszuk and Hammarlund 2008). Warp yarns need to be sufficiently strong to sustain tension, abrasion, and friction caused by the changing of sheds and insertion of weft. Weft yarn does not need to be particularly strong, and warp and weft yarns are often made in different ways. They are also often perceived differently. For example, among the Berbers in North Africa the warp is considered male, the weft female (Messick 1987: 212–13). Similar notions were held in ancient Greece where the crossing of the masculine warp and the feminine weft was perceived as a marriage, and a textile as ‘being’ marriage (Scheid and Svenbro 1996: 29, 68). Perceptions like these could explain why Scandinavian Bronze Age textile makers preferred one twist for warp yarns, another for the weft. If so, it does not, however, explain why some textiles had only one twist of yarn, except if such fabrics signified wholly male or wholly female, or being unmarried. There are, however, further possible explanations.

In many cultures, the act of spinning is steeped in notions of belief and is linked to cosmology. In Slavonic folk traditions, the spindle is perceived as the axis of the world (Lysenko and Komarova 1992: 7, 12f). The Berbers of North Africa consider the spindle and especially the distaff to have magical powers: it cannot be lent to women from another house (Makilam 2007: 85). In most societies one direction of twist is the norm and is perceived as correct. The other direction is considered wrong, in some cases even seen as evil (Bender Jørgensen 2013a).

SUNWISE AND WITHERSHINS

Today we talk of direction in terms of ‘clockwise’ and ‘anti-clockwise’. Before the time of clocks words like ‘sunwise’, ‘sunwards’, ‘deiseal’ in Irish, or in the Shetlands ‘sungaets’, were used of the direction we call clockwise, and ‘withershins’, ‘widdershins’, ‘wrang-gaites’, or ‘tuaitheal’ of anti-clockwise. All these words hold strong notions regarding the right or wrong way to move. Traditionally Russian peasants thought that access to the underworld could be obtained by moving against the sun, and that wizards could be identified by the way they moved around a table, a house, or a herd (Lysenko and Komarova 1992, 12). According to the Concise Oxford Dictionary of English Etymology the word ‘withershins’ means ‘the wrong way’. In traditional European folklore it was considered unlucky to move withershins around a church, and
the word conveys associations of witches and witchcraft (Dovell-Dennis 2011; Lynn Linton 1861: 83; Mitchell 2009). Could similar notions of sunwise and withershins be embedded in Bronze Age twist directions?

In his studies of Bronze Age religion, Flemming Kaul has shown that depictions of ships on razors illustrate the movements of the sun, sailing to the right during the day and to the left during the night (Kaul 1998, 2004a, and this volume). He further perceives the wheel-cross as a symbolic expression of the sun’s cyclic movement, and argues that the Chariot of the Sun from Trundholm, Denmark, and the wheeled cauldrons from Skallerup in Denmark and Bujoru in Romania are representations of what he calls the myth of the ‘eternal cycle of the sun’ (Kaul 2004a: 252–3, and this volume).

If we translate Kaul’s idea of the movement of the sun as the key to Bronze Age cosmology into the twisting of yarn and bronzes we encounter an immediate problem. As we have seen, the most important twist direction is s, in textiles as well as twisted bronzes. Moreover, this preference is emphasised by the development towards textiles made solely of s-twisted yarns. As s-twist is also described as anti-clockwise (i.e. withershins), this would suggest that yarns and bronzes were twisted against the direction of the sun. This problem may however be solved by looking closer into how yarn is made.

The notion of s-twisted yarn as anti-clockwise and z-twisted yarn as clockwise or sunwise rests on the assumption that the spindle is held vertically. If it is held horizontally, and turned forwards, the resulting yarn will be s-twisted, and would appear to have been twisted sunwise (Figure 2.13). Twisting z requires a backwards movement that may have been perceived as withershins. Another option is that the spindle is held upwards rather than downwards. This, too, would result in a reversal of sunwise and withershins.

Spinning can be carried in a wide variety of ways, and may even be done without any form of spindle, either by the hands alone, or by rolling fibres down the thigh. Spindles have been found in many forms. They may have a spindle whorl, placed at the top, in the middle or at the bottom, but spinning may also be carried out on a spindle without any whorl, rotating it in the hand or rolling it down the thigh. A simple crooked stick may also serve as a spindle (Barber 1991: 39–78; Crowfoot 1931; Gleba and Mannering 2012: 9–11; Hald 1980: 134–6).

According to Grace Crowfoot, who investigated methods of hand spinning in Egypt and the Sudan in the 1920s, spinning performed by rotating a spindle in the hand was particularly suited for short-stapled wool, as it is possible to produce very fine yarn this way. By this method, the spindle is held horizontally or upwards (Crowfoot 1931, 10–12, 45, plates 4–5 and 7–8). Spinning performed by twisting a hooked stick results in coarse yarns (Crowfoot 1931: 44). The
textiles of Bronze Age Scandinavia are mostly made of thick yarns, although finer yarns also appear in specialised textiles (Fossøy this volume). Bronze Age wools consisted of short-stapled under-wool and coarse, longer hair, and kemp. As there is a conspicuous absence of spindle whorls in Bronze Age Scandinavia (Mannerering et al. 2012: 102), it is quite likely that spinning was carried out on whorl-less spindles held horizontally, like the hooked stick, a simple stick rolled down the thigh, or rotated in the hand.

The introduction of wool and the techniques and tools necessary for transforming it into textiles at the beginning of the Bronze Age in Scandinavia may well have been accompanied by craft traditions circumscribing how things should be done. The idea of textiles as constructed from opposites in a kind of ‘marriage’ may well be one such tradition, as similar phenomena are seen in several parts of Europe, such as the slightly older wool textile from Pustopolje in Bosnia-Herzegovina (Bender Jørgensen, Grömer and Marić Baković forthcoming). The change from using yarn twisted in two different ways may be seen as a creative departure from this tradition, instead drawing inspiration from cosmology. Instead of perceiving a web as a ‘marriage’, spinners would...
carry out their work following the sun in its eternal cycle, and be comforted by the thought that much less yarn would have to be twisted in a direction they saw as withershins. It also simplified work processes and, presumably, the number of tool types needed.

As mentioned above it is noteworthy that until spindle whorls begin appearing in the archaeological record, in settlement layers, or as grave goods, s remained the dominant twist direction in Scandinavia. The mission of the spindle whorl is to add momentum to the twist of the spindle (Verhecken 2010). This works best if the spindle is held in a vertical position, downwards, regardless whether it is used as a drop spindle or a supported spindle, or if the whorl is placed at the top, the bottom, or in the middle of the spindle. In this way of spinning, twisting z will be perceived as sunwise. The appearance of spindle whorls seems to have begun in the late phase of the Pre-Roman Iron Age; by the Late Roman Iron Age spindle whorls turn up regularly, and the common way of twisting yarn had changed to z (Bender Jørgensen 1986: 134–40; Mannering et al. 2012: 110–11). We may infer that the advent of the whorled spindle caused the link between cosmology and spinning established in the Bronze Age to be broken, and reversed to fit the new type of tool for spinning.
Production practice refers to the many different aspects of how materials are processed and shaped to become objects with different visual and physical properties. It is not possible to provide a comprehensive overview of all the stages, decisions, and consequences involved, but in the introduction to Part II we pointed to the chaîne opératoire as a means of focusing on production as process, to tools in the facilitation of practices, and to communities of practice as central to learning and innovating. We also highlighted time – duration, temporality, and rhythms – as a significant dimension of all production practices. Based on these considerations, and augmented by the essays, a number of themes emerge through which we can begin to reflect upon where creativity may be located within practice, and what may be helpful preconditions for the development of creativity.

DECISIONS

All the production sequences reveal critical points at which certain decisions are made that impose restrictions on the final object. The mounting of the loom, for example, is decisive for the size of the finished fabric. The mould decides the shape and size of the metal object. In clay, it is only upon firing that the shape of the object is irreversibly fixed. These points of decision are
therefore extremely interesting in terms of innovations and departures from established norms. Not all points in the chaîne opératoire are therefore necessarily equally weighted when it comes to the development of new forms. New objects developed through the pushing of such restrictions or by exploring different aspects of the materials and tools. More complex textile surfaces became possible through changes to the tools (e.g. multiple heddle rods). New metal types were dependent on more complex moulds. In clay, the ‘body as tool’ remained constant throughout but the articulation of body gestures was modified.

ANTICIPATION AND ABSTRACTION

An important characteristic of the innovations we observe during the Bronze Age is a striking increase in the ability of craftspeople to anticipate how a material will respond, and a growing dependency upon this kind of prediction. We also see clear indications of new ways of craftspeople being able to imagine and manipulate processes that cannot be directly observed. Metalworking is striking in this regard. The metal was probably usually melted inside crucibles introducing a level of separation, or distancing, between the craftsperson and the production practice, as the material could not be handled. This separation is even more obvious after the two-piece mould was invented as the melted copper alloys were poured into a closed container; the process of ‘making the object’ thus takes place out of view. In addition, the use of the two-piece mould and in particular the cire-perdue method involves a high degree of abstraction as the mould contains the negative impression of the finished object. In pottery production a similar sophisticated abstraction and use of the ability to anticipate outcome without empirical observation is found in the firing of pottery in a kiln or pit.

CONTROL AND PREDICTION

One may see production practices during the Bronze Age as being pushed towards becoming more stable with more predictable outcomes. An important motivation for innovations is therefore likely to have been the desire to control outcomes. This rests on the ability to predict and assess the materials, how they can be worked, what tools are needed, and how the influence of various formative factors, such as yarn qualities or temperature, can be controlled. This aspect of production, and creativity, is also about assessing stability; acknowledging what was unstable or difficult to control for each material. It is thus also about how to evaluate and take calculated risks. The deliberate alloying
of copper with tin is an example of this. Alloying resulted in a material that behaved in predictable manners. After the recipe for tin-bronze was invented the same material could be produced again and again. The use of kiln firing is another example. When the firing is successful colours can be standardised and desired outcomes achieved, but if the kiln misfires, all or most of the pottery will be ruined.

Being able to calculate risks was, in all likelihood, based on a considerable degree of experimentation and trial and error. We therefore want to emphasise that mistakes are a crucial (and interesting) factor behind innovations, even if they leave few traces in the objects that were kept. Each material presented different challenges and potential solutions in this regard. There are different points in the production procedures for each of the three materials where mistakes may happen, as well as different reasons for them. There were also different options for how they could be responded to. The development towards deliberate copper alloys is a very informative example of this. Naturally alloyed copper had properties that were difficult to predict. Its composition could only be guessed at, resulting in each smelt progressing in different ways and the resulting alloy having uneven properties. With the advent of ‘design alloys’, risks linked to the behaviour of metal were minimised.

Depending on where in the production sequence of a particular material the mistakes happen, they may be corrected either by problem solving within that stage, or by returning to a previous stage. There are several examples in Bronze Age textiles of mistakes during weaving being corrected. Uneven warp tension, resulting in a curved shed, was remedied by gores, double gores in the middle of the web, or single gores at the edges. At the beginning of a web, the occurrence of double warp threads indicates that the warp had not been sufficiently meticulously divided. This type of fault is usually quickly corrected, but occasionally it continues throughout the web (Broholm and Hald 1940: 123–5). These corrections are to a certain extent visible as irregularities in the fabric’s texture. They may well have been perceived as drawbacks, but in other cases they may have inspired the weaver to create new types of textures and surfaces. In potting it is possible to erase mistakes or to amend previous gestures again and again as long as the clay is kept moist. Corrections can be made by dismantling and starting again, or by altering existing work, such as by modifying vessel symmetry or decoration. Such responses reveal the crafts-person’s attention towards the crafting process. This ability to relatively easily correct mistakes and the relative ubiquity of clay may allow for a particular element of experimentation within the making of ceramic objects. There is a difference between catastrophic mistakes and those that can be accommodated or that lead to experimentation in form and methods.
Although it is not possible to always predetermine where in production practices creativity may exist, it is equally clear that each of the different materials offers a range of points within the chaîne opératoire at which creative responses could be generated. To understand this crucial aspect of Bronze Age craft, the kind of close scrutiny that is reflected in the essays provides a useful method of engagement. It begins to reveal Bronze Age craftspeople as more than skilled or routine practitioners, but as people who actively made decisions and engaged with the materials with which they worked.
PART III

EFFECTS: SHAPE, MOTIFS, PATTERN, COLOUR, AND TEXTURE
In this section we look at finished objects in terms of how Bronze Age people imaginatively explored different qualities of materials and production practices to create a variety of effects. Effects are a function of the properties that structure the perception of things (Gamble and Coward 2010; Gibson 1979; Gosden 2001) and during the Bronze Age we see the explicit manipulation of material properties in order to create these. The most important effects for Bronze Age people were shape, motifs, pattern, colour, and texture. These all relate to fundamental aspects of human sensory experience. There is not necessarily a hierarchical relationship between them; none of them takes priority in terms of how effects may be obtained and thus experienced. Each provides a means of altering, adding to, and exaggerating surfaces in order to lend a given object specific qualities.

Many Bronze Age objects were made with a distinctive aesthetic but effects were differently articulated at local, regional, and European scales in our three different materials. They were expressed through substantial experimentation and provided ways of highlighting differences between objects and of giving sensations that were not only visual, but often part of broader haptic experiences including tactile, auditory, and olfactory encounters. The possibilities that effects offer in terms of a range of sensory provocations mean that their manipulation generated substantial opportunities for Bronze Age creativity.
This raises questions not only regarding how creativity might be implicated in the ways that objects were elaborated, but also how creativity may have been a means of consciously creating particular kinds of interaction with the material world. The creativity expressed in objects was thus also a matter of developing the ‘technical virtuosity’ of the maker and this was critical to generating responses in the people reacting to them (Gell 1992: 52).

Bronze Age objects were frequently vehicles for the expression of Bronze Age understandings of the world and thus for story-telling and imagination. Recent discussions have established detailed insights into Bronze Age cosmological narratives (Kaul 1998, 2004a and b; Meller 2004), making it clear that cosmology permeated many material practices in a range of domestic, mortuary, and other contexts. Thus one of the distinctive characteristics of the Bronze Age is the embedding of cosmology within certain kinds of objects. A central theme was the journey of the sun facilitated by the bird and the boat, and in some regions the horse (Kaul 1998, 2004a and b, and this volume). In this sense, objects provided a context for the development of ‘concrete thinking’ (Turkle and Papert 1992: 3). They made the abstract concrete, making it tangible. At this level, objects were not merely semiotic representations but were a ‘presence rather than a sign’ (Taussig 2009: 6). They did not stand for something else but made it manifest. Shared materiality is a precondition for communication (Gamble and Coward 2010: 48) and the analysis of creativity in the making of effects allows us to unpick the often ingenious ways in which meaning was embedded within objects to create such shared experiences.

In this part of the volume we therefore aim to consider different routes to Bronze Age creativity. On one hand this refers to the ways in which haptic effects were generated by the makers of Bronze Age objects. On the other hand, it embraces the ways in which aesthetic experiences and effective responses were embedded within objects. These two strands were frequently intertwined but nonetheless form distinct analytical points of departure. Both required not only a sense of the creative potential of materials but also knowledge and ability to produce them (this volume Parts I and II). It also involved a Bronze Age vision that was consciously directed towards the material articulation or incorporation of particular ideas and experiences. Although we acknowledge that embodied receptions of these effects may vary (Gamble and Coward 2010), it is possible to identify how effects may have been activated during the Bronze Age (see Hamilakis 2011). Our aim here is not therefore to reveal ‘authentic’ meanings or experiences per se, but rather to investigate the creative processes. We explore the deployment and development of effects to help us locate how creativity was materially played out. Rather than do this separately for textiles, bronze, and pottery, in order to facilitate comparisons and contrasts, in the
discussion below we discuss effects thematically with examples drawn from each of the three materials.

SHAPE

The concept of shape refers to the three-dimensional form of an object. Shape can be described in terms of surface contours, edges, symmetry, or asymmetry. Shapes can be simple or complex, solid, hollow, or open. To say that objects have shape is also to imply a process of *shaping* as can be seen, for example, in the tailoring of Bronze Age garments. This may be expressed through the creative play between silhouette, orientation, and proportion. It is, however, challenging to describe shape as this is also a matter of lines and crispness of execution (c.f. Ingold 2007c). Within each of our three materials some objects stand out for their complexity and the scale of the technical challenges that underpinned the achievement of particular forms. Some are also startling in their sheer appeal, raising obvious questions regarding the relationship between modern and Bronze Age sensibilities.

For Bronze Age objects, which are all handmade, no two objects are identical. This is the result of slightly different inflections during the making process. Furthermore, understandings of shape depend upon the angle or viewpoint from which one sees an object and are therefore a matter of perspective. This can be used to create illusions. For instance, the bodies and rims of Early Bronze Age Vatin amphorae from the south-east Pannonian Plain were made by thumbing and coiling so that they have curved interiors but they were pinched out in such a way that from the outside they appear to be square. Such objects reveal not only a Bronze Age awareness of shape but deliberate play with it. In some areas we see the development of very elaborate, almost baroque objects for which the silhouette becomes increasingly exaggerated. For metal, this increasing complexity of shape can be traced at particular points in the Bronze Age and is differently shown by different types. The developments in female ornaments such as pins show this, with some types reaching exaggerated lengths of more than half a metre (Kubach 1977; Sørensen 1997). In ceramics, baroque forms appear in regional bursts, such as some of the very complex exaggerated shapes of Middle Bronze Age Vatya-Koszider pottery in Hungary (see Bóna 1975; Vicze 2011).

It is clear that during the Bronze Age shape easily follows certain trends seen in the way that the shape of objects very often can be traced from pre-existing forms. When established forms were broken or challenged this constitutes a particular form of innovation as, for instance, in the development of the form of the socketed axe due to the changed method of hafting. In addition,
there were innovations, such as the sword, which were probably closely linked to new emerging social ideas such as warriorhood and face-to-face combat. Others, such as the bronze pin, might have been a response to the new wool textiles (Rast-Eicher 2005: 125, 128–9).

An interesting distinction between our three materials is the extent to which shape is flexible. Textiles are highly flexible, they can be folded and unfolded, they can be tied and untied to change the perceived shape of an item. In addition, when worn, textiles respond to the movement of the body, a quality which may have been explicitly exploited in the corded skirts of the Nordic Bronze Age where the attached bronze tubes would have tinkled when the wearer moved (Sofaer et al. 2013a; Sørensen 1997). Textiles can also be modified by pinning or fixing them in different ways on the body so as to give them, and the body, the appearance of different shapes (Grömer et al. 2013b). Metal and ceramics do not have the same flexibility and do not therefore offer the same possibilities.

Over and above their functional aspects, objects may have various kinds of connotations built into their form. This is particularly clear when shapes are representational, such as when they have cosmological, zoomorphic, or anthropomorphic elements. Compared to earlier and later periods, there are relatively few such objects and they are clustered in particular regions with geographical and chronological variations found within the three materials. Thus, objects such as the Trundholm sun chariot stand out in their representational nature since surfaces, rather than three-dimensional representations, were frequently the primary focus for Bronze Age craftspeople. Such departures are therefore particularly informative of creative acts.

**MOTIFS**

During the Bronze Age a common range of motifs was used across Europe, although regionally specific motifs are also found. Motifs are themselves creative expressions, many of which bridge between ideology and materiality. In terms of creativity a useful distinction is between figurative and abstract motifs. Among figurative motifs, the most frequent were linked to cosmological notions, these being the bird, the sun, the wheel, and the boat. Regional figural motifs included, for example, the horse in Scandinavia, and the bull in south-east Europe (Kaul 1998; Palincaș 2010). Human representations are rare, usually highly stylised and often appear to be set in cosmological contexts (e.g. Csányi 1992; Kalicz-Schreiber 1990). Figurative motifs were used on metal and ceramics but do not appear to have been applied to textiles, despite the potential to do so using embroidery. It therefore appears that motifs were
linked to materials in an indexical manner. Abstract motifs were used on all three materials and there is a much wider range of these than figurative motifs. They include circles, concentric circles, running circles, and spirals, as well as horizontal, vertical, and wavy lines, triangles, meanders, dots, swags, dashes, kidney-shapes, heart-shapes, and so-called ‘tear-drops’.

However, the distinction between figurative and abstract motifs is not always clear cut. The deliberate evocation of cosmological notions through material culture may have resulted in the development of designs that aimed to condense ideas through symbols into abstract form. The trend towards a high degree of abstraction is thus another distinct feature of Bronze Age creativity. For example, the form of the water bird relatively quickly became reduced to a simple S-shape, as seen in the shape of bronze bucket handles. In this way the reference to the bird subtly permeated a wide range of objects. Likewise, cosmological elements, such as the sun, were represented through concentric circles. Furthermore, effects were not just a matter of motifs themselves but also of the manner of their presentation through composition. Thus, for example, the deliberate orientation or placement of motifs, such as the ship, contributed to the ways in which they were meant to be understood emphasising a sense of movement that relies on the viewer’s ability to understand the design principle. In some cases motifs were also integrated into the shape of objects. An example is how the circular shape of some fine ware bowls in the Carpathian Basin gradually became part of a decorative scheme for the display of cosmological ideas in new and overt ways (Sofaer 2013).

Alongside this move towards abstraction, a small number of composite motifs were also in use. In some cases these were articulated through the combination and recombination of a standard range of elements in order to produce new motifs, further revealing creativity in Bronze Age objects. In these cases the understanding of their meaning appears to be dependent on acquiring shared representational conventions. A notable example is the so-called Vogelsonnenbarke, or bird-sun-boat, found as decoration on bronze (Becker 2015) where elements were joined together.

On a larger scale, the decoration of bronze and ceramics was frequently a matter of bringing together different motifs in a structured way so as to form compositions across the object (as opposed to integrating elements within a single composite motif). Such compositions are a distinctive and widespread feature of the elaboration of Bronze Age objects. Compositions were arranged on objects in different ways. Whereas for bronze and ceramics compositions of motifs were usually fixed during the production process, in textiles the construction of compositions were more frequently created by layering after production of the cloth to produce complex haptic effects. The ‘foundation’
was the fabric, which could be embroidered or piled as seen in caps from the Danish oak-log coffins. An additional decorative layer was achieved by the attachment of dress accessories in metal, amber, or bone, such as pins, buttons, bronze tubes, tutuli or discs. Decorative compositions achieved through dress accessories were flexible to some extent since their configuration could be moved around.

**PATTERN**

In the Bronze Age there is a tendency for the use of aesthetic principles that include the use of repetition, direction, orientation, and contrast. The notion of pattern, as used here, refers to the repetition of elements or sequences of elements drawn from the repertoire of Bronze Age motifs. The more regular the repetition, the stronger the pattern. Both repetition of elements and sequences are found in all three materials. Pattern forms an organising structure for decoration and can be used to cover surfaces, to divide them into sections, or as framing devices (see also Adamson 2007: 31). It can also be used to highlight certain parts of an object, such as the hilt or blade of swords, or the neck or belly of ceramic vessels. Patterns can be conspicuous or subtle. They can draw the eye across an object (Wells 2012), thereby either accentuating a particular area, or conversely, distracting from the overall shape. They can be directed in particular ways (e.g. right to left; top to bottom) thereby giving orientation to an object and directing the way it is intended to be viewed. The use of patterns implies pre-planning or design and expresses an attention to system and order. These reflect both aesthetics and mental templates, for which there were highly structured understandings of the ‘correct’ ways to do things.

The elements that make up Bronze Age patterns are both representational and non-representational but not all regions and phases drew upon the full repertoire of motifs. The use of the wheel, sun, and water bird is particularly common, as are a range of geometric and curvilinear elements. For metal and ceramics, patterns were applied to surfaces. By contrast, in woven textiles patterns are by definition integral to the weave; you cannot weave without creating a pattern. What is therefore of importance to textiles is the complexity of the pattern sequence. The development of complex weave patterns began during the Bronze Age with the emergence of dyes, and twill as a new weave (Grömer et al. 2013a, 2014).

It is, however, important to note regional and local variations in the ways that patterns were formulated and the scale at which these differences played out for different materials. For ceramics, in particular, there is a wide range of highly local variations in decorative compositions, perhaps reflecting the
long-standing use of pottery to express local identities. Furthermore, there are striking contrasts between different areas of Europe with regard to the proportion of surface covered by patterns. Ceramics in Scandinavia, for example, have almost no decoration throughout the Bronze Age while those in south-east Europe are heavily decorated, particularly in the Middle Bronze Age where decorative compositions sometimes filled the entire surface. In the latter, while choice of motifs may be linked to particular vessel forms, in some local potting traditions, such as for example on elaborate encrusted pottery, it is clear that no two vessels are identical in their decorative compositions; although they draw on a similar stock of motifs these are selected and arranged differently. There therefore seems to have been a great degree of freedom and play in choice. It is, however, difficult to untangle what can be considered simply a matter of variation in human practice, what was a matter of creative improvisation in the manner discussed by Tim Ingold (2007b), or what were deliberate attempts at creatively exploring difference. In bronze there is a wide range of patterns that change rapidly through time. There are some regional expressions but these can be over-ridden by the association between certain forms and particular kinds of decorations. Early Bronze Age shaft-hole axes, for example, have similar decoration from south-east Europe to Scandinavia with local variation expressed only at the level of single elements. For textiles the data are too limited to draw wide conclusions although there are a few examples of applied patterns in the form of embroidery. Textiles seem rather to have been largely a background for accessories.

COLOUR

Colour is a fundamental aspect of human sensory experience. It is a visual effect due to the way light reflects off surfaces. Just as every object must be made in some way, every object has colour (Adamson 2007: 1). The manipulation of colour affects human perceptions of objects and is therefore a way of creating experiences and of responding to differences between things (Taussig 2009).

An interest in colour already existed prior to the Bronze Age and was not, therefore, unique to it. Colour was used in cave paintings in the Palaeolithic but the specific selection of certain colours of raw materials for portable objects is most clearly first seen in the Neolithic. For instance, colour was clearly important in choices of raw materials for Neolithic axes in Britain, Ireland, and elsewhere (Bradley and Edmonds 1993; Cooney 2002, 2012: 199). As a prelude to the Bronze Age, it has been argued that colour was important in the development of metallurgy, the lustre of the ‘flashing blade’ being a desirable quality (Keates 2002), although this should be placed in the context
of many lustrous materials already in circulation (Roberts and Frieman 2012). In pottery, the use of colour to create pattern and decoration is known, for example, in the striking white and red inlays of the Eneolithic Vučedol ceramics of south-east Europe (Dimitrijević 1979). If the pre-existence of colour can be taken for granted and human interest in it pre-dated the Bronze Age, what is at stake with regard to Bronze Age creativity is the question of colour preferences and the ways that colour was deliberately sought out, created, and manipulated.

In this volume we have previously argued that colour was used to guide observation during the selection, processing, and production of materials and objects (Part I and II). Technological developments during the Bronze Age provided the opportunity for craftspeople to seek out, play with, and control the colour of objects in new ways. The emergence and development of white wool, bronze technology, and greater control of firing of ceramics presented new possibilities to deliberately manipulate variation, choice, and intensity of colour in finished objects. In this development we see new kinds of exploitation of plants and minerals as they were converted into dyes or coloured pigments, and new levels of control of pyrotechnology. This represents a move away from colour as a direct manifestation of the inherent substance of objects, towards the widespread manipulation of materials to create desired colours that were not immediately available in the ‘natural’ state of materials.

At a fundamental level, Bronze Age changes in craft production therefore offered possibilities for new and different applications of colour to objects, in particular through the development of dyes. For textiles the Bronze Age was a phase of experimentation leading to those that later became established. These added bright colours such as blue, red, and yellow to pre-existing colour choices (Hofmann-de Keijzer et al. 2013). To create such colours and coloured objects, is to change perceptions of the world in a radical way. New spin patterns and weave patterns, such as stripes, could be worked in a manner that attracted the eye much more than natural shades. Glitter was also occasionally added through the use of gold threads (Grömer, this volume). In ceramics, colour contrasts were sometimes deployed in order to highlight motifs but additions such as inlays also offered different possibilities for matte or more reflective sparkly colours (Sofaer and Mihelić this volume). In other cases, block colour sometimes seems to have been deliberately intended and desired for ceramics, such as in the Middle Bronze Age Vatya group in Hungary where there was a distinct preference for black fine ware vessels produced by reduction during firing. By comparison, the use of colour contrasts for metal objects was rare. There are relatively few bimetallic or damascened objects (Berger et al. 2010; Berger et al. 2013), although there are a few notable examples such
INTRODUCTION

as the Nebra disk or the Trundholm sun chariot where colour was used to express cosmological ideas.

In all three materials we therefore see deliberate attention to colour but expressed very differently and focused on distinct colour ranges and colouring agents. While some uses of colour clearly become standard, such as the colour of tin-bronze, others such as the range of colours in pottery, show regional preferences that were the result of local clay variations as well as firing techniques and decorative preferences. Recent archaeological interest in colour in the Bronze Age has stressed its social and symbolic significance as a mnemonic for significant associations and meanings (Jones 2002; Owoc 2002). As colour symbolism is known to be culturally specific (Taussig 2009), the exact meanings attached to colour can be difficult to access. The great importance and creative investment in colour effects is, nonetheless, apparent. The valuing of colour is a notable aspect of creativity in Bronze Age objects.

TEXTURE

Texture refers to the qualities of surfaces such as bristly, even, rough, smooth, hard, or soft. Texture also creates light and reflection depending on the degree to which a surface is polished. Textures vary between our three materials. Pottery and metal objects both have ‘hard’ surfaces, whereas textiles have ‘soft’ surfaces. With regard to textiles, however, a wide range of surface textures can potentially be created depending on the selection of fibres and the construction and treatment of surfaces. Whether things are wet or dry may also affect their texture.

In the Bronze Age, the new materials of wool and bronze created novel possibilities for developing hitherto unavailable textures. In clay, its malleability offered the possibility to respond to textures in other materials through imitation or iteration. The use of cord impressions, for example, is well-known from the Neolithic but developments in Bronze Age materials may have offered opportunities to reconfigure established practices in new ways.

Texture is experienced through touch. It literally exists as a surface we can feel but also one we can imagine. Texture is therefore a way of engaging both tactile and visual attention (Gibson 1977, 1979; Hurcombe 2007; Paterson 2007a and b; Wells 2012). Understandings of texture are linked to memories of surfaces we have previously felt. Where we have no such reference point, texture can be difficult to assess. This raises questions regarding how Bronze Age people may have responded to an engagement with a new material prior to having accumulated experiences of how it felt to touch. This is particularly interesting from the point of view of creativity.
as it provokes consideration of how people imagined the texture of objects without being constrained by any pre-existing experience or reference points.

Neither colour nor pattern is integral to texture but both can be used to affect its perception and feel. Patterns are generally more noticeable than textures but pattern may be perceived as texture when the eye is overwhelmed by the detail of pattern and it becomes difficult to take in its individual elements (Adamson 2007; Wells 2012). Creation of the illusion of texture thus offers creative possibilities complementary to the tactile qualities of the actual materials and surface of the object itself.

It is useful to remember that Bronze Age objects were made to be used. They were created to be touched and handled, as well as for optical impact. Texture enabled particular kinds of interaction or haptic experience with a finished object. For example, textiles not only covered the body but also changed its appearance and feel. In metal, embossed elements could have been traced with the hands while punched patterns primarily created a visual sense of texture. It is, however, likely that the main textural quality of metal was an impression of smoothness, hardness, and sharpness of edge, for example on razors. In pottery, rustication can be considered both as a functional and aesthetic quality.

In all three materials a high degree of attention was paid to texture. The difference between them is in the range of textures found in each and the means by which they were created. A great range of textures are found in textiles. These were created through the choice of materials, the selection of weave pattern, and in finishing processes such as washing, fulling, or brushing to create a nap. In bronze, texture was primarily created through polishing. In ceramics it resulted from the selection of raw materials including tempers, and the methods of surface treatment.
CASE STUDIES

INTRODUCTION

In the following essays we aim to explore the generation and use of these kinds of effects as creative practices through a series of case studies. We do not aim to be comprehensive in our treatment of the European Bronze Age but rather to explore what Bronze Age people actually did through a series of illustrations. The essays deal with each of our three materials – textiles, bronze, and ceramics – but the ways that Bronze Age people dealt with the distinct nature of each of these means that a discussion of some effects and their potential for variability is more relevant to some of these materials than to others. Thus, for example, here we do not include an essay on creativity in relation to the texture of bronze, although texture is included in discussions of textiles and ceramics.

The order of the essays loosely follows the different kinds of effects discussed above: shape, motifs, pattern, colour, and texture. They begin with a discussion of the shaping of garments by Helga Rösel-Mautendorfer, in particular, how the blouses found in Scandinavian log-coffin graves may have been made to fit specific individuals. This is followed by Flemming Kaul’s discussion of the origin of the shape of the Nordic one-edged razor and the integration of inspirations from one cultural context into another. Darko Maričević and Joanna Sofaer then explore shape in terms of the variety of figurative and more abstract ways that birds and ‘birdness’ were imaginatively modelled in clay.
Many contributions deal with more than one kind of effect, thereby revealing how Bronze Age makers creatively developed relationships between them. The essays by Marie Louise Stig Sørensen and Grahame Appleby on the design challenges provoked by the relationship between shape and motifs regarding Nordic Bronze Age razors, Joanna Sofae on the temporal shifts visible in the relationship between the shape and decoration of bowls in the Carpathian Basin, and Sebastian Becker on the haptic effects of bird iconography on bronzes, each explore this inter-linking of effects. The essays also reflect upon the ways that the production of specific kinds of effects and their combination were closely intertwined with the expression and experience of cosmology. This theme is particularly taken up by Flemming Kaul in his discussion of left–right logic in the structure and orientation of motifs on the Nordic Bronze Age razors.

The essays then turn to the production of pattern, colour, and texture. Karina Grömer discusses pattern, structure, texture, and decoration in textiles and the creativity embedded within the sensory impact of play with these. Joanna Sofae and Sanjin Mihelić examine pattern, colour, and texture in the elaborately decorated encrusted ceramics of the Carpathian Basin. They argue that creativity in these was a matter of the assembly and reassembly of different kinds of knowledge – materials, technologies, cosmology, and meaning – expressed in and through effects. Finally, Karina Grömer, Sanjin Mihelić, Sarah Coxon, and Joanna Sofae examine how effects were created in Litzenkeramik. They ask whether the distinctive cord decoration on these vessels were thought about and articulated in ways that responded to developments in other Bronze Age materials, and explore the knowledge-base or conditions implicated in the development of novelty.
Clothing can be made in three different ways: by draping, made to shape, or tailoring. Draped garments consist of a length of textile wrapped around the body, or part of the body; modern examples of this are the sari and turban. ‘Made to shape’ refers to clothing that is pre-shaped on the loom rather than cut from a rectangular piece of cloth, such as the semi-oval Roman toga (Granger-Taylor 1982). The corded skirts of Bronze Age Scandinavia are other good examples of made-to-shape garments (Fossøy and Bergerbrant 2013). Tailoring refers to the use of cutting and sewing in order to turn a two-dimensional textile, or other material, into a three-dimensional garment. Tailoring is the most complex of these three techniques and the one focused on in this essay as the decisions involved provide particular opportunities for going beyond established norms. In tailoring, to obtain the desired form the textile has to be cut into appropriate shapes, re-assembled, and put together by various types of sewing, each of which has a bearing on the form and properties of the finished object.

SEWING

Sewing is central to tailoring as it is a means of joining different materials. It is a simple technique, but holds huge potential for connecting a variety of
flexible materials such as textiles, furs, and cured skins through seams and hems. Sewing can also serve to modify the surface, for example by pleating (Wolff 1996) or embroidering (Butler 1979). Through these applications sewing offers many options for shaping objects and carries the potential for creativity.

Sources that may inform on tailoring and sewing are tools, in particular needles, and stitching found on various materials. Curved edges and other evidence of shaping offer further clues about how fabrics were cut and tailored. Needles are known from the Palaeolithic at sites such as Petersfels im Hegau, Germany (Stradal and Brommer 1990: 7) or Grubgraben bei Kammersr, Austria (W. Antl pers. comm.), dated to about 20,000 BC. The oldest evidence of sewn textiles derives from Neolithic lake dwellings in Switzerland where hems were sewn with oversewing or overcast stitches, as at Wetzikon-Robenhausen and Lüscherz (Médard 2010). A single example of seams joining two textiles together is known from Zurich (Médard 2010: 239). Sewn-on fringes appear on several finds (Médard 2010). The garments found on the Chalcolithic ‘Iceman’, the glacier mummy from the Ötztal Alps (Egg and Spindler 2009) give insights into the variety of early sewn objects. His garments were made of bast fibres, grass, cured skins, and fur. The skin and fur garments were sewn with overcast stitches. The original seams were done with sinew; repairs were neatly done with a double Z-plied yarn of animal hair or more coarsely using grass and bast fibres (Egg and Goedecker-Ciolek 2009: 62).

Stitches can be done in many different ways, these having different physical properties in terms of tightness and security of attachments, as well as appearance. Evidence of Bronze Age sewing and tailoring has been recovered from several parts of Europe. In central Europe the main finds derive from Molina di Ledro in Italy, Irgenhausen in Switzerland (Bazzanella et al. 2003), and Hallstatt in Austria (Grömer et al. 2013a). The Early Bronze Age finds from Molina di Ledro and Irgenhausen offer insights into surface design by stitching. Interestingly, a textile from Molina di Ledro is embroidered with blanket stitches, while the Irgenhausen piece is embroidered with a combination of line stitches and cross stitches (Bazzanella et al. 2003; Vogt 1937: 76–90), resulting in different effects. The Middle Bronze Age finds from Hallstatt show a variety of techniques suggesting conscious decisions about which stitches to use. In addition to overcast stitches they include running stitch, stem stitch, and blanket stitch. Hems are sewn with overcast stitches or blanket stitches over the entire width, or hemmed with a hem stitch. Seams are much rarer than hems. There are some cases of stitch lines made with running stitches. There is also an example of an appliquéd thread and a hem with a sewn-on cord. Repairs are documented in two cases: a braided edge and a fabric that has been darned (Grömer et al. 2013: 254–5, 292–4). Complete Bronze Age garments
from central Europe are not preserved, except for a skin cap from Hallstatt

In northern Europe, several examples of complete clothing ensembles are
known. They derive from oak-log coffins (Broholm and Hald 1940). These
finds reflect a variety of garments. The women’s clothing consists of a tai-
lored blouse with sleeves, sashes with tassels, various types of hairnets and
bonnets, an approximately rectangular piece of cloth that could be wrapped as
a skirt, dress or cloak around the body, and – in the Egtved burial – a corded
skirt. Garments worn by men include an oval or kidney-shaped cloak, a sash
or leather belt, and two types of cap. Men also wore wrapped garments or
‘kilts’ (Broholm and Hald 1940; Mannering et al. 2012; c.f. Bergerbrant 2007;
Bergerbrant et al. 2013). Both men and women wore leather shoes. Their feet
were often wrapped with scraps of fabric, although it is not clear whether these
were part of the funeral rites (Mannering et al. 2012: 97–100). The garments
were sewn using a variety of types of stitches including running stitches, over-

PATTERN-RELATED CONSIDERATIONS AND SEWING IN THE
MANUFACTURING OF PREHISTORIC GARMENTS

Tailoring is based on pattern pieces. To obtain the desired form, the surface
of the material has to be cut into appropriate shapes. The shapes of pieces of
fabric, skin, or fur can range from very simple to complex. If working with
textile, a further consideration is the direction of the bias (thread direction of
the fabric) and how working with or against this generates particular qualities.
Simple forms are usually cut according to the thread directions of the fabric,
favouring rectangular shapes. Non-rectangular shapes are therefore based on
pre-planning for a specific garment. All shapes demand appreciation of tech-
nical considerations and require intentional cutting.

Technical considerations are apparent in the earliest tailored garments.
Except for the grass cloak, all the garments of the ‘Iceman’ mentioned above
were composite, made of pieces of fur or cured skin. All of these were cut. In
other words, none retained the form of the skin when it was taken off the
animal (Egg and Goedecker-Ciolek 2009). The leggings were made of small
irregular pieces, the loincloth and the top garment of strips of cured goatskin.
The bear fur cap was made in a sophisticated pattern. It was basically com-
posed of two strips of fur but in order to achieve a hemispherical shape the
upper band had two darts. The remaining hole at the top was closed with a
diamond-shaped piece of fur. The tunic was made of black and brown pieces
of goatskin, forming a simple striped pattern. Unfortunately, the shoulders and
sleeves are too badly preserved to supply information about how they were made, but the remaining parts show that the tunic’s pattern is the result of intentional design. Pieces of fur corresponding to the underbelly of the goat were incorporated at both sides of the tunic’s front. It appears that the teats of the goat were positioned in such a way that they would lie over the nipples of the man wearing the garment. This suggests that the garment may have had additional meanings. Tailoring methods used to make these pieces of clothing were based on geometric shapes. This same method is used today in creating some traditional costumes, such as the *choli*, a woman’s blouse from India (Anawalt 2007: 239–41), the *thob*, a woman’s dress from Palestine (Anawalt 2007: 59), or the *yélék*, a Turkish lady’s mantle (Anawalt 2007: 61).

Fragments of fabrics with stitches indicate tailoring in Bronze Age Europe. Among the Bronze Age garments from Denmark the cutting technique of the women’s blouses is of special interest. Three completely preserved items have been recovered from oak-log coffins at Borum Eshøj, Egtved, and Skrydstrup (Broholm and Hald 1940). All three blouses have a T-shaped seam on the back that ends at the seams of the sleeves (Figure 3.1). They are based on the same overall pattern, but a closer look shows some differences. Based on the reconstructions by Margrethe Hald (Broholm and Hald 1940: 71, 91, 83) the following features can be identified. Firstly, the Borum Eshøj and Egtved blouses are roughly the same size. The Skrydstrup blouse, however, is about 7 cm longer. The strips sewn on to the hems of the two shorter blouses do not outweigh that difference. This may be due to the Skrydstrup woman being taller (170 cm) whereas the Egtved woman was only 160 cm tall. Secondly, the blouse from Borum Eshøj has a much larger width across the shoulder and sleeve than the other two blouses; the former is 120 cm whereas the Skrydstrup and Egtved blouses are only about 100 cm long. The Borum Eshøj woman was short and stocky; traces on her bones show that her arms were muscular (http://en.natmus.dk/historical-knowledge/denmark/prehistoric-period-until-1050-ad/the-bronze-age/the-family-from-borum-eshøj/the-woman-from-borum-eshøj/). The width of her sleeves was probably made to accommodate this. Thirdly, the blouse from Egtved has the narrowest circumference around the waist (84–88 cm) whereas those from Borum Eshøj and Skrydstrup are larger (93–100 cm and 99–102 cm respectively). Fourthly, none of the blouses is completely symmetrical. That from Egtved is most symmetrical but has asymmetrical sleeves, although in contrast to the other two blouses the neck opening is symmetrical. The blouses from Borum Eshøj and Skrydstrup are both asymmetrical in the back and in the sleeves. The upper edge of all three blouses is asymmetrical. Analysing the three blouses it is clear that they were also different with
regard to how the front and the back compare. Overall these observations suggest that the blouses were not direct copies of each other, but different iterations of the same general pattern, and also that they may have been tailored for specific bodies.

Figure 3.1 Blouses from Egtved, Skrydstrup, and Borum Eshøj, with T-shaped seam at the back.
The pattern of the blouses is constructed from an approximately rectangular shape. An important decision in making the garment is to determine the position of the neck opening. As the garment is made by folding over the upper part of the pattern (Figure 3.2), to get the right position it is necessary to know the dimension of the upper arm (i.e. the dimension of the sleeve). The position of the neck opening can then be established by folding the pattern in half widthways. In addition, the width of the back has to be determined. The top edge of the original pattern has to fit together with the upper edge of the back pieces. This pattern design is sophisticated. As the seams are in the back it is not easy to make the pattern fit well if the tailor and the user are the same person, assuming that tailors aimed to fit garments to particular individual bodies. If people made garments for their own use then the production of such clothing required a high degree of spatial imagination, a good eye, as well as an accurate assessment of one’s own body measurements.

An alternative method of making the blouse was by draping it on the body of the intended wearer. This would have involved at least two people, one as model, the other for pattern-making and assessing the fit of the garment. For this method, the seam at the back is not a disadvantage because the person

Figure 3.2 Creating the blouse by folding over the upper part of the pattern. Photo: H. Rösel-Mautendorfer.
who does the draping can correct the shape on the model. In addition, the front of the blouse does not need to be congruent with its back, as would be the norm if designing patterns on two-dimensional material based on measurements. The curved edge on the upper part of the pattern could be seen as a result of matching this edge to a curved edge in the top of the back, causing a narrower back shape. The great advantage of the draping method is the possibility to fit to individuals. From a technical point of view, the narrower width in the back of blouses from Borum Eshøj and Egtved indicates draping.

The seams of the woollen blouses were made by putting the edges of the two pieces of fabric on top of each other and stitching. No consideration was made of the fraying of cut edges in a woollen fabric. Instead, the way of working corresponds to that suitable for sewing together pieces of skin or fur (Broholm and Hald 1940: 159). If thick and dense, woollen fabrics can be sewn this way without disadvantage. The seam does not resemble today’s idea of careful stitching, but it is functional. Other aspects of the blouses show that Bronze Age tailors knew about fraying and responded to it by stitching the cut edges of the neck, sleeve openings and lower hemlines with blanket stitches. It is therefore possible that they applied known sewing techniques to the new material of wool and only adjusted this when necessary. The transfer of sewing techniques to wool does not, however, imply similar shapes of clothing. While sewing technique may be perceived as connecting clothing made of skin and clothing made of wool, it does not explain the shape of the cut. Cutting the fabrics opens up a wide range of new possibilities for shaping garments.

The origin of the shapes of Bronze Age garments was discussed by Broholm and Hald (1940). They argued that the woollen garments are based on older forms of clothing made of fur and cured skin. This view has been upheld by later scholars (Mannering et al. 2012: 102). The appearance of the men’s piled caps is reminiscent of fur, and the shape of the wraps from Muldbjerg and Trindhøj may have originated from a hide; this also fits with the way they were worn. Broholm and Hald also found ‘primitive’ aspects in the female garments. The blouse was seen as developed from a poncho. The extension strips seen in the Bronze Age blouses were interpreted as a relic of fur or skin clothing, as they are unnecessary when made from woven fabric, in contrast to garments made of skin or fur where the size of the material is limited (Broholm and Hald 1940: 158–9). Regardless of whether this type of blouse was developed in fur, skin, or woven wool the creative process of such a development is quite evident. The Bronze Age blouses suggest that they could potentially be made by different ways of using patterns, each requiring different skills.

Production of textiles and clothing is very time consuming, especially when sheep husbandry, harvesting, and processing of fibres are included. Minimising
waste caused by cutting may therefore have been an important issue. Nevertheless the Danish Bronze Age blouse pattern produces more waste than if the blouses had been made from patterns consisting of several parts. This suggests that offcuts were no reason for modifying the pattern. Maybe the scraps of fabric were reused for other purposes. More importantly, this suggests that the use of patterns became a fixed way of approaching the making of woollen garments.

CONCLUSION: PATTERNS AND TAILORING

There is evidence of Bronze Age clothing being made from patterns. The best examples of this are the Early Bronze Age women’s blouses from Denmark which show the use of an elegant and complex pattern. In contrast to patterns composed of small parts, they show the use of one single piece of textile which allows no errors in the cutting. Cutting the sleeves too long, or the wrong positioning of the neck opening, would lead to a badly fitting garment. Garments composed of many small parts have a significantly higher workload because of the sewing involved, but wrongly tailored parts can easily be mended without disturbing the overall picture. To minimise errors made in cutting the blouses it was necessary to develop a specific workflow. This involved different stages in the cutting of the textile, measurements, and adjustments; the production of pattern pieces can be done in different ways requiring different skills.

Responses to the new material of wool clearly resulted in an adaptation of existing sewing techniques but also in new ways of conceptualising how to ‘build’ a garment. The design of the patterns made it possible to use folding and sewing as a means of transforming two-dimensional pieces into a three-dimensional object. This in turn set a new norm for the making of clothing with the blouses showing small variations between individual garments, but at the same time a strong adherence to a shared blueprint.
THE ONE-EDGED RAZOR: A VIVID MEDIUM OF CREATIVITY AND MEANING

Flemming Kaul

The one-edged bronze razors of the Nordic Late Bronze Age are among the objects where the creative process is most apparent. Although not all razors were decorated, around 1100 BC the surfaces of the blades of some razors became the canvas for new creative expressions. On these surfaces, miniature works of art were located, including figural motifs such as ships, fish, horses, birds, and snakes. In these depictions the ship often stands alone or is associated with circles that can be interpreted as solar motifs. More complex scenes, where different motifs or elements are combined with the ship and where direction of movement is shown, can be read as pictograms representing parts of a basic myth recounting the eternal cyclical voyage of the sun. The images can be interpreted as showing different stages of the sun’s travel: over the heavens during daytime and through the underworld at night (Kaul 1998). Like elements of a cartoon strip, the imagery of each individual decorated razor conveys a part of the story of Bronze Age cosmology. The creativity of these images is further emphasised by the emergence of fantastic creatures such as snake-horses, double-horses or double-snake-horses, which I have previously argued had symbolic meaning related to the solar religion of the Bronze Age (Kaul 2009b). The razor was not, however, the only bronze object on which figural depiction was employed. Figural and partly stylised decoration is also found on female belt ornaments and neck-rings, but here the creative ‘explosion’ of
surface decoration appeared slightly later, around 900 BC. The repertoire also
seems more restricted than on the razors, but we still find ships, solar images,
horses and horse’s heads, and even some fantastic creatures combining horse
and snake elements. I propose that the religious ideas of the period were the
sources for this creativity, and that the apparent urge to express these ideas in
pictorial form is particular to the Nordic Bronze Age.

A razor was a personal item that may have been used by its owner from his
initiation into the adult world until his death. Traces of wear show long-time
regular use. Even though the basic motifs are shared, each of the richly dec-
orated Late Bronze Age razors has its own individuality, leading to questions
regarding whether a personal identity may have been expressed. It is possible to
speculate that the owner’s name might even be hidden in the decorative narra-
tive (for example, Dawn may have been a common man’s name). One could also
ask whether such a personal item was used to communicate shared religious
ideas openly or in a more subtle, personal way. Many of the same motifs as seen
on the razors, such as the ship, the (sun) horse, and the snake, are found on the
open rock carvings of southern Scandinavia. There is, however, one interesting
exception. The fish is very rarely seen on the open Bronze Age rock carvings,
while it occurs on many bronze objects including the razor. Here some taboo
about representation may have been observed regarding the open rock carvings.

Prior to 1100 BC, decorative aspects of the razors of south Scandinavia were
almost entirely limited to the handle, which was shaped in the form of a horse
head. Some of the horse’s heads can be regarded as fine pieces of miniature
plastic art, in an elegant way expressing a peculiar ‘horseness’ (Figure 3.3). But
how did the figural iconography on the blades emerge? Was it a result of local
Nordic development, or foreign influences that stimulated a new creativity?
This essay explores these questions, leading us to the eastern Mediterranean
and eventually back to Scandinavia.

THE EARLY BRONZE AGE TWO-EDGED RAZORS OF THE AEGEAN

The earliest bronze razors known from Europe come from the eastern
Mediterranean where they belong to the Early Minoan, Early Cycladic, and
Early Helladic periods of the Aegean Early Bronze Age. The razors are more
or less leaf-shaped with both sides worked-up as edges. They probably derive
from Egyptian prototypes where similar shapes are known (Petrie 1917: 50ff.;
Weber 1996: 37ff.). In the Aegean the two-edged razor had a long life, only
being replaced at the transition between the Late Helladic/Late Minoan II and
IIIa, c. 1450 BC according to the new Thera-based chronology (Weber 1996;
Kaul 2013a).
The two-edged razor spread over a large part of central and western Europe at the beginning of the Middle Bronze Age (c. 1600–1500 BC). Petrie (1917: 50–1) suggested that the two-edged razor spread from Crete via Sicily to central and western Europe including Britain and Ireland. It is generally accepted that this introduction of the two-edged razor reflected new ideas of fashion and body care deriving from the Mediterranean, the razor often being accompanied by tweezers (Jockenhövel 1971: 25, 1980: 27). The central European two-edged razors have sufficient features in common with many British razors to suggest that they are related (Butler and Smith 1956: 24). However, this early spread of razors did not reach Scandinavia and northernmost Germany. It does not, therefore, seem to be implicated in the creative developments seen in the razors in the Nordic area. It is therefore more useful to trace the specific path of the one-edged razor.

**RAZORS OF ANCIENT EGYPT**

In order to follow the development and spread of the one-edged razor it is necessary to go south to ancient Egypt, where a tradition of shaving had deep roots going back to at least the Early Dynastic period. For the ancient Egyptians, shaggy beards and overall hairiness indicated bodily negligence and uncleanliness. The face, neck, limbs, armpits, chest, and pubic regions were regularly shaved (Davies 1982: 189). Men and women wore their natural hair...
close-cropped, attiring themselves with wigs on public occasions (and the ceremonial beard for Pharaohs). Wigs would have been expensive and were probably restricted to the nobility (McCreesh et al. 2011). Men were generally clean-shaven, facial stubble being allowed only in special circumstances, such as at times of mourning. Professional barbers called *chaku* played an important role in Egyptian society. They were attached to the permanent staff of royal and noble households, of temples, and also to the army (Davies 1982).

The so-called rotating razor originated during the New Kingdom (Petrie 1917: 49; Davies 1982: 189). It has a long, broad, bronze blade that ends in a relatively narrow cutting edge. From the middle of the blade a handle fastened by rivets projects at a right angle (Figure 3.4a). By making a rotating movement

![Image of Egyptian razors](https://www.cambridge.org/core/asset/1234567890abcdefg/89765432109876543210/89765432109876543210.png)

Figure 3.4 Egyptian razors. a) New Kingdom Egyptian rotating razors. Upper without find provenance, lower allegedly Abydos. Originally the lower razor would have had a longer blade, the primary cutting edge at its end now missing, and a new ‘blunt edge’ has been created, probably due to some ‘restoration’ work. Originally the two razors should have had approximately the same length. Both seem to have an extra cutting edge along the blade at the opposite side of the handle. (The Petrie Museum of Egyptian Archaeology, London, and the National Museum of Denmark, Copenhagen.) L: c. 16 cm. b) Egyptian razor with a handle in the shape of a plastic rendering of an ape. (The Petrie Museum of Egyptian Archaeology, London.) Drawings: Thomas Bredsdorff.
of the wrist, the short edge could be used in swift cutting movements, cutting upwards and downwards, or to alternate sides. This seems to be an excellent tool for the skilled barber, especially since the method of alternating up-and-down cuts or slashes are most easily employed by a person other than the one being shaved. In other words, we may not be dealing with a personal item belonging to the person being shaved. A few razors have another sharp cutting edge along the side of the blade, in addition to that at the end of the blade. The extra edge does not negate the concept of this razor being for professional use, but it may have been easier for a person to use this edge if shaving himself without involving a barber.

Apart from a zigzag-like pattern on the handle and one short hieroglyphic inscription, these razors do not seem to be decorated. Although some weak striations can be observed on some items it is difficult to decide whether we are dealing with decoration, or just a means to get a better grip on the handle. Another type of razor does, however, carry decoration. Like the rotating razor, this razor has a narrow cutting edge at one end of the blade, but there is no handle projecting at a right angle from the middle of the blade. Instead there is a handle with plastic figural decoration at the opposite end to the blade; because of its small size and delicacy it has been suggested that this type was a woman’s razor (Davies 1982: 190). It might be argued that the decorated handle indicates that we are dealing with a personal object for individual use. Examples of decoration on the handle include a plastic rendering of a hippopotamus (Petrie Museum of Egyptian Archaeology, inv. no. UC 30135), and one with an ape plucking palm-nuts over a lotus decoration (Petrie Museum of Egyptian Archaeology inv. No. UC 40665) (Figure 3.4b). This decoration may be considered as iconography with underlying religious significance.

Nonetheless, not all decorations on Egyptian razors were related to the religious sphere. A third type of Egyptian razor is a piece of toilet equipment belonging to the 18th Dynasty (c. 1550–1292 BC). In some cases this carries a handle in the shape of an animal figure onto which a small razor blade or a pin for curling hair could be inserted. The animal may be a representation of a royal horse in flying gallop because of the plumes on its head (Davies 1982: 190; Freed 1982; Petrie 1917). It likely represents a horse for a chariot, indicating a military connection; these implements belonged to members of the highest military ranks. The meaning of such horse representations was not a religious one since the horse in ancient Egypt was not related to the religious sphere. Rather the horse (and chariot) became a symbol of the military capacity of Egypt and was a social symbol of power.
THE MI NOAN AND MYCENAEAN ONE-EDGED RAZOR

In the Aegean, at the transition between the Late Helladic/Late Minoan II and Late Helladic/Late Minoan III A, the two-edged, symmetrical, leaf-shaped razor was succeeded by the one-edged, asymmetric razor. On the latter, the handle protrudes as a continuation of the back of the slightly curved blade. The handle of the Aegean razor is mostly flanged with holes for rivets (Figure 3.5). Parts of the handle were made of organic material – wood, bone, or ivory – secured by the flanges and rivets. It remained more or less the same until the end of the Late Helladic/Late Minoan III C. This one-edged, asymmetric razor seems to emerge rather suddenly, without any prototypes.

Given its shape, it has been suggested that this type of razor could have derived from the New Kingdom (Evans 1906: 116; Weber 1996: 7). It is tempting to compare the outline of the blade of the Egyptian rotating razor with that of the Minoan/Mycenaean one-edged razors; if the peculiar handle projecting from the blade and the knob securing the handle are removed from the rotating razor, then it is similar to the blade of the Minoan/Mycenaean razor.

![Figure 3.5 Aegean one-edged, asymmetric razors, Late Helladic/Late Minoan III A, from Zapher Papoura and Epano Gypsades, Knossos, Crete, and Prosymna, Argolis, Greece. L: 17.5–23.6 cm. Redrawn after Weber 1996.](image-url)
Even greater similarity appears if one considers that some of the Egyptian razors had a cutting edge along their longer side. On the Minoan/Mycenaean razor the handle was placed at its end, making it easier for a man to shave himself. If we accept that the Egyptian rotating razor could have been used as a professional ‘barbershop’ item, then we should consider the Minoan/Mycenaean razor as an object that was probably used by the individual. It is often found in warriors’ graves in combination with weapons, succeeding the earlier Aegean two-edged leaf-shaped razor found in these same contexts; if the Minoan/Mycenaean razor was inspired by its Egyptian cousin then the setting of the object seems to have changed with geographical distance. It has been noted that iconographic evidence of the Late Minoan/Mycenaean period shows the members of the warrior class as beardless or partially shaven (Weber 1996: 20–1).

The new razor type spread rather swiftly, and it is not possible to detect any differences in the development on Crete, the Greek islands, and on mainland Greece. Perhaps these razors were introduced and made at certain centres of production such as Knossos. No Egyptian razors have been found in the Aegean area, and vice versa (Weber 1996: 39–40). Nonetheless, at a time when contacts between Egypt and Crete were close, around 1450 BC, a creative hybridisation of razor elements could have taken place. Ideas and influences can ‘travel’ without the occurrence of detectable import materials.

Since the handle of the Minoan/Mycenaean one-edged razor was partially of organic material, it has not been possible to determine its full shape. Nonetheless, some votive objects found deep in the Dictean Cave at Psychron, Crete, shed light on this matter. The Dictean Cave ranks among the most important sacred places of Minoan Crete, and according to one ancient tradition was the birthplace of Zeus. At the bottom of the cave there is a pool out of which rises a forest of stalagmites. Most of the bronze votive objects, including knives, razors, tweezers, pins, chisels, and double axes were found in crevices in the stalagmite pillars and in the pool area (Hogarth 1900). The main period of the bronze votives dates to Middle Minoan III to Late Minoan III, but there are also later depositions (Boardman 1961; Weber 1996). The votive razors from the Dictean Cave belong to the one-edged type, and can be dated to Late Minoan III. The razors are all cut out of thin sheet bronze. On these votive razors the full shape of the handle is present. In some cases the handle terminates in a spiral curl, in others it terminates in an animal’s head (Boardman 1961: 50–1; Weber 1996: 156–7). In one case we are seemingly dealing with a stylised horse’s head (Figure 3.6). By means of the votive razors from the Dictean Cave it is therefore possible to infer the shape of the full handle of at least some of
the Minoan and Mycenaean one-edged razors and to suggest that the handles were decorated with animal heads, including the head of a horse.

Given that the horse head seems to have been represented on some Minoan razors it is tempting to also include the Egyptian toilet implements with horse-shaped handles in the process of creative amalgamation. In Egypt the horse figure was a symbol of military power, well suited for the warrior class, but it should not be ruled out that the horse and the horse head could have obtained additional or different meanings in the religious sphere in the Minoan/Mycenean world. In later Greek religion the horse gained an important place. For instance, Poseidon could take the shape of a horse or mate with a horse. Even though Poseidon is known from Linear B tablets, it is uncertain whether his mythological link to horses had already begun at the beginning of Late Minoan III. Nonetheless, a couple of Linear B inscriptions point to the importance of the horse in the religious sphere. In a list of divinities from Knossos we find Atana Potinija – Athena as Potnia – the Mistress, and from Pylos an inscription relates a Potnia to horses – being the Mistress of the Horses, perhaps implying a link between Athena and the horse; in Classical times Athena

Figure 3.6 Votive razor with handle in the shape of a horse’s head, from the Dictean Cave, Crete. L: 8.6 cm. Photo: F. Kaul.
CASE STUDY: THE ONE-EDGED RAZOR

was clearly related to horses. It is, of course, difficult to say whether these texts refer to different goddesses, to different aspects of the same goddess (Peruzzi 1980: 159; Schofield 2007: 160), or whether gods with the same name had the same character as in later times. Nonetheless, it is worth considering that the horse may already have had a religious significance during the Bronze Age.

In pictorial renderings of horses it may at first glance seem difficult to find religious aspects represented. The Mycenaean vase paintings, for instance, show representational processional scenes or hunting scenes with horses. There are, however, depictions of processions including horses pulling a wagon where solar discs seem to be involved and in which the horse might have gained a divine status. This could be the interpretation of scenes depicted on a Late Minoan III Larnax from Episkopi, Crete (Davaras 1976: 176–7), but it is quite possible that we are not dealing with a procession in the world of the living, but with a rendering of the deceased going in his horse-drawn chariot to the afterlife (Mellink 1991: 301). On a couple of Late Minoan III Larnakes from Armenoi, Crete, exhibited in the archaeological museum of Rethymnon, horses are depicted in what this author would consider a religious/mythological setting, together with solar symbols, spirals and other animals such a snake and a fish that could be seen as related to the eternal voyage of the sun. Even though these Larnakes should probably be dated to 1300–1200 BC, they seem to evidence a growing interest in the horse as a divine animal, and this tendency could perhaps be traced back to the beginning of Late Minoan III. Later, in the Geometric Period, many bronze votive horse figurines were deposited at major Greek sanctuaries, while horse representations surrounded by solar symbols on funeral pottery yield evidence of the horse’s religious significance.

It seems likely that if the Minoan/Mycenaean one-edged razor was created from Egyptian prototypes in a deliberate process of amalgamation, the meaning of the horse figure of the handle changed, from being related solely to the secular, military sphere to being connected to the religious sphere. When the next spatial leap in the presence of the one-edged razor took place – this time a gigantic leap – the religious character of horse representation increased considerably.

THE NORDIC BRONZE AGE RAZOR: THE MIDDLE BRONZE AGE

The Nordic Bronze Age razors are one-edged and asymmetrical; the handle continues the line of the back of the blade and is shaped in different ways. The earliest razors, appearing during Montelius Period II of the Nordic Bronze Age, are commonly characterised by a handle terminating in a plastic horse head. Here the full handle is cast, and some of the horse heads are beautiful
EFFECTS: SHAPE, MOTIFS, PATTERN, COLOUR, TEXTURE

pieces of miniature art. The back is straight or slightly concave (Figure 3.7). The overall design of the early one-edged razors, as well as the shape of the horse-head handles, show a striking resemblance between the Aegean and southern Scandinavia. Due to recent reassessments of the absolute chronology in both areas it is possible to track a ‘time corridor’, during which this shape of razor could have been transferred within a relatively short period of time in the later half of the fifteenth century BC (Kaul 2013a).

Reassessment of the absolute chronology of the eastern Mediterranean, based in particular on the dating of the Thera eruption (Friedrich and Heinemeier 2009; Manning et al. 2002), has led some scholars to argue in favour of a chronological synchronism between Late Minoan II and perhaps an early part of Late Minoan III A with the reign of Tuthmosis III (1479–1425 BC) (Manning 1996, 2009; Wiener 2003). Thus, these reassessments of the absolute chronology indicate that the transition between Late Minoan II and Late Minoan III A took place around 1450–1420 BC, and it seems likely that the one-edged razor appeared in the Aegean around 1450 BC. The Nordic Bronze Age has also been subject to re-examination of its absolute chronology. In
CASE STUDY: THE ONE-EDGED RAZOR

Scandinavia, Montelius Period II began around 1500 BC. Recent chronological studies based on absolute dendrochronological dates of the Danish oak coffins demonstrate that the mature Period II of the Nordic Bronze Age is dated to around 1400 BC (Randsborg and Christensen 2006: 21). The first Nordic bronze razors with the handle in the shape of a horse head can be related to this mature phase of Period II, though a very few specimens could be one or two decades earlier. These chronological observations render it possible for there to have been sufficient time for the dissemination of this particular shape of razor from the Mediterranean to Scandinavia.

How could such ideas move through Bronze Age Europe? Trade of tin and copper, as well as of Baltic amber to the Mediterranean, should be seen as a vehicle of social interaction and diffusion of ideas. It is important to note that the sources of so-called Baltic amber were both the coasts of the Baltic Sea and the beaches along the North Sea (Jensen 2000). Collection and storage of unworked amber is evidenced at a Middle Bronze Age farm near the coast in north-west Jutland, Denmark (Bech and Mikkelsen 1999: 50). Recently, glass beads found in Scandinavian Bronze Age burials have been found to derive from Egypt and Mesopotamia (Varberg et al. 2015).

Whatever routes may have been used for the dissemination of the asymmetrical one-edged razor, it is an astonishing fact that no such razors have been found between the Aegean and the area of the Nordic Bronze Age. Another type of razor had already been introduced into these central European regions some decades before, namely the symmetrical, two-edged, leaf-shaped razor. After this form of razor and the idea behind it was introduced, no replacement by another type was seemingly needed. When hearing about the one-edged razor in central Europe, the answer may have been: ‘Sorry, we have one already’.

It was not only the shape of the razor that was transferred to Scandinavia, but also the ideas behind it, probably reflecting new ideals related to the shaven warrior (Kaul 2013a). It was via travel that such knowledge became extended. This does not necessarily mean that contacts were direct. Networks of exchange and ideas could have involved several steps, although there may have been some meeting places or ‘routes’ that were significant for the transfer of the razor. Prominent members of societies could have met, and conversations as to ideals of bodily appearance could have taken place. Following the line of recent discoveries, candidates for such places could be Monkodonja in Istria, Croatia, in the Po Valley, at Lago di Garda, north Italy, or Bernstorf in Bavaria (Kaul 2013a).

The diffusion of the razor just prior to 1400 BC and the ideas that it carried should not be seen as part of a wave that overwhelmed the passive receivers in
the north. Terms like ‘influence’ or ‘diffusion’ do not seem sufficiently explanatory. We could perhaps talk about ‘active diffusion’, where leading members of societies having knowledge of the world of the Mediterranean, probably after long journeys, deliberately picked up certain elements that could be used in self-promotion in a dynamic time of change. Such leaders must have had great authority within their local network, since it was possible for the razor with horse-headed handle to spread all over southern Scandinavia within a generation or an even shorter span time. Men of importance felt obliged to possess and use razors. The introduction of the razor should not, however, be regarded as an isolated phenomenon, but as part of a larger picture of south–north social interaction and changing body ideology. It should be considered as a component of an ‘aristocratic package’, reflecting a new chiefly elite culture (Kristiansen and Larsson 2005: 212–26; Treherne 1995). At the same time, elements such as the folding stool, bronze drinking vessels, and the horse-drawn chariot were introduced or chosen in the north. These features, together with the razors, indicate the acceptance of parts of a Minoan/Mycenaean lifestyle.

The horse figure gained a prominent place in Nordic iconography shortly after the introduction of the razor in Scandinavia. The most splendid example is the Chariot of the Sun, from Trundholm Mose, Zealand, Denmark, probably created c. 1375 BC – fifty years or less after the introduction of the horse-headed razor. The golden, spiral-decorated sun disc testifies to the Nordic craftsmanship of this object, showing how influences from outside were transformed locally. Here the horse figure has become the divine sun horse, pulling the sun over the heavens during the day and through the underworld at night – one of the cornerstones of Scandinavian Bronze Age mythology (Kaul 2004a). It is quite clear from the style and craftsmanship of the horse head of the Chariot of the Sun, that a close connection exists with the heads found on the early razors. Another example of the sun horse is the pair of horse figures from Tågaborg, at Helsingborg, Scania, of the same date (Montelius 1917).

At about the same time, the horse figure also appeared in other media, in particular on rock carvings. It also appears on the slabs of the large stone cist at Bredarör, Kivik, Scania, Sweden (Goldhahn 1999; Kaul 2004a; Randsborg 1993); the slabs show some horse figures standing alone as an emblematic rendering together with wheel-crosses, but chariot driving is also represented. What characterises these early horse depictions, whether as plastic sculpture or carved on rocks, is the relatively long, low neck of the horse (Kaul 2004a). It is the same posture or angle of the neck we see on the razors. Since the razor spread swiftly over large parts of south Scandinavia, its horse-head handle with its low neck would have provided an obvious ‘blueprint’ for horse figures on other media. The impact of the newly introduced razor with horse-headed
handle must have been great, if we consider it as a medium for dissemination of the emerging cosmological importance of the horse.

THE NORDIC BRONZE AGE RAZOR: THE LATE BRONZE AGE

After the razor with the handle in the shape of a horse head was introduced in Montelius Period II and after a short phase of creativity and innovation, a certain conservatism took over and there was very little change for centuries. At the beginning of Montelius Period IV (c. 1100 BC), however, something happened again. Due to influences from the central European Urnfield Culture, the handle of the razor in the shape of a horse head was replaced by a handle in the shape of the neck and head of an aquatic bird (Kaul 1998: 67–8). At first glance it may look as though the dominating role of the sun horse was seriously challenged, but since both the horse and the aquatic bird can be considered somewhat homologous symbols or helpers related to the voyage of the sun, this change may not have effected any serious alteration of the worldview. In the following centuries the horse and aquatic bird are found together on ships found on rock carvings and on bronzes. In these ship depictions we find stems both in the shape of a horse head and in the shape of an aquatic bird.

Of even greater importance is the fact that at the beginning of Montelius Period IV the blades of the razors became the canvas for figural decoration, for instance ships, horses, fish, snakes, and human-like creatures (see also essay by Sørensen and Appleby this volume). Before that the back of the blade was decorated with lines of geometric patterns, such as triangles and zigzags. A peculiarity of the Late Bronze Age razors is that images of ships often show them as folded, and in some cases the handle of the razor could be conceived as the stem of the ship. In such cases the razor may be seen both as being (half) a ship representation and as creating the frame for ship images (Figure 3.8). This may imply that in the preceding period, the whole razor may have been conceived as (half) a ship image, and that the horse head could have been seen as the prow of a ship. At a time between 1400 and 1100 BC a change in the notion of the horse head may have emerged, from being ‘more horse’ to ‘more ship’. In the subtle symbolism of the razors the sun horse and the sun ship merge together. The move to figural imagery may be considered a significant creative process in the Nordic Bronze Age, but one can still question whether this development was fully independent. Perhaps the surface decoration of the Urnfield Culture bronze buckets with the Vogelsonnenbarke motifs gave inspiration for utilising the surfaces of the razors. In central Europe and in Italy a one-edged razor with a highly curved blade appeared around 1100 BC (Jockenhövel 1971; Peroni 1979), to continue for some centuries. In some cases these razors carry
decoration related to religion, such as aquatic birds. They do not, however, seem to be directly connected with developments in northern Europe.

When the surfaces of the razors first opened for the vivid art representing the sun ship and the other helpers of the sun, the blade in general grew in size, creating room for larger ship images. In Montelius Period V (900–700 BC), we find the largest razor blades totally covered with ships or other motifs; a fleet of five ships can be observed on the richest decorated razor. In Period V the style of the razors changed and became more flamboyant, even though the motifs were the same. In general, the venerable horse gained more ground on the blades. The keel extension of the ships rises higher in Period V while the horse heads of the stems display stylistic changes. From being drawn in a comparatively simple line, the horse heads became curly and could be adorned with extra excrescences in the forms of curls and spirals; the muzzle can end in a spiral (Figure 3.9), while the horse’s high neck can be wavy or curly. Over the ships rows of spirals can be seen (Kaul 1998: 95). It is interesting to note that very close parallels to the many ships on the bronzes dated to Period V are found in the rock carvings, and that these parallels are found over the whole of the Nordic rock carving zone. It may be assumed that Period V is the most active period of creating rock carvings in Bronze Age Scandinavia.

In the final period of the Nordic Bronze Age, Montelius Period VI (700–500 BC), the quantity of imagery on the bronzes decreases, and other razor types were introduced due to influences from the Hallstatt culture, among these, one-edged symmetrical razors with two handles. On this type, in a few

Figure 3.8 Late Bronze Age razor with ship representation from Vendsyssel, North Jutland, Denmark, 1100–900 BC. The handle could serve as a ‘stem aft’ for two ships, stem for one ship, or being the prow of the whole ‘razor-ship’. The head of the horse and the stylised aquatic bird’s head seem to live nicely together as stems. L: c. 9.5 cm. Redrawn after Kaul 1998. Drawing: B. Skaarup.
cases both handles are in the shape of horse heads and a full ship representation emerges (Kaul 1998: 102 ff.). Until the very end of the Bronze Age, the typical Nordic Bronze Age imagery remained represented on the bronzes. At the beginning of the Pre-Roman Iron Age, the light was turned off, and there was no more iconography on the bronzes. On rock surfaces, however, ship images were still created during the following centuries.

Even though the razors of the Nordic Bronze Age should be considered as bearing significant evidence as to beliefs, mythology, and cosmology they still served as a practical implement. It was recognised as early as 1897 by Sophus Müller that razors occur exclusively in male graves, often together with a sword or a dagger. Furthermore, Müller pointed out that for the well-preserved bodies from the Danish oak-coffin graves of the Middle Bronze Age where hair is preserved, no trace of a beard has been found (Müller 1897: 234–5), suggesting that men were groomed. Analyses of some Late Bronze Age razors supplemented by experiments have demonstrated that the edge is sufficiently sharp for shaving after hardening by beating with a smooth hammer and honing (Drescher 1963). In some cases it can be seen that the ornamentation has

Figure 3.9 Detail of razor from Melby, North Zealand, Denmark, 900–700 BC, showing a horse-headed prow, the horse’s head terminating in a spiral curl. Reproduced by permission F Kaul 1998.
disappeared almost entirely; the surface has been worn smooth at the place where one would expect the fingers to have been placed. Sometimes we can observe that the edge has become concave by shaving, the concavity being the result of repeated pressure on the hard jawbone (Kaul 1998: 148–50). It is possible that a razor was given to a young man on the occasion of rites of initiation. The richly decorated razors carrying motifs related to solar mythology could indicate that the young man in question was initiated into a priest-like and/or a warrior status.

FROM BARBERSHOP TO BELIEFS: CONCLUDING REMARKS

This essay has followed the long journey of the one-edged, asymmetric razor from Eighteenth Dynasty Egypt to Bronze Age Scandinavia. Even though all the razors discussed above had a practical function, some acquired other meanings. Whereas it is not likely that there was any deeper meaning behind the so-called rotating razor of Egypt, except being an instrument for the generally accepted hair fashion, on other types of razors religious motifs appeared. These were probably for more personal use.

When the horse head appeared, on at least some one-edged razors of the Aegean, in the context of the Late Minoan/Helladic Period it seems to have been increasingly associated with the religious sphere, the horse probably being related to a great female goddess. Soon after the emergence of the one-edged razor in the Aegean the idea of this razor travelled through Europe, to south Scandinavia/northern Germany where it became more popular than in the Mediterranean. Even though the association with the warrior and ideals about the shaven warrior were transferred, the razors became particularly connected with local religious ideas in northern Europe, which at this point gained a new dynamism. The result was elaboration of the shape of the one-edged razors to make its association with, first, the horse, and later, the aquatic bird explicit. In addition, the surface of the blade became a canvas for the representation of aspects of the dominant cosmology. The development of the one-edge razors thus illustrates a regional creative response and elaboration of a form which was fundamentally shared over large areas but which locally gained a very specific status and connotation.

NOTE

1 For example inventory nos. UC 40550; 40545; 40538 at The Petrie Museum of Egyptian Archaeology in London studied by the author in 2010.
CREATIVITY IN MIDDLE AND LATE BRONZE AGE BIRD-SHAPED AND BIRD-ORNAMENTED CERAMIC OBJECTS IN THE CARPATHIAN BASIN AND THE LOWER DANUBE REGION

Darko Maričević and Joanna Sofaer

Bird imagery is one of the most striking themes explored by Bronze Age potters in many parts of Europe, not least along the middle and the lower reaches of the Danube in the Carpathian Basin and central Balkans. While the ideas and symbolism at the root of this widespread manifestation were broadly shared and had their origin in the Bronze Age belief system, the way in which bird imagery was expressed in clay was highly variable. These variations offer an opportunity to explore the creative processes behind bird-shaped and bird-ornamented objects.

All bird-shaped and bird-ornamented clay objects were a conceptual marriage of bird iconography and the role of the object. In creating bird-shaped objects potters faced a number of choices that deviated from those routinely offered by the production of vessels that formed the bulk of their potting work. Many of the bird representations, while recognisable as birds, either lack features such as a head or wings, or have extra features such as four legs. It is therefore clear that the representation of birds was highly variable in its degree of naturalism and was not necessarily always intended to be realistic, allowing for creative expression. It is through the workability of clay as a material on one hand, and the maker’s skill, imagination, and external influences on the other, that the final form of the object became reality.
TYPES OF BIRD-SHAPED AND BIRD-ORNAMENTED CERAMICS

Previous studies in the Carpathian Basin and the Balkans have concentrated on the typology, chronology, and distribution of bird representations (Kovács 1972), their cataloguing, contextual analysis, and possible religious roles (Guba and Szeverényi 2007; Szathmári 2003), decorative motifs and their symbolism (Reich 2005), as well as the ornithological identification of bird images as waterfowl (Sturm-Berger 2004; Vasić and Vasić 2000, 2003–2004). The range of three-dimensional plastic bird imagery includes solid and hollow clay bird figurines, bird-shaped rattles, vessels with bird-head protomes or projections, and bird-shaped vessels. The latter includes both bird-shaped containers as well as highly stylised askoi. In addition, bird imagery appears as a two-dimensional motif incised on pottery (Figure 3.10).

Solid and hollow clay figurines of birds are the rarest form of bird-shaped object in the Carpathian Basin and Lower Danube, although some well-known objects such as the aquatic birds (possibly mallards) pulling the famous

![Figures](https://www.cambridge.org/core/terms. https://doi.org/10.1017/9781108344357.023)

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Dupljaja chariot broadly fall into this category (Bonev 1996; Garašanin 1951; Vasić and Vasić 2003–2004). Most examples of clay bird figurines in the area are relatively late and date to the Late Bronze Age/Early Iron Age transition in the Srem region of Vojvodina in Serbia, and neighbouring Slavonia in northern Croatia (Medović 1988; Metzner-Nebelsick 2002; Ilkić 2006; Daria Ložnjak Dizdar pers. comm.).

More widespread are the hollow models of birds made into rattles. In the Carpathian Basin and the Lower Danube their chronology mainly fits within Middle Bronze Age traditions (Guba and Szeverényi 2007; Kovács 1972). Elsewhere, such as in the Lusatian Culture in the north-east of Europe, bird rattles become numerous in the Late Bronze Age and Early Iron Age. Conceptually these objects form a distinct group that is clearly defined by their bird shape on one hand and their function as an object to create sound on the other. Nevertheless, there is a great deal of variation within this basic concept, even among bird-shaped rattles found in the same area or related to the same ceramic tradition. A relatively small proportion of rattles in the Carpathian Basin and the Lower Danube region exhibit sufficient similarity in shape, decoration, and degree of stylisation to have been recognised as a clearly defined sub-type (Guba and Szeverényi 2007).

Pottery vessels, such as bowls and jugs, can feature either fully formed bird-shaped protomes attached to the rim, handle, or shoulder of the vessel, or bird-shaped projections of the rim. These two groups have mutually exclusive distributions. The protomes occur on both Middle and Late Bronze Age bowls and jugs in the Lower Danube region on either side of the modern Serbian–Romanian border, for example on bowls from Vajuga-Pesak and Glamija in Serbia (Krstić 2003; Popović and Vukmanović 1998; Premk et al. 1986) and bowls and jugs from Ostrovul Mare in Romania (Berciu 1939). The bird-shaped rim projections mainly date to the Middle Bronze Age. They are found on bowls in southern Pannonia at sites such as Vršac-At and Feudvar in Vojvodina, and Szeremle in south Hungary (Reich 2005), but also further north at Pákozd-Várhegy (Guba and Szeverényi 2007). After c. 800 BC birds cease to be the sole carrier of animal symbolism and are joined by bovines, equines, and other forms of imagery characteristic of the early Hallstatt period, while zoomorphic models, protomes, and appliqués become more varied and common in clay and in metal (Benac 1983, 1987; Kossack 1954; Patek 1993).

Bird-shaped vessels come either as containers or as askoi made for pouring. Both of these are more numerous during the Middle Bronze Age, but continue into the Late Bronze Age (Filipov 1974; Guba and Szeverényi 2007; Kalicz-Schreiber 1991; Kovács 1972, 1990; Shalganova 1995). Bird-shaped containers are found across the Carpathian Basin and Lower Danube region,
but are particularly concentrated along the Lower Danube within the Žuto Brdo – Gârla Mare cultural complex. They exhibit close stylistic similarities to each other (e.g. Berciu 1939; Dumitrescu 1961; Filipov 1974) and are rather homogeneous in shape compared to their more diverse counterparts from the Carpathian Basin. Some of the bird-shaped containers from the Lower Danube region are similar in their shape to the vessels with attached protomes, the difference being that in the former the entire vessel forms a representation of a bird, rather than the bird protome simply being attached to the vessel. Askoi are virtually unknown in the Lower Danube region at this time and are concentrated in the Carpathian Basin to the east of the Danube. Bird-shaped containers and askoi cannot be seen as regional variants of each other as they are not entirely compatible in a functional sense. Some of the containers have perforations or lug handles, which suggest that they might have been suspended on relatively thin strings or cords. By contrast, in addition to being made for pouring liquid, many (but not all) askoi are larger vessels with broad bases, which made them stable when full and heavy. These differences pose a series of questions about the respective roles of these vessels, not only in terms of the social context that they were meant to be seen in, but also with regard to the different contents that they might have held.

The incised bird motif is exceptionally rare on ceramic vessels in the Carpathian Basin and the Lower Danube throughout the Middle Bronze Age. It is not until after c. 800 BC that this form of highly stylised decoration appears on pottery vessels (Czyborra 1997; Tasić 1991). Such two-dimensional representations did not, however, replace three-dimensional bird-shaped objects as the latter did not entirely disappear in the Late Bronze Age and the Early Iron Age. Rather there were local differences in the uptake of bird-shaped and bird-ornamented objects. In Slavonia and in neighbouring areas west of the Carpathian Basin such as Istria, Slovenia, and northern Italy, for example, two-dimensional bird images appear around the same time as their three-dimensional counterparts, on the cusp of the Iron Age (Benac 1983, 1987; Ilkić 2006; Majnarić-Pandžić 1998; Metzner-Nebelsick 1997, 2002; Vasić 1973). For most of the Bronze Age these regions seem to have been outside the bird-forming ceramic traditions present in the Carpathian Basin and the Lower Danube. This is particularly striking in relation to Slavonia, which is in the eastern part of the Carpathian Basin and is otherwise culturally and geographically closely connected by the River Danube to both Hungary in the north and Vojvodina in the east throughout the Middle and Late Bronze Age (Ložnjak Dizdar 2004; Majnarić-Pandžić 1985; Tasić 2003–2004). Further specific regional sequences and developments in bird imagery can be observed in other parts of Europe, especially in the north and west of the continent, for
example in Slovakia, Czech Republic, Poland, and eastern Germany (Buck 1996; Gediga 1970; Gedl 1996; Kossack 1954).

CREATIVITY IN SHAPE IN BIRD-SHAPED AND BIRD-ORNAMENTED CLAY OBJECTS

Different types of bird-shaped and bird-ornamented objects employed distinct kinds of creative solutions in order to link the idea of the bird with ceramic forms. These also required different levels of technical skill in their realisation. One solution to the incorporation of bird imagery was to add bird iconography to an existing ceramic form. This was also the least technically demanding option. This could be done either by adding plastic bird depictions in the form of bird-head protomes or by decorating a vessel surface with two-dimensional bird images. Neither of these two types of embellishment changed the basic shape of the pot. Modelling one or more parts of the rim of the vessel to form projections shaped like a bird’s head went half a step further towards creating a bird-shaped vessel but still did not alter the basic vessel shape. In this case the difference to the vessels with added protomes is mostly in the technique, which did not involve joining together two separate preformed entities of the vessel and the bird. Instead, the shaping of the bird’s head was the last step in the shaping of the body of the vessel and was made by pulling and shaping the clay away from the rim. It constitutes a modification of an existing form rather than its full reconceptualisation.

As opposed to the additive solutions outlined above, a more radical means of linking the bird and ceramic forms involved the full fusion of imagery and form, as is found in bird-shaped containers and askoi. This required a complete redefinition of the nature of existing vessel types through the development of novel vessel forms. It was also a more technically demanding response to the desire to integrate birds with ceramic forms as it changed the shape of the pottery vessel so that it resembled the bird’s body, with or without representations of all anatomical features such as tail, wings, legs, or head. It was particularly challenging because it changed the fundamental geometry of the vessel from a familiar round shape to an asymmetric, bird-shaped form. The biggest difficulty associated with this is getting the balance of the vessel right, especially as at least some of these vessels held liquid; by impacting on the overall roundness and symmetry of the vessel its stability would be affected by even a relatively small degree of deformation. This is particularly true of the askoi, which, being most asymmetrical in shape, show the highest degree of deformation compared to other contemporary vessels and would therefore have been the most difficult form to get right.
The integration of bird imagery and ceramic shape can also be seen in the way that the formation of the shape of the bird’s body was a basic requirement in the production of bird-shaped figurines and rattles. The added technical quirk in the making of the bird-shaped rattles is that the clay still had to be sufficiently soft before the objects were closed, while at the same time their contents must not stick to the inside of the objects during the drying process, otherwise they would not work as rattles.

Bird-shaped vessels and bird-shaped rattles were the most dramatic conceptual departures from the shapes in existing ceramic repertoires. They were also the most technically demanding objects to make of all the categories considered in this essay. Yet at the same time they are by far the most numerous ceramic bird representations in the Bronze Age. The paucity of comparatively simple plastic bird representations in the form of solid clay figurines, which can be formed by stretching and pinching a lump of clay, is not only surprising but serves to emphasise the close association of bird imagery with relatively few well-defined ceramic types. It also reveals particular kinds of creative responses to the development of bird-ornamented and bird-shaped objects. The associations between bird imagery and different ceramic types were not random. Bronze Age potters had clear ideas about which forms should be associated with birds.

‘BIRDNESS’ AND THE WAYS IN WHICH IT WAS ACHIEVED

Despite the limited number of categories of bird-shaped and bird-ornamented ceramic objects in the region, even a cursory visual inspection of the corpus reveals a great variety of different-looking objects. It may be argued that this reflects a wide range of ways in which potters responded to the challenge of taking on a seemingly unified subject – the bird. In other words, potters chose different creative paths within the otherwise restricted range of bird-shaped ceramics.

If a potter’s aim was to create an object that was both functional and socially meaningful in terms of its bird iconography, then what was required was something that, in its essence, encapsulated both its role and ‘birdness’. ‘Birdness’ is used here to characterise the visual and other sensory qualities of objects that were made to look like birds and to capture their cultural associations (see also Becker this volume). Although, by definition, all of the objects discussed here carry a degree of ‘birdness’, their ability to evoke an image of a bird as seen in nature varies tremendously according to the levels of stylisation or realism applied in their production. On one hand there are objects that are heavily stylised or abstracted. On the other hand there are objects that have
naturalistically depicted avian anatomical features. Furthermore, some objects also evoked ‘birdness’ through sound or movement.

The different ways of creating ‘birdness’ must not be understood as a qualitative gradation by which one or other end of the scale should be classed as more or less successful or meaningful. It would be a mistake to think about these objects merely as imitations of natural forms. Much of the variation apparent among ceramic bird forms can be ascribed to departures from the realistic representation of natural forms through stylisation and abstraction. The stylisation of bird-shaped ceramic objects was realised by reduction and omission of certain anatomical features and bodily details of the bird. Abstraction can generally be understood as a visual paring down from the realism of a portrait-like representation through the introduction of visual ‘short-cuts’. This can be seen in objects in which angular lines have been introduced to stand for feathers or where functional parts of the pottery vessel, such as handles and pedestal bases, have replaced anatomical features, such as wings and legs (see Figure 3.10).

At one level, by non-commitment to the naturalism of the portrait, in abstraction the maker gained much greater freedom of expression. At another other level, the technical side of the task was often greatly simplified without danger that the intended message of the object would be lost, as long as a certain degree of ‘birdness’ was retained.

Reduction was most often applied to the lateral extremities: the wings, tail, legs, and head/neck. Rather than representing the full extent of such features the maker could decide to represent them in reduced form as small projections or stumps which are out of proportion to the body, but nevertheless contribute to the ‘birdness’ of the object. This process was at times extended further so that certain anatomical features were omitted completely (see Figures 3.10d and e). Once again it was the extremities that were usually chosen for such treatment, perhaps because they often did not play any functional role in the object or could even be detrimental to it. It is interesting to note that their absence does not significantly impact on the ‘birdness’ of the object as this was frequently clear from other aspects of the object such as body shape.

The relationship between the role of objects and their ‘birdness’ was sometimes further negotiated by the replacement of a bird’s anatomical features with functional parts of the object. These are normally handles or, particularly on some bird-shaped vessels, pedestal bases. Handles could be placed onto the side of the bird-shaped vessel so that they not only performed their function, but also created a reduced version of the bird’s wings. A similar effect was achieved with the pedestal bases, these forming the legs and the feet of the bird (Figures 3.10a and b). It is not uncommon that a combination of several techniques was applied to a single object. For example, askoi from Hungary often
express extreme abstraction, indeed they are defined as a form by the omission of the bird’s head and its replacement with the vessel opening (Figure 3.10e).

Although the anatomical extremities offered possibilities for reduction, omission, and replacement, the retention of the shape of the bird’s body was more or less obligatory for all bird-shaped vessels and rattles. Yet the bird’s body alone is rarely enough for a ceramic vessel to resemble a bird without some other indication of the neck, tail, or wings. The exact boundaries of different parts of a bird are sometimes difficult to draw, but it is often enough to have one end tapered in a manner that suggests the tail in order that the vessel can unmistakably be recognised as a bird. In many cases, the bird’s chest is also suggested by the widening of the object’s profile. This effectively constitutes the basic bird shape, which could be elaborated upon in a number of different ways. Many bird-shaped vessels, especially in the Middle Bronze Age Žuto Brdo – Gârla Mare tradition, do not deviate much from a basic globular vessel shape but by adding even slight asymmetry to the vessel the potter could achieve the impression of the bird’s body, especially if other features such as tail, neck, or head were indicated as well. Making the body of the pot asymmetric has the effect of angling the central axis of the vessel in one direction and creating the sense of the front, sides, and back of a bird.

Occasionally the three-dimensional Bronze Age bird representations have added features borrowed from other animals or humans. Most often these include bovine horns or extra legs, including human-like feet or facial depictions (Palincaş 2010; Reich 2005). Mixing anthropomorphism with bird imagery is attested from early in the Middle Bronze Age. The important aspect to highlight in this ornithomorphic – zoomorphic – anthropomorphic ‘mish-mash’ is that all of these objects remain ‘birds’, albeit with added extras. As far as the Middle and Late Bronze Age imagery is concerned, the central role of the bird does not seem to have been questioned. In other words, we do not find ceramic representations of horses or bulls with wings or bird’s heads. Such additions do not therefore introduce challenges to the ‘birdness’ of the objects, which was usually retained through the basic shape of a bird’s body. The perception of the object, however, becomes dependent on the angle from which it is viewed (Palincaş 2010). For example, with horned birds it is often the case that their identity is much more ambiguous when viewed from the front because the bird’s body shape and its head with the beak/bill is always most recognisable from the profile. Likewise, birds with four feet might be perceived as quadrupeds only from the profile as the front view conceals the additional limbs. These hybrid features may suggest an ability to ‘shape-shift’ that might have been essential to the narratives they were intended to project. It has to be stated, however, that not all ceramics with four feet were necessarily meant
to be animal crossovers. Some may have been made in such a way simply to balance the object.

Many of the most abstracted bird representations related to Bronze Age ceramic objects are the incised two-dimensional depictions of birds on otherwise non-bird-shaped vessels. They appear on Late Bronze Age/Early Iron Age Basarabi pottery and related ceramic styles across southern Pannonia and the eastern and central Balkans where they were often formed through the combination of S-lines and triangles. Here birds became part of broader compositions on pottery. They often form repetitive patterns that were used decoratively to fill particular zones on the surface of vessels or to emphasise aspects of vessel geometry (Figure 3.10f). There are several ‘schools’ of stylised bird depictions that appear at the end of the Bronze Age and during the transition to the Early Iron Age, but it is important to stress that for most of the Bronze Age ceramic bird imagery was an emphatically three-dimensional phenomenon in the Carpathian Basin and Lower Danube region. Further to the west equally stylised bird depictions appear on Urnfield-influenced pottery from Istria and northern Italy (Hencken 1968; Vasić 1973). These compositions often closely resemble the bird imagery seen on bronze vessels, forming bands of bird ‘processions’ circling the pot.

Nonetheless, in some ways these two-dimensional bird images are not radically different from some of the three-dimensional bird-shaped ceramic objects discussed above. Both are characterised by heavy stylisation without too much concern for the realism of the bird imagery, sometimes to the point of being schematic. The emphasis is different, however, in as much as two-dimensional birds form part of broader compositions which may also involve other kinds of schematic and abstract imagery. Furthermore, the two-dimensional bird images are frequently standardised and replicated in greater numbers than their three-dimensional counterparts. This marks a clear departure from the earlier bird-forming ceramic tradition of the Middle Bronze Age related to the production of bird-shaped vessels and rattles, which were frequently characterised by individual blends of attributes that defined their ‘birdness’ and that gave the objects a level of uniqueness beyond their identification with a certain ceramic type. In Middle Bronze Age contexts the deployment of birds in patterns or as part of wider compositions was relatively rare. Bird-head protomes were sometimes replicated around the rim or the shoulder of the same vessel, for example at its quarter or half-points, but overall there is not the same level of repetition and density of pattern as in the later two-dimensional bird images. Thus, we can recognise two different ways of incorporating bird imagery into ceramics that were explored by Bronze Age potters; one that was centred on the ‘birdness’ of an individual object and another that used multiple repeated bird images in the building of a broader composition.
‘Birdness’ was also evoked through haptic engagement with objects. The bird-shaped rattles require shaking in order to produce sound. This opened additional sensory avenues to the audience by adding another kind of experience to the already established connection between the rattle and its bird shape. The fact that the sound produced by the rattles is not necessarily the sound a bird would make was probably not important. Instead it is arguable that the entire set of associations was a closed package; it was concreted by a repetitive performance through which the association between the rattle sound and the rattle shape was learned and from there on expected by the audience. In addition to the sound produced by the object, motion could also be introduced through shaking the object whilst held in the hand. A certain number of bird-shaped rattles have perforations, often on their wings, feet or the crests on their backs, which were probably used to hang the rattles on some sort of string or cord, and perhaps to whirl the bird around to make it ‘fly’.

Askoi can be seen as recreating some of the bird’s natural back and forth motions when used for pouring, resembling the way birds move when feeding. The way the askoi were handled might also have been important to the overall experience provoked by the object. Most of them require both hands to be used due to their shape, size, and weight, especially when full. Movement was also sometimes communicated in the shape of objects. A small number of bird-shaped objects have movement expressed in the shape of the neck and the head, for example by tilting it over slightly to the side. This too constitutes a fundamental part of their ‘birdness’. It can be seen, for example, in a bird-shaped vessel from Cîrna (Figure 3.10d) and a bird-shaped rattle from Cruceni, both in Romania (see Dumitrescu 1961, pl. LXXIV.297; Szentmiklosi 2006, pl. II.1). In both cases the representation of the movement of the neck and the head is clearly deliberate. The Cîrna vessel is much more realistically executed and its movement is both dramatic and completely believable. The movement on the rattle from Cruceni is much more subtle, yet it has the effect of making the abstract representation of the bird’s head more real. The latter was emphasised with the help of a slight turn of the decoration at the front and the back of the neck, which further supports the sense of bird-like head movement.

DEcoration

Decoration provided another opportunity for creativity in the articulation of ‘birdness’, particularly when applied to three-dimensional plastic representations. At the same time, decoration was also used to put the signature of a particular ceramic tradition onto an object. It allowed potters to visually embed objects within their own cultural background, although the bird iconography
that was being represented had a resonance that went beyond their own community.

To illustrate both of these points we use two brief examples from different parts of the study area. The first of these is a group of askoi from the Urnfield cemetery of Békásmegyer in modern Budapest (Kalicz-Schreiber 1991, 2010) (Figure 3.11). The askoi were part of a very distinctive assemblage with a number of unusual forms including fenestrated cinerary urns, spouted ‘libation’ vessels, boot-shaped vessels, firedogs, and a series of small star-shaped and spoon-shaped ceramic objects interpreted as being part of a shaman’s kit (Kalicz-Schreiber 1991). Irrespective of form, the majority of vessels were highly burnished to create a shiny surface and were modestly decorated with parallel fluting. The latter emphasised different parts of the vessels by running around the neck, the widest part of the belly, the top of the shoulder, or around the spout. Perpendicular areas of fluting were also used to emphasise different zones, for example around the belly of urns. Askoi were decorated in this way. In their case the fluting follows the shape of the bird, flowing along the widest part of the body, running perpendicular across the back and up to the handle, and around the neck. In some instances fluting continued across the back of the bird shape and into a projected tail, which was plastically modelled, thus creating representation of the feathers. Overall the effect of the burnish and fluting worked together to visually unify the otherwise rather disparate assemblage.

The second example is drawn from across the Lower Danube region, which is characterised in the Middle Bronze Age by a distinctive tradition of profusely decorated encrusted pottery. The rich corpus of bird-shaped and bird-ornamented forms from this area conforms to the same extravagant style of decoration as other ceramic objects in the region (Figure 3.10c and d). Here local potters used some of the same motifs from the repertoires found in

![Figure 3.11](https://www.cambridge.org/core/core/userimages/95e7e0e36b7d490b9d3b404f4e0504f8/311.jpg)

Decoration as a means of visually embedding objects into local decorative tradition. Pottery from Békásmegyer, Hungary. a) Fenestrated urn; b) ‘Libation’ vessel; c) Askos.
assemblages from key sites in order to decorate bird-shaped objects, such as from the cemeteries at Glamija-Korbovo, Pesak and Vajuga-Pesak in Serbia (see Cermanović-Kuzmanović 1961; Krstić 2003; Letica 1974; Popović and Vukmanović 1998; Premk et al. 1986), Cîrna and Balta Verde in Romania (Berciu and Consa 1956; Dumitrescu 1961), Orsoya in Bulgaria (Filipov 1974), as well as settlement sites at Livade, Serbia (Vukmanović and Popović 1986a and b) or Ostrovul Mare, Romania (Berciu 1939). One of the most intriguing motifs is the apparent depiction of faces. These can be seen on anthropomorphic figurines found in the area and are also sometimes found on the neck or chest of bird-shaped vessels. This may suggest possibilities of bird-human crossovers as also found elsewhere in the Carpathian Basin, such as the bird-shaped rattles with human feet or anthropomorphic askoi (Palincaș 2010; Reich 2005).

CONCLUSION

Bird-shaped and bird-ornamented objects offered possibilities for Bronze Age potters to make different kinds of choices to those that they were accustomed to making on a routine basis. In particular, the production of bird-shaped and bird-ornamented vessels reveals creative impetus not only to add to and modify existing vessel forms in order to accommodate bird imagery, but also to reconstitute it in a radical manner so as to integrate the bird into the vessel form. Furthermore, the creative responses of potters to the bird theme were expressed in the constitution of ‘birdness’ in many different ways. This included abstraction, reduction, omission, and replacement of the anatomical features of the bird with functional parts of the pottery vessel, as well as by creating haptic responses to the object through sound and movement. Rather than imposing restrictions on the form and the appearance of objects, the bird’s anatomical features created an opportunity for creative play and for capturing the ‘essence’ of the bird image through varied degrees of deviation from realism in depiction. This often resulted in highly individual objects, albeit sitting within a restricted range of object categories.

Although object shapes and their ‘birdness’ offered fertile ground for creative exploration of shape, this was less so for decoration. This was sometimes used to accentuate aspects of the form of objects but also conformed to established local norms, thereby ensuring the cultural acceptability and integration of otherwise novel objects. Thus, while there was no single right way to make a clay bird in the Bronze Age, the creativity of the potter resided in the process of materialising the bird form, and therefore its symbolism, into an object that fulfilled a desired utilitarian role while satisfying restrictions imposed by the ceramic tradition to which it belonged.
Towards the end of the Bronze Age and into the Early Iron Age in the Carpathian Basin and along the Lower Danube there was a shift in the representation of the bird. The importance of ‘birdness’ expressed through the production of individual three-dimensional objects gave way to geometric compositions and two-dimensional depictions. The schematised images of the latter still radiate the essence of a bird, but it is a mere presence without the kind of singular identity possessed by the three-dimensional objects. The Late Bronze Age approach to bird imagery on ceramics was connected to the influence of that appearing on bronze vessels, as well as bronze fittings and ornaments. This reveals a change in emphasis to a different suite of creative qualities. Rather than novelty of expression in shape, the Late Bronze Age ceramics show creative influences from other materials, with a new emphasis on geometric compositions and patterns made from abstract and highly stylised bird motifs.
TO DECORATE A NORDIC BRONZE AGE RAZOR: A DESIGN CHALLENGE

Marie Louise Stig Sørensen and Grahame Appleby

Razors are a very interesting group of objects within the Nordic Bronze Age, both in terms of their apparent social roles as they are closely associated with males and due to the development of their shape and decoration through time. The latter is the main focus here. Our aim is to use the changes in the decoration of razors to investigate creativity expressed through ways of solving the challenges of how to fit complex decorative motifs/narratives onto the asymmetrical surfaces of the razors.

Nordic Bronze Age razors are found widely distributed in southern Scandinavia and northern Germany with no obvious concentrations. They are a well-known group within Bronze Age material repertoire, and they are thoroughly integrated in various discussions of the period. The attention given to razors as objects is seen, for instance, in the details of Baudou’s typological division of Late Bronze Age razors in which he created four types with 19 further sub-divisions (1960: 30–8). More recently, due to Kaul’s detailed analysis, their decoration has become a major medium for discussions of cosmological beliefs during the period (Kaul 1998).

The one-handled razor appears in the Nordic Bronze Age material in Period II probably due to influences from the Aegean, as recently argued by Kaul (2013a, this volume). Through time the object undergoes changes regarding its shape as well as the character and extent of its decoration. The most obvious
change in form is that Early Bronze Age razors have forward-pointing handles whereas razors with handles turned backwards appear during Period IV and stay in use until the end of the Bronze Age. The shape of the handles also shows interesting changes. Spirals and simple rod terminations are used from Period II to the end of the Bronze Age, whereas the horse-head terminals are only used during Periods II–IV. Bird-head handles begin to appear in Period III, probably due to influences from central Europe (Baudou 1960: 29; Sprockhoff 1955; for further discussion of the bird figure in the central European Bronze Age see Becker this volume). Thus in terms of the visually most distinct element of the razor (the handle) there is a continuity of elements, the introduction of new forms (although bird and horse heads are used in parallel for a while), and also a distinct change in the design of the handle as its direction is reversed in Period IV introducing a more sophisticated emphasis on the handle as a distinct element.

Kaul (1998) has used the decorations found on many razors (and other metalwork) for an exhaustive discussion of the sun, ship, and horse motifs. His concern was to decode how these designs each depict a fragment of the story about the cosmos, in particular the movement of the sun. Here, rather than exploring the ‘message’ of the decoration, we are interested in decoding their design principles and how the desired designs are expressed and fitted onto the available space. We assume that Kaul’s account of the meaning arising from the design in general is as close as we might ever get to understanding what the images were depicting and how they were understood at the time they were made; our aim is to consider the design solutions that made these compositions possible. In addition, whereas Baudou (1960) produced a very useful typo-chronological division of the razors based on their shapes (the shape of the handle and the blade), we shall not assume that design solutions necessarily follow typological or chronological divisions as there may be regional trends as well as conservative elements and crossovers. Establishing the design groups used in the following analysis was therefore done irrespective of typology and chronology.

In terms of design there are several aspects of the razors that are complex and would have influenced how they were responded to. Accepting Kaul’s argument (1998) that these images are substantially connected to a narrative account of Nordic Bronze Age cosmology, a major challenge would have been how to condense and signal elements of this complex narrative in a manner that was understandable. In other words, the challenge was to fragment a complex narrative and to present it visually. Another substantial challenge was how to fit such representative fragments onto the irregular space of the razors’ surfaces. This must have been a particular concern as symmetrical designs were
highly favoured at the time as seen, for example, in the *Vogelsonnenbarke* (bird-sun-boat) motif and in decoration on ornaments and weapons (for discussion see Becker this volume). The asymmetrical shape of the razors must therefore have posed a challenge in terms of making designs fit onto the available surface while still maintaining their links to general notions of how these narrative tropes should be presented.

Since Kaul’s seminal work on decorated razors much attention has been given to this corpus, and it should therefore be stressed that throughout the Bronze Age the majority of razors were undecorated showing that the link between decoration and razors is not pre-given. The earliest razors were undecorated but even amongst the later types undecorated objects dominate. In our data set, amongst Baudou’s Type XIB–C razors, which are the ones most commonly decorated, only 25% were decorated (see Figure 3.12). The decorated razors therefore need to be understood as a particular kind of elaboration that began during Period III. On the early examples the decoration appears to have been added to the wax model prior to the casting (see Rønne 1989, 1991) and it was thus integral to the design of the razor as a whole. Later we see decorations made both as part of the cast objects and as subsequent incised decoration, as well as a combination of the two. Another distinctive feature of Early Bronze Age razors is that, if decorated, they are usually decorated on both sides (Baudou 1960: 31); this contrasts with Late Bronze Age razors which, with very few exceptions, only have one ‘picture-side’. The early
decoration takes the form of lines placed parallel with the back edge and composed of simple elements, such as triangles, semi-circles and circles, or vertical slashes. While these decorative elements continue to be in use, from Period IV we see the addition of other decorative elements, in particular ships. From then on further elaborations and the development of different design principles all focused on how to present the ship, either on its own or in combination with other motifs.

THE DATA SET

A total of 1,327 razors provide the basis for the following analysis of the design principles and grammar used in decorating Late Bronze Age razors from Denmark. The data set was constructed from the catalogues of Baudou (1960), Kaul (1998), and supplemented with data from Sørensen (1984). It only includes razors with backward-pointing handles or no handles (i.e. Baudou’s types XIB and XIC), as these are the ones commonly decorated. In terms of secure contexts, 390 of the razors were found in graves with the rest being single finds or unprovenanced, and probably originally from graves. Very few have been found in hoards or settlements (Baudou 1960: 30; Kaul 1998: 154). There are 381 decorated razors of which 303 are provenanced. The distribution of the razors follows the familiar distribution of Danish Late Bronze Age burials with a few regions, such as west Jutland, being almost empty, and no clear indication of centres (Figure 3.13). In terms of Baudou’s typological division, there is no obvious distinction in the distribution of the different types, although some of the less common types, such as XIB2b and XIB3a, appear to be regionally restricted.

RAZOR DESIGN

The shape of Nordic razors is generally a long unequal-sided triangle with the ‘back’ and the cutting edge constituting the two long sides. At one end a short side connects the back and the cutting edges at a more or less right angle, and at the other end the blade tapers out to become a handle (Figure 3.14). Within this general description the exact shapes of razors vary, as do their size. Of interest for understanding the development of the design is the shape of the terminal end. As mentioned above, during the Early Bronze Age the horse-head shaped handle was the only means through which razors were explicitly linked to narratives or cosmological elements. The change to the shape of the handles during Period III with the introduction of the water bird corresponds with the beginning of more elaborate decorations and these two features may
CASE STUDY: TO DECORATE A NORDIC BRONZE AGE RAZOR

Figure 3.13  Distribution of decorated and undecorated Late Bronze Age razors in Denmark.

Figure 3.14  Razor shape terminology and the principles of the four design groups.
potentially be linked. In the later Bronze Age we also witness further interest in the handle, and decorations were often used to either delineate it or to incorporate it into the design.

Interestingly, the change in the shape of razors through time does not seem to be a result of a desire to accommodate the decoration better. In fact, drastic changes to the shape are only represented by Baudou’s types XIC and XID (Baudou 1960), both late in the sequence. The different physical forms Baudou placed under Type XI either take the form of elongated leaf-like razors or are composed of two joining rectangles; they do not make an obviously cohesive group, and the XIC type may be interpreted as a kind of ‘odds and ends’ category as a result of the formality of form starting to slip towards the end of the Bronze Age. The other type, XID, not included in our database, is an imported type. Although these two types may be considered better suited to geometrical designs due to their shapes, there does not appear to be a co-evolution of shape and decoration during the end of the Bronze Age, as many of these late razors are either undecorated or have simple line decorations that are very different from the complex ship motives seen earlier in the Late Bronze Age. From this we can conclude that the changing shape of the razor is not the result of a desire to make the surfaces more suitable to the complex designs. Rather, for the richly decorated Late Bronze Age razors it was a matter of the cosmological design having to adapt to the shape of the object.

Before proceeding to the analysis of how this placing of narrative fragments on the razor blade is ‘solved’ we shall briefly consider possible connections between the use of decoration and typology, chronology, as well as geographical location. Baudou (1960: 32–5) defined a number of sub-types amongst the Period IV–V razors (types XIB1–B4); their details suggest that razors were undergoing significant morphological changes and typological differentiation during this period. Interestingly, in terms of presence/absence of decoration there is some correlation with types. In sub-group XIB1a, for example, only five of the 75 razors listed in our catalogue appear to have been decorated, whereas for Type XIB2a approximately one quarter (94) of the 385 examples are decorated. For Type XIB4a, with 274 examples listed, close to half are decorated. The reason for this variation could be many and will not be considered here. It is noteworthy, however, that the two late Period V/VI types (Type XIB4a and b) are the ones with the highest percentage of decorated razors (see Figure 3.12), although it is clear that there are also earlier types that show strong links to decoration. Razors with spiral ends are, for example, more frequently decorated, irrespective of the dates of the types, than razors with simple rod terminals suggesting that other qualities than the overall morphology (i.e. type) mattered with regard to whether the razor was decorated. One such
difference may be the perceived value of the object or the perceived identity/status of its future owner, or it could relate to control mechanisms affecting what different metalworkers could or were allowed to make. Potential geographic patterns of decoration are therefore also worth considering, especially regarding early trends as the addition of decoration may reflect practices and experimentations, the creative responses to the surfaces of razors, within a particular workshop or communities. For most of the types the distribution of decorated examples does, however, compare to that of undecorated ones and there are no suggestions of decoration emerging from particular places of production. Type XIB1c, which might be the earliest group of razors with a backward-pointing handle, is, however, interesting in showing a slightly more complicated distribution pattern, albeit based on a very few objects. There are six examples of this type, but they seem to represent a small group of innovative shapes dating to early in the Late Bronze Age. Five of these razors, all undecorated, were found on north-east Zealand (with two razors coming from one grave). The sixth razor of this type is, however, decorated and was found at the other end of the country, in north-west Jutland, where it is the only example of its type. The technique and design elements used in its decoration are very similar to a distinct decorative style found on other razors in that region. The small numbers make it difficult to draw firm conclusions, but it is possible to speculate that a local metalworker in north-western Jutland combined knowledge of a new fashion of shaping the handle with local ideas about how to decorate razors and that out of these arose a locally distinct razor design.

The challenge with regard to the placing of the decoration is how to fit a concern with cosmological narrative depictions and a preference for symmetry (ship-borne sun motifs) onto a non-symmetrical space. What is clear is that a number of shared, or largely shared, broad design principles developed. Within these we see, in particular, a strong tendency for shared ideas about the orientation and placing of the decoration. At the core of the design is the ship, almost all of which are either symmetrical or placed so that it appears orientated towards the handle (i.e. the up-turned stem of the ship faces the handle). The consequence of this alignment is that most decorations are placed so that the picture-field is orientated from the back edge of the razor, in other words it should be seen from that line. A shared design grammar or rule seems to have emerged making exceptions interesting rather than significant, and, importantly, making it possible to consider how this grammar diversified. Changes in the design, we argue, were due to the metalworkers aiming to make a more compact and complex composition within this surface; being linked to the back edge restricts the size of any image and also the use of the rest of the blade. Two basic solutions to how the surface available for decoration
could be extended developed. One was to move the image around the edges; the other was to extend it across the blade. These solutions show levels of sophistication and abstraction in terms of how the design elements are used to present a complex image and linked narratives. Kaul has already discussed some of the complexity in these designs, in particular how the area around the handle through time is increasingly incorporated into the ship design (Kaul 1998: 135), but here we want to discuss the particularity of the design solutions.

In the following analysis we use three notions to investigate the decorated razors. The first is whether there is decoration along more than one edge. The second is whether there is more than one viewing direction, or in other words whether the horizon or pictorial base line moves around the edge. The third is whether there is more than one motif group. Based on these notions, the razors can be divided into four groups. These groups are flexible with permeable borders towards each other as different elements are emphasised. Our aim is therefore to use them to locate certain common design solutions rather than creating a rigid typology. Moreover, as these groupings are based on design principles rather than the actual shape or dates of razors they may form groups that are independent of typology. The analysis excludes razors made secondarily, such as reused decorated neck-rings or other fragments of metalwork, as their designs were made in reference to a different shape, although they are included in the general data set. With these considerations in mind the basic design principles for the different groups can be outlined, as shown in Figure 3.14, which also introduces the terms used in the description of the different parts of the razor, as well as what we call the ‘viewing direction’.

DESIGN GROUPS

Group One is composed of razors (36 in total) with a single motif, in most cases a ship, presented with its keel or bottom line parallel to the back edge of the razor and no elements of the design adhering to the razor’s other edges. The viewing direction is from the back edge. Almost all Group One razors totally ignore the handle in their decoration, and the motif is placed centrally on the back edge.

The ship (and other) motifs placed on the back edge differ in terms of quality of execution and elaboration of design, such as how many lines it has, but almost all follow the same notation system. Ships are composed of three parts. First from the back edge is the base/keel with a stem, on top of this a ‘hull’ with prows (which can be more or less elaborate including ends with snake/dragon heads or wave-like patterns), and on top of this most of the razors have either a line or lines of vertical dashes or triangles, often interpreted as
representative of crews (Kaul 1998). This may be considered the design principle for the ships, or the basic grammar used. Group One razors may have additional elements connected to the ship, such as waves added on top of the ship, depictions of the sun, triskele, a fish, the ‘mushroom’ or double axe, and a few human/god outlines, but these elements are all closely connected to the ship rather than presented as separate motifs. These elements were presumably directly related to the narrative content of the ship image. The remaining parts of the blade are not included in the designs.

**Group Two** is composed of razors which, in addition to the back edge, incorporate one of the other edges into the design (in total there are 32 examples of this design). The inclusion of a second edge is used for the extension of elements, or for adding elements to the design. Structurally these designs are an elaboration of the design used in Group One. Despite such elaborations the viewing point continues to be the back edge.

Including a second edge in the design raises a number of spatial challenges. Incorporating the short edge means a right-angle change of line, but this can be done in a manner that does not affect the viewing direction. There are a few examples where the viewing direction is affected by the extension along the short edge, but this relates only to additional motifs rather than the ship; such examples may have a decoration that is added in stages. Incorporating the angled edge, however, presents a different challenge in terms of whether, and how, the handles should be included in the design. A number of solutions were explored, ranging from including the handle itself as part of the decorative zone to using vertical lines to separate the handle from the blade.

In general the ship grammar is the same as found in Group One designs (a base/keel with a stem, a ‘hull’, and a crew line), although it seems that lines of semi-circles are used as an additional method of indicating crews. On some examples the convention of triangles or slashes placed as the top line of ships seem to have become an abstract design element, being used merely decoratively rather than directly representing people. In other cases short slashes, rather than representing crews, appear to be used to annotate or emphasise core aspects of the motifs, such as the mane on the horse heads or the beams around the sun. There are also several examples where the distinction between horizon lines or framing lines and the actual body of the ship is difficult to make.

**Group Three** refers to designs which continue over more than one edge through a continuation of the design (i.e. the design ‘goes around the corner’ or, as expressed by Kaul (1998), it is ‘folded’). The second edge may be used to add additional linear elements, such as the prow of ships or horizon-like lines. The effect of the folding is that the picture-field moves around the frame, so that a ship may be seen to continue along the edges; in the process the
‘horizon’ moves around so that the viewing point rotates between 90 and 180 degrees. The dominant viewing point for the 79 Group Three razors is from the working edge. In contrast to Group One and Two depictions, which are all limited by the back edge, these designs break the restriction of the space available along the back. At the same time, the effect of this change is a framing of the area between the edges in such a manner that it becomes more integral to the design and additional elements are placed within this space (Figure 3.15). Although there are several viewing directions, the most prominent elements, such as the stem and additional motifs like the sun horse, have to be seen from the working edge rather than the back edge. That this complex change in the viewing of the design is a deliberate choice is clear when compared with Group Two razors, where the extension of the frame over the angled edge does not affect the viewing point. The technique of ‘folding’ the image suggests an abstraction and sophistication in how a complex design is packed onto the rather awkwardly shaped surface of the razor. As was the case with the Group Two razors, the incorporation of the handles is a design challenge and it is responded to in similar ways.

Group Four refers to razors with the design along two or more edges and more than one central motif. There is, however, no continuity between Horizon A and B or C, and the design is therefore not folded. These razors are characterised by extensive use of the surface using solutions such as the ‘stacking’ of motifs to add more images. There can be several viewing angles, but the back edge is the dominant one.

Many of the designs include an element that separates the handle from the blade, in effect creating a framed, almost rectangular area for the depiction of the ship(s). This separation can be created either by incised parallel lines or the
root of the handle can be filled-in with two joined ship prows, which in some cases merge to create an elongated heart-like shaped design (see Figure 3.16). The surface is thus divided into two areas, an almost rectangular one and a triangular area beneath the handle. The two are decoratively separated from each other with the former area acting as the narrative space, whereas the decoration on the triangular space below the handles often has a double ship that is so extremely stylised that the image is often lost in abstraction. This design structure is thus radically different from the Group Three razors where the horizon moves around the edges of the razor, and through which a tight narration is maintained.

Razors with more than one central motif include examples with several ships together, either overlaying each other or one above the other (‘stacking’). Two ships together is the most common motif, but there can be up to five ships on one razor. In their design principles, such Group Four razors are similar to those in Group One, but they are over-endowed with images. There is also a tendency towards greater abstraction with the different elements of the ship (i.e. keel, prows, crew) appearing more similar to each other and the prows tending towards greater elaboration or stylisation and merging with depiction

Figure 3.16 Example of Group Four design with ‘heart-shaped’ ships used to decorate the handle.
of waves. The decoration extends over most of the blade, and the individual motifs are combined in a number of ways; only one of the motifs is directly connected to the back edge. Despite this elaboration, including the potential use of several viewing points, the dominant viewing direction remains the back edge. Whereas most of these motifs are ships there are a few examples of additional motifs, such as ringed dots, horizontal s-forms, waves, or suns scattered above and/or in front of ships.

DISCUSSION

Several issues are illuminated by the observation and analysis of these design solutions. They address questions about the association between form and decoration, illustrating how standardisation and elaborations may be connected, and introduce representations and the theme of movement as relevant concerns.

At the simplest level we asked which razors were decorated, as clearly the majority were not. The answer seems to be that although there is some correlation between the presence of decoration and particular types, such as the greater frequency of razors with spiral handles being decorated than any other type, this is a weak pattern and generally we cannot tell why only some razors were decorated. At the level of the design groups, the analysis shows that none of them are exclusively associated with particular types of razors, although there are preferences (Table 3.1). This is possibly because decorative schemes had different input from local metalworkers and certain design elements may have become part of the design ‘repertoire’ of particular workshops, or it may be because the morphological types defined by Baudou (1960) have little, if any, correspondence with the criteria for deciding how they should be decorated. Alternatively, decisions about decoration could be due to the exchange of ideas between metalworkers which led them to be influenced by similar trends but employed on different razors. Clearly, there are many possible suggestions, but the important observation is that the design groups reflect a level of engagement in the making of razors that is not predetermined by the razor’s type.

The presence of workshops is sometimes suggested by particular design elements, as also argued by Kaul (1998: 125), but the design groups we could discern are not connected to specific regions and their distributions are overall similar to that of the undecorated razors. This suggests that the influence of workshops is either limited (i.e. expressed only through particular versions of the constitutive elements), or the subsequent movement of the finished objects caused items from distinct workshops to become geographically dispersed. The clarity of the design groups do, however, reveal differences in their underlying
grammar, although their weak correlation with types, chronology, and distributions may suggest that they are essentially alternatives that could be chosen from. We might imagine that it was the customer who did the choosing, asking for a razor with a particular kind of design, although subtleties and variations in how the designs are executed strongly suggest the presence of a specific metalworker who had his or her own preferences and ways of executing the design. Overall we therefore suggest that the design groups are the results of metalworkers making choices about what kind of schema to use.

Although Group One may represent the earliest design it stays in use throughout, and we suggest that the different designs arose as alternative schemas very early in the development of the tradition of decorating razors. They appear, moreover, to have been essentially conservative in nature, and we do not see continuous elaborations of their basic principles, such as further versions of folding, after the core solutions to the design challenge had been reached. This raises interesting questions about the relationship between individual designs and tendencies towards standardisations and conventions. If the ship motif, as commonly agreed, was part of a cosmological narrative then an

<table>
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<th>Design Group 3</th>
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important motivation would have been to make the image intelligible, and this would have pushed towards agreed and shared narrative tropes and thus standardisation. Within the decorated razors we see that the degree of elaboration and specific sophisticated versions of the design do not automatically mean more unique results. Razors with spiral handles, for example, have some of the most elaborate designs, but there is at the same time also a high level of repetition amongst them and a ‘sameness’ in the motif composition. Repetition and standardisation enabled the metalworker to follow the structure of a design language and to convey the normative image intact despite minor individual adjustments. The strict adherence to the core components of the design confirms that their guiding structure was provided by the story.

The form of the ship motif, its degree of standardisation and stylisation, therefore raises interesting questions about what the ship is and how it makes clear what it is. Is this a representation of an actual ship or of ships as idea or symbols? In this context it is noteworthy that of the decorated razors (where this could be assessed) there is a slightly larger number where the ship images, despite the general prevalence of symmetrical depictions of boats on other objects at the time, are not symmetrical (13 symmetrical versus 19 asymmetrical). Their design often stresses the stern, which is predominantly shown pointing towards the handle (14 examples), with a smaller number pointing away from the handle (4 examples). This suggests that directionality, and thus potentially a sense of movement, was emphasised in the design. This emphasis on movement may be important for understanding the elaboration of the ship design seen in Group Two and Three designs; they use the edges of the razors to stress the length of the ship and, in the case of Group Three razors, even use the physical rotation of the razor to follow the ship around the edge. Movement, as an essential quality of ships, is also known from other contemporaneous images, such as ship depictions on rock art (Bradley 2006; Bradley et al. 2002; Fahlander 2012; Kaul 1998; Ling 2008; Nordenborg Myhre 2004). The essence that makes these ship depictions intelligible as a particular kind of ship (the cosmological ship) is therefore its ability to move. As Bronze Age cosmology reached representational maturity during the Late Bronze Age, the various design groups represent attempts to inscribe the cosmological schema onto a socially important object in a manner that preserved and emphasised important themes.

The Group Four razors do, however, seem to suggest that there can be other stories within the designs as well. This suggests, perhaps, that the narrative accounts are complex and that more than one story may, in some cases, be condensed into these designs. The razors with more than one ship, all pointing in the same direction, are an interesting case in point. These,
especially the designs where ships are shown stacked one over the other, seem to be representations of fleets rather than depictions of the sun ship as a singularity. It is therefore possible that on these images the design is representational of real ships rather than cosmological ones. Kaul (1998: 111) and others have recognised the importance of the ship image in terms of access to metal through trade. The question remains whether the ships on these razors at times were showing the symbolic sun ship and at other times real ships with important economic functions or, alternatively, that these very different ideas of ships could merge within individual designs, so that all the ships were annotated with stylised horse’s heads even if different kinds of ships were depicted.

The study of the razor designs reveals underlying shared schemes formulated around important narrative tropes at the time but also, it seems, influenced by ideas about the importance of the ship in other spheres of life. At some point during the end of the Bronze Age (Period VI) these local objects were replaced by razors of different shapes, decorated in totally different manners, and without any apparent links to the ship as an important image. The appearance and disappearance of the Nordic Bronze Age razor illuminates the central role design schemes may have in reflecting socio-cultural concerns, ways of thinking and seeing the world, and how creative solutions are found in response to the tension between what an object apparently can facilitate and what is desired of it.

NOTES

1 Type XID razors, which are also decorated, were excluded from the analysis as they are imports, or local copies of imports, and use totally different design schemes and elements.
2 This contrasts, for example, with how Viking Age designs developed through time.
CREATIVITY AS SENSUAL COSMOLOGY: BIRD ICONOGRAPHY ON METALWORK IN LATE BRONZE AGE EUROPE

Sebastian Becker

The body and the material world emerge and decay – they are unstable – what is stable, however, are the cosmological principles, which structure the world. To say something is present and yet absent is to understand this absence in terms of physical and visual co-presence. Ancestors, the dead, cosmology, and God are most emphatically present, but not apprehended in terms of visual and physical co-presence that the term ‘absent presence’ signifies. As a result, various complex technologies have been devised which are commonly glossed as ‘ritual activity’ to presence these entities in a given material register, which in another context, say the colloquial empirical, might be thought of as ‘absent’.

(Buchli 2010: 186–7)

This quote by Victor Buchli summarises the paradoxical nature of religious belief: based on immaterial principles, it can only be experienced in the here and now. Thus material culture plays an important role in the articulation of religious ideas, by giving them an experiential dimension. This, however, is a challenging affair; for such material culture needs to overcome its own materiality in order to presence religious contents. As Birgit Meyer (2008: 132) has recently argued, religious objects need to ‘invoke a sense of the divine as present in – and at the same time surpassing – the forms through which it is to be accessed’.

The notion of creativity provides a useful way to reconceptualise this constitutive role of material culture in religious discourse. Creative action may be
envisioned as the on-going engagement of people with materials, thus as the continuous transformation of matter into media. This view chimes closely with Tim Ingold and Elizabeth Hallam’s (2007: 11) idea of creativity as ‘a process that living beings undergo as they make their ways through the world’. From this perspective, creativity, as the dialectic relationship between people and the material world, plays a fundamental role in the mediation of cosmological knowledge. Indeed, it is creativity that resolves the tension between the presence of the divine and its material articulation, that is to say, the inherent paradox of materially experienced transcendence (Boivin 2009). In that sense, religious objects are creatively designed to combine religious ideas with particular sensory experiences. The objects thus created appeal to particular sensory registers, thereby lending sensory authenticity to immaterial principles. In a nutshell, creativity makes religion real.

Thus we may ask ‘how creative were Bronze Age cosmologies?’ If, as suggested, creativity is the process by which religious knowledge is transformed into sensory experience, then how did it underpin Bronze Age cosmologies? What sensory registers did it activate, what were the technologies of presencing the immaterial, in short, how was cosmological knowledge brought down to earth to become part of people’s being in the world?

To explore these issues further, this essay focuses on Late Bronze Age bird iconography on central European metalwork. During this period bird images were arguably the most significant figurative motif, as suggested by their widespread distribution throughout central and eastern Europe and their occurrence on different categories of artefacts, both as two-dimensional engravings/repoussé work and three-dimensional appliqués. That birds were cosmically important in Bronze Age communities is suggested by their depiction as creatures guiding, accompanying, or pulling the sun across the sky. It thus seems that their cosmological significance revolved around ideas of solar movement, cyclical and, quite possibly, a cyclical worldview (Guba and Szeverényi 2007: 88–95; Wirth 2006: 559–61, 2010).

Metalwork and its design played an important role in the mediation of such ideas, and this essay suggests that the relationship between objects and motifs, best envisioned in terms of design choices, creatively materialised notions of cosmological movement in two different ways: the first, to which I shall refer as epitomic visualisation, brought cosmological information into a mnemonic format by creating a high degree of visual synchronicity between objects and bird motifs; in the second, design aimed at a different set of sensory registers, primarily the haptic and auditory, to presence cosmological notions revolving around movement. Both design trajectories illustrate the capacity of creativity, here understood as residing in the relationship between motifs and objects, to resolve the intrinsic tension, if not paradox, of materialising an ontology of eternal movement through the material limitations of artefact design.
FROM BIRDS ON BRONZES TO MATERIAL TRANSCENDENCE

The archaeological literature has long drawn attention to the widespread distribution of bird iconography throughout Europe and its unique status as the most common figurative design throughout the later European Bronze Age (for example: Bouzek 2000; Jockenhövel 1974a, 1974b, 1997; Kossack 1954, 1999; Matthäus 1980, 1981; Roes 1939/1940; Schauer 1988–1989; Sprockhoff 1954, 1955; Vasić and Vasić 2003; von Merhart 1952). So far research has tended to concentrate on the question of its origins. Still seminal in this respect is Georg Kossack’s study, Studien zum Symbolgut der Urnenfelder- und Hallstattzeit Mitteleuropas (1954), in which he suggested that bird imagery may have originated in eastern Europe, most probably in what is nowadays Hungary and Slovakia. More recently, a number of attempts have been made to locate the origins of Urnfield bird imagery outside Europe, focusing on possible connections with the eastern Mediterranean and Near East (Bouzek 1985: 178–9; Ernst 1995: 28–52; Matthäus 1980, 1981). Somewhat surprisingly, however, there have been relatively few attempts to interpret its socio-religious significance. Kossack (1954), for instance, was hesitant to interpret the material, stating in a single footnote that any interpretation would be uncertain and unfounded (1954: 5, footnote 2). Alongside this rather pessimistic position, there has been a tendency to use textual/mythological sources to get access to the meaning behind bird representations. For instance, it has been argued that the latter may be related to the Greek Apollo cult, based on the formal correspondence between the bird wagon from Dupljaja Serbia, and the Homeric narrative of Apollo’s annual journey to the land of the Hyperboreans, using a wagon pulled by swans (Hänzel 2003; Jockenhövel 1997: 261–2; Sprockhoff 1954: 67–77). Other studies have sought inspiration in the fact that only waterfowl seem to have been depicted – a species of bird that is able to move between three physical and conceptual realms: the sky, earth, and water (Jung 2005: 335; Sturm-Berger 2002, 2004; Vasić and Vasić 2003). What these interpretations have in common is a representationalist understanding of bird images, as symbols signifying concepts beyond themselves. As a result, cosmological meaning is understood as being inscribed onto objects, rather than actively articulated through them. Thus, the important observation that birds epitomised notions of movement (as animals able to exist in different physical realms) has been left underexplored: how ideas of movement were articulated materially is a question that yet remains to be answered.

Some progress in this direction has already been made. About 60 years ago the German prehistorian Ernst Sprockhoff (1955) emphasised the ‘Bild der Einheit’ (‘image of unity’) (1955: 21) between the functional/morphological design of Nordic Bronze Age belts and their decorative features, including images of birds. In a similar vein, Hermann Müller-Karpe (2009a: 88–90, 2009b) suggested that the placement and display of bird motifs on ornaments and weapons may have...
fulfilled apotropaic functions. Recently, Stefan Wirth (2010) has given us an elegant account of how the positioning of bird motifs on sheet-bronze vessels may have played an important role in the materialisation of a cyclical, hermetical worldview.

It is in line with these studies that this essay seeks to highlight some significant connections between the material design and cosmological significance of Bronze Age bird iconography. Of particular interest in this respect is the visual relationship between bird images and certain types of objects, for it helped materialise core elements of Bronze Age cosmology. The next section takes a closer look at the kinds of design through which that was achieved.

Epitomic Visualisation

The familiar saying that ‘seeing is believing’ reflects the idea that truth and authenticity are defined exclusively by what can be observed through visual perception. That particular notion can be seen as part of a long-standing tradition in Western thought (Buchli 2010), but it also resonates with certain features of Bronze Age bird iconography. That is because the design of that type of imagery helped express salient aspects of Bronze Age cosmology visually, through certain categories of metalwork. The kind of visual design that informed that process was ‘epitomic’, in the sense that it relied on reductive visual techniques to incorporate and express cosmological principles. A number of examples help illustrate that point.

One of the most widely discussed motifs in the existing literature is the so-called bird-boat motif (Figures 3.17, 3.18a, 3.19, 3.20c), which by definition consists of a pair of antithetical bird heads, joined together so as to form the basic outline of a ‘boat’ (Jockenhövel 1997; Kossack 1954: 28–39; Matthäus 1980; Wirth 2006, 2010; von Merhart 1952: 40–8). Frequently, this motif is associated with a sun motif, centrally positioned between both heads, a compositional arrangement that is known as the ‘bird-sun-boat’, or Vogelsonnenbarke in German. Visually, the most striking feature of this motif is its intrinsic symmetry. If we accept the idea that what is depicted is the daily course of the sun, mediated by birds, then the two-dimensional, symmetrical structure of the motif presents this idea in a condensed format: cyclicity is reproduced linearly, in terms of a mirror-symmetrical, bi-directional layout. The important mnemonic role of symmetrical designs has long been noted in cognitive research, and it could be argued that a similar concern with the ‘simplicity and thus easy-to-read character of symmetrical form’ (Washburn 1999: 551) is at the heart of the bird-sun-boat complex.

This becomes clear when taking a closer look at the positioning of the motif relative to the overall morphology of objects. On a particular type of Late Bronze Age sheet-bronze vessel, known as Hajdúböszörmény bucket (Figure 3.17), named after the eponymous find spot in north-eastern Hungary,
the bird-boat motif is punched into the vessel’s surface so as to enhance the symmetrical morphology of the vessel itself. This visual strategy takes place on two levels: first, the arrangement of motifs on either side of the vessel is identical. Second, the intrinsic symmetry of the motif, in turn, visually structures
either side into identical panes. The overall visual effect is thus one of a choreographed, mimetic relationship between the vessel and the motif, centred around a symmetrical layout (Figure 3.17b). This design visually epitomised the notion of solar cyclicality expressed at the level of the motif by translating it into a visual property that appears to underlie both the morphology of the vessel and the layout of the motif itself. Intriguingly, however, apart from this symmetrical design, the notion of cyclicality was also emphasised in another way. The linear structure of the motif follows the intrinsic ‘roundness’ of the vessel, thus adding a three-dimensional, spatial dimension to the overall scene. Indeed, it seems as though the bird-boat is circling around the vessel, further cementing the mimetic relationship between vessel and motif.

Thus, the case of Hajdúbószörény-type vessels illustrates the significance of visual designs in the expression of a cyclical worldview. In fact, what we can see is a deep concern with the visual condensation and replication of religious information through carefully orchestrated motif-object relationships. A symmetrical, linear design and its translation into a three-dimensional perspective were both strategies that visually enacted notions of cyclical movement. This design creatively narrowed the gap between transcendental and immanent temporalities, between the eternity of a cosmological narrative and its materialisation through metalwork.

Interestingly, with slight modifications, elements of this design were still present in the Early Iron Age. A number of ornate bronze lids from the late Early Iron Age cemetery of Kleinklein in Styria, Austria (Figure 3.18), provide a good example. Punched onto the surface of these lids are either bird-boats or full-bodied birds, featuring stylised legs and a tail. The sun, or sun-wheel motifs, invariably occupy a different register. Importantly, however, both sun and bird motifs are arranged so as to follow the inherent roundness of the vessel; as in the case of Late Bronze Age Hajdúbószörény-type vessels this kind of arrangement creates a visually mimetic relationship between motif and object. In a couple of cases, the visual efficacy of this design was enhanced through the repetition of motif registers, creating a particular kind of visual illusion: when moving one’s sight from the inner centre of the lid to its outer perimeter, or vice versa, one essentially witnesses the same scene again, the difference being that it either narrows or widens. In other words, the repetition of motif registers had the effect of extending/narrowing the overall composition spatially; this visual effect both depended on and emphasised the circular arrangement of the motifs, which in turn mimicked the shape of the lid. Thus, as with Hajdúbószörény-type vessels we can note a carefully orchestrated relationship between motifs and objects, geared towards the visual summation and emphasis of a cyclical narrative.
CASE STUDY: BIRD ICONOGRAPHY ON METALWORK

Applied to vessels, this strategy of visually epitomising cosmological information was thus part of objects that were communally used and displayed. The occasion of a feast would have provided an ideal setting for both the display and enactment of shared ideologies. It is perhaps also no coincidence that the visual strategies outlined above are found on vessels that would have probably been used for the preparation, storage, and consumption of mind-altering (alcoholic) beverages: *sensu in vino veritas*, as their contents diminished, their visual effects would have become more effective and authentic.

Visual design strategies focused on the creation of mimetic relationships between objects and motifs were not limited to communal items. They are also found on objects with more personal connotations, as is well illustrated with the case of Late Bronze Age swords. The earliest two-dimensional representations of the bird-boat motif are found on a particular type of solid-hilted swords, dating broadly from the middle of the thirteenth to the eleventh centuries BC (Reinecke: Ha A1 – Ha A2) (Figure 3.19). On these so-called *Dreiwulstschwertern* (solid-hilted swords with three raised ridges on their handle bar) the bird-boat is consistently positioned on the lower section of the hilt, precisely at the point where the blade enters the hilt. This relationship between the motif and the sword recalls some of the design elements that we have already noted for the somewhat later Late Bronze and Early Iron Age vessels.

Figure 3.18 Examples of mimetic object-motif relationships on late Early Iron Age lids from Kleinklein, Leibnitz District, Styria, Austria. The bird and solar motifs follow the circular shape of the lids, thus further emphasising notions of cyclical movement. a) Kröll-Schmiedkogel tumulus; b) Pommerkogel tumulus.

Thus, the intrinsic two-dimensional symmetry of the motif chimes with the symmetrical morphology of the sword. As illustrated in Figure 3.19, if one were to dissect the sword into four identical sections down its vertical axis, one would end up not only with four identical sections of the sword, but also with four identical parts of the bird motif. Importantly, as with Hajdúböszörmény-type vessels, this linear symmetry was transposed onto a three-dimensional pane, thus tracing the intrinsic roundness of the hilt. Again, what we see is a mimetic relationship between motif and object. Compared to vessels, however, there is an important difference: the motif is comparatively small and when the sword is held by its handle, barely noticeable. The emphasis was clearly not on public display. Yet, in spite of this, the relationship between the sword and the motif is visually orchestrated so as to epitomise a cosmological narrative revolving around cyclical movement. Why is this the case? Due to its particular position on the hilt of a sword, the motif not only entered an effective relationship with the visual appearance of the sword but, importantly, it also followed the outline of the human hand which enclosed the hilt. In other words, by i) being positioned on the hilt of the sword, and ii) by following the latter’s
shape, the motif also became an extension of the user’s body, for it could be held whenever the sword was used. Thus whilst the visual efficacy of the motif may have been reduced by both its small size and position on the hilt, it was precisely this kind of design which facilitated a more personalised engagement with the narrative: quite literally, to hold the sword was to clasp the narrative.

In conclusion, the design choices which I have referred to in terms of \textit{epitomic visualisation} constituted a creative strategy of presencing cosmological principles by emphasising them visually. On the one hand, the creation of this visual effect depended on the use of a linear symmetrical design, which in its two-dimensional format (as the bird-boat) represented a visually economical, and thus mnemonically effective way of representing cyclical movement. On the other hand, however, it was only by coupling the motif’s linear symmetry with both the symmetrical morphology and roundness of the respective objects that it became visually effective. Creative design transformed objects into micro-cosmos that visually and (as in the case of swords) physically enacted a cyclical narrative. It is the physical dimension of this design to which I shall now turn.

\textit{Designs of Movements and Animated Motifs}

Whilst vision plays an important role in how we perceive our surroundings, we experience the world with more than one sense (Hegel 2007; Merleau-Ponty 1962). Religious material culture engages several of our senses at the same time and thus creates a state in which religious knowledge can be experienced holistically through bodily perception (Sobchack 2008). That is also true of metalwork with Bronze Age bird imagery.

As shown in the previous section, bird images materialised a cyclical worldview through a visual design that choreographed the relationship between objects and their imagery. In the case of vessels this design would have optimised the comprehension of religious information during communal rituals. In the case of swords, the same kind of design would have facilitated the incorporation of human movement into the narrative, thus forging a close link between an individual’s visual and tactile perception. In that way, the design of images and objects allowed people to animate and experience part of the narrative.

This point can be further illustrated with a couple of examples: first, the use of bird images on wagons, and second, their use as personal ornaments. Within these two categories, the relationship between motifs and objects was designed so as to incorporate human-centred movement, thus making it possible to physically animate and emphasise certain aspects of Bronze Age cosmology.
The recurrent association between bird images and Late Bronze Age wagons has long been noted for central and eastern Europe (Müller-Karpe 1955; Pare 1987a and b, 1989; Reim 1981; Winghart 1993, 1999: 521, fig. 4, 524, fig. 8), and it has been suggested that the ancient Near East may have provided an initial stimulus for its development; for here birds and wagons played an important role in the death rites of the Hittites and other civilisations (Schauer 1987). While the possibility of such intercultural connections is difficult to assess, the combination of bird representations and Late Bronze Age wagons is a characteristic feature of a number of Late Bronze Age cremation burials in central Europe, known as the Hart an der Alz group (Müller-Karpe 1955; Winghart 1999).

In terms of metalwork, the association of bird images with wagons falls into two main categories: on the one hand, bird representations occur three-dimensionally on wagons, either in the form of small figurines attached to the vehicle’s outer frame, sockets or linch pins; on the other hand, and less frequently, they form part of miniature or so-called cult wagons, which contained cremated remains or other, presumably, feasting-related substances. It was within these two categories that religious ideas revolving around movement could be dramaturgically enacted.

As for the first category – the occurrence of bird appliqués on ceremonial wagons – the bird-shaped linch pins shown in Figure 3.20 (a and b) provide a good illustration. Here the recurrent association of bird and sun/wheel motifs has been translated into a three-dimensional format that could be brought into motion by using the wagon. This was possible because, syntactically, the wheels of the wagon formed part of the motif composition, being a three-dimensional rendition of the sun/sun-wheel motif. Thus, as in the case of solid-hilted swords discussed above, we can note the presence of a mimetic relationship between the functionality of the object and the physical animation of the scene: the use of the wagon brought the motifs into motion. In the case of the linch pins from the site of Bullenheimer Berg, in southern Germany (Figure 3.20b), the bird would have been perceived against the background of a spinning wheel when the wagon was used. A similar design can be noted for the bird-shaped linch pins from Bobrovček, Slovakia (Figure 3.20a), but here the effects of visually animating the scene would have been amplified acoustically through the clinking noise created by the rings inserted through the birds’ beaks. Thus, cosmological notions of cyclical movement were dramaturgically enacted through physical movement and sound.

Perhaps the most illustrative example of such animated design comes in the form of miniature wagons, such as that from Acholshausen, southern Germany (Figure 3.20c) (Pescheck 1972). With a length of around 18 cm the wagon is
Figure 3.20 Examples of motif animation on wagons. a) One of a pair of linch pins from Bobrovček, Kis Bobrócz District, Slovakia; b) One of four linch pins from the Bullenheimer Berg, Kitzingen District, Bavaria, Germany; c) Cauldron wagon from Acholshausen, Würzburg District, Bavaria, Germany.

essentially a three-dimensional version of the classic bird-boat motif, consisting of two pairs of antithetical bird protomes and a central ‘sun’ motif in the form of an ornately decorated bronze cauldron. In taking this form, the motif could be moved, thus animated through human agency at significant occasions, in this case the burial of a social elite. Mnemonically, it facilitated the dramaturgical performance of ideological information through physical movement.

Thus the combination of bird representations and wagons can be seen as a creative solution to the theological challenge of presencing notions of
cosmological, eternal movement materially in the here and now. Through a design that integrated bird images into the functionality of wagons (i.e. into their movement), it became possible to create a mimetic relationship between physical and cosmological movement. In other words, on wagons, bird images materialised notions of cosmological movement visually and acoustically. In socio-ideological terms, this was a design that allowed certain individuals to control the presence of the divine, by materially animating it at socio-culturally significant occasions in public display.

A similar strategy of materialising movement through objects can be noted for a range of body ornaments, such as Late Bronze Age fibulae and pendants. The objects depicted in Figure 3.21 feature three-dimensional bird representations which are combined with various types of sheet-metal pendants. When worn on the body – in their function as fibulae or pendants – such ornaments create a jingling sound. Thus, as with the combination of birds and wagons, movement resulted in the acoustic animation of the scene. In the case of fibulae and pendants, however, the movement required for this kind of animation was directly related to the action and gestures of an individual’s body. The materialisation of cosmological movement became both activated and channelled through the human body, thus anchoring religious knowledge to corporeal performativity and self-awareness. Indeed, what I have referred in terms of a mimetic or choreographed relationship between motif and object, became extended to the kinaesthetic identity of the wearer: a design that facilitated the fusion or co-presence of corporeal and cosmological movement through sensory experience.

CONCLUSION: CREATIVITY AS SENSUAL COSMOLOGY

Thus, the case of Late Bronze Age bird imagery suggests that creativity was intrinsic to the materialisation of Bronze Age cosmologies. Bird representations stimulated people’s sensory awareness of a core narrative, centred on notions of cyclical movement. That was achieved through a design that synchronised the relationship between information expressed at the level of motifs and people’s perception of objects. In that way, bird imagery not only presented core elements of a cyclical worldview, it also integrated them into the design of metalwork and people’s experience of it.

This essay suggested that this process took two main forms, one of which aimed at the visual condensation of cosmological information, the other of which focused on the physical and acoustic animation of motifs through human agency. Following either design, bird representations did not just reflect a cosmology of cyclical movement; rather they articulated it through objects.
so that people could perceive and, in certain cases, enact notions of cyclicality. The result was a material universe which fused the material with the immaterial, the abstract with the experiential. In other words, creativity as sensual cosmology.

NOTE

1 Nonetheless, whether it was really understood as a boat in the central European Bronze Age/Early Iron Age is questionable (see Wirth 2006: 553).
The bowl is a common vessel type throughout the Bronze Age of the Pannonian Plain, found in both settlement and cemetery contexts. Although, by definition, all bowls share similar morphological characteristics of open containers, in this region the relationship between vessel shape and decoration shows striking changes between the Early Bronze Age and the Late Bronze Age (2500–800 BC). In particular, there is a distinct shift in emphasis from two-dimensional to three-dimensional use of the vessel surface in which the circular shape of the bowl becomes integrated into the decorative scheme. This essay discusses this change in terms of the creative development of design principles that allowed the expression of common cosmologically significant Bronze Age motifs, such as the sun and the wheel, through vessel form as well as surface decoration. Furthermore, Middle and Late Bronze Age developments in vessel form also created possibilities for the display of cosmological ideas in new and overt ways, while changes in the positioning of motifs on bowls provided new opportunities for concealing or revealing the motifs depicted by them. These shifts in the design principles of bowls also allowed for creative play with the objects, so lending the possibility that they may have been part of a performative telling of cosmological myths. In other words, creativity in material culture may have been linked to creativity in telling stories through objects.
TRACING CHANGES IN VESSEL SHAPE AND DECORATION

The Bronze Age of the Pannonian Plain was a dynamic period in which several different cultural groups have traditionally been identified. These groups differ in burial practices, settlement type, and traditions of ceramic decoration (Basler et al. 1983; Bóna 1975; Sorensen and Rebay-Salisbury 2008), reflected in complex national chronological schemes. Yet despite these undoubted differences, many of them share similar general trajectories in terms of the development of pottery shapes and motifs, including those of bowls. Rather than focus on already well-described cultural differences, here I want to try to pull out some of the common themes in the ways that decorated ceramic bowls developed in the Pannonian Plain during the Bronze Age, focusing on some of the larger, more geographically widespread, cultural groups.

Early Bronze Age Decorated Vessels (2500–1800/1700 BC)

At the start of the Early Bronze Age, ceramic vessels in the region are of a limited range of types and generally have very little decoration. Vessels of the Makó-Kosihy-Čaka complex are found over a large part of the middle Danube region including south-west Slovakia and the Great and Small Hungarian Plains. The pottery includes jugs, cups, storage vessels, and pedestalled bowls (Machnik 1991; Vollmann 2005). The latter may be decorated on the inside with incised lines forming chevrons around a four-pointed star, although compared to other pottery types such fine wares are relatively rare. In Transdanubia and eastern Slavonia, the main categories of vessels in the pottery of the Vinkovci-Somogyvár group are bowls, one and two-handled mugs, jugs, and deep storage vessels (Hirschler 2009; Machnik 1991) (Figure 3.22a). If the surface is elaborated at all then it is rather coarse, such as applied and finger-impressed cordons or roughening of the lower segment of domestic vessels. Jugs and bowls are the most frequently decorated vessel types. When these are decorated it is with rather simple slanted incised lines (Machnik 1991). Bowls may have horizontal incised lines around the vessel and more rarely incised cross-zigzags or a herringbone motif (Hirschler 2009; Tasić 2004).

In the full Early Bronze Age there is an increase in the range and number of decorated vessels. In central Hungary (the south-west of the Great Hungarian Plain and northern Transdanubia), Nagyrév pottery includes several types of jugs, cups, pedestalled vessels, hanging vessels, storage vessels, and bowls. Several of these types may be decorated. Some vessels have applied plastic ribbed decoration, although this is relatively infrequent (Csányi 1982–83, 1992; Vicze 2009). Another form of decoration is a series of incised motifs that are either placed
in bands or in vertical fields around the vessel, or alternatively cover the whole of the vessel exterior (Figure 3.22b). The motifs are most frequently geometric, including crosses, zigzags, dots, triangles, vertical and horizontal lines, L-shapes, and step-like motifs. These motifs appear on other media including house wall decorations, worked bone and boar tusk, and probably also extended to dress and body ornamentation (Vicze 2009). There are also occasional rather schematic human representations with apparently upraised arms or sometimes with comb-figure motifs, as well as a so-called ‘house’ motif (Csányi 1982–83; Vicze 2009).

Nagyrév motifs can be used rather simply or in quite complex combinations; the structure and organisation of the patterns are quite diverse. Nonetheless, Vicze (2009) has described three main ways in which they are deployed. Most commonly, motifs and their individual elements are used to create symmetrical or strictly geometrical compositions such that elements are used repeatedly in bands or ribbons. The second way in which they are used involves the complex arrangement of a combination of selected motifs in horizontal and vertical arrangements. The third way of deploying the motifs is through the elaborate, and not necessarily symmetrical, division of the vessel into sections with complex motifs within some of these. This latter category includes the vessels with the human figures and house motif; these are not common (Vicze 2009 reports at least 15 examples) but they nonetheless constitute a distinct class of finds rather than just a ‘one off’. The decoration on these vessels has been widely interpreted as cosmological or quasi-religious in nature, such that the pots depict creation myths or are, at very least, used for narrative purposes (Girić 1971; Schreiber 1984; Tasić 1972; Vicze 2009).

Similar vessels are known from the southern Pannonian Plain, including from the Maros culture in south-east Hungary, northern Serbia, and western Romania (Girić 1971; Vicze 2009). In this group assemblages include cups,
bowls, jugs, two-handled vessels, storage vessels, cooking pots, and strainers (Michelaki 2008). Here too there is an emphasis on incising vessel bodies with horizontal and vertical lines or sometimes semi-circles. Rims may be decorated with incised zigzags or lines (Michelaki 2006).

Rather than discuss the details of interpretation of the motifs, in the context of creative developments in design principles what is important to draw out here is the way that vessel exteriors of pots, and sometimes splayed rims, were used as a surface on which to inscribe. Vessel shape is not critical to the narrative depiction or to elaboration in general, as decorated vessels including those used as ‘story pots’ are not just bowls but a rather varied range of types. What seems to be important is the smooth curved surface of the vessel; thus different vessel shapes could be inscribed equally well to express the desired motifs and ideas.

In the south-east of the region (Slavonia and Vojvodina) the ceramics of the Vatin group straddle the Early and Middle Bronze Age (Tasić 2003–2004) (Figure 3.22c). The fine wares are exceptionally complex and exaggerated in shape, sometimes imitating metal forms (Medović 2006) and becoming increasingly intricate over time. Vessel forms include two-handled cups or so-called amphorae, bowls, strainers, and globular hanging vessels, as well as some zoomorphic vessels. In the early phase there is a clear emphasis on shape, the ceramics being rarely or sparsely decorated with horizontal or vertical bands of incised lines. Here, as with other contemporary groups in the region, the vessel is used as a drawing surface. By late Vatin, however, decorative schemes are extremely complex, particularly on amphorae, and can cover almost the entire vessel exterior with combinations of fluting, incised lines, spirals, swags, hashed triangles or semi-circles, impressed dots, and pointed bosses (Garašanin 1983b). The decoration reveals an increasingly baroque decorative ideal in which the three-dimensionality of exaggerated vessel shapes is highlighted through surface embellishment, reflecting a Middle Bronze Age trend throughout the region.

**Middle Bronze Age Decorated Bowls (1800/1700–1300 BC)**

The Middle Bronze Age saw an increase in the number of cultural units in the Pannonian Plain. Among these are the Füzéres and Hatvan in the north and north-east, the Ottomány-Gyulavarsánd in the east, the Vatya and its later Koszider phase in central Hungary, the Transdanubian Encrusted Pottery Culture, and the Szeremle-Bijelo Brdo group in eastern Slavonia and Vojvodina (variants of encrusted pottery that extended further south-east), while the final phases of Vatin were superceded by the Beletiš I group. In the south, the later
phases of the Maros, also known as the Perjámos, continued into the Middle Bronze Age.

Although there is great regional variability in ceramics, throughout the area the Middle Bronze Age witnessed a rise in the number and range of vessel forms including some very elaborate, complex, and exaggerated shapes (Sofaer et al. 2013a). For example, in the Vatya Culture there are biconical and tripartite storage vessels (urns in cemeteries), a range of cooking vessels, cups, jugs, strainers, and several different kinds of bowls (Sofaer and Budden 2012; Vicze 2011) (Figure 3.23). There is also an increase in the use of additions and applied decorations such as bosses, lugs, and plastic decoration. Alongside this is a codification and standardisation of motifs and their combinations in terms of what motifs are applied to which vessel types; vessel type and decoration are thus connected. Not all types of bowls are decorated but, particularly in the Koszider phase, so-called Swedish helmet bowls consistently display a restricted range of motifs that fall into two main categories reflecting Bronze Age cosmological concerns with the sun and the wheel (Sofaer 2013) (Figure 3.24). These motifs are also found on fine ware bowls of other contemporary cultural groups in the region (with the exception of Belegiš) although their expression shows stylistic variation depending on the cultural group in which they are found.

Figure 3.23 Vatya ceramic vessels (Matrica Museum, Százhalombatta). Photo: J. Sofaer.
The sun motif (Figure 3.24a) is most frequently expressed by concentric circles incised around the exterior base of bowls; sometimes there may be a single circle, but most often there are two or three, and in some cases up to five circles. This may be further elaborated by the addition of four more concentric circles or half circles at the quarter points of the vessel, smaller impressed dots, or small circles, depending on cultural affiliation. In some Füzesabony fine ware inverted rim bowls the incised circles may be replaced by rather baroque-looking pointed bosses surrounded by at least one, and more frequently two or three, concentric circles. In some Füzesabony, Gyulavarsánd, and occasional Vatya and Transdanubian Encrusted Pottery examples, circles may be drawn around an omphalos base, the dimple acting as an integral part of the motif. More rarely, the concentric circles at the centre of the base may be replaced by a spiral, as in some Füzesabony examples (Bóna 1975). In another version of the sun motif found particularly on vessels in the Füzesabony group, the sun is represented through a star (c.f. Kristiansen and Larsson 2005). Sometimes this is formed through the linking of five or more incised semi-circles, swags, or zigzags around the base of the vessel, with a central circle or concentric circles in the centre. In some cases, where there are more than four bosses on a vessel, the baroque sun motifs of the Füzesabony and Gyulavarsánd groups can also be read as stars, depending on whether the viewer takes the bosses or the space between them as the focal point of the decoration.

The wheel motif (Figure 3.24b) is expressed through the division of the circular vessel base into quarters with the four spokes of the wheel radiating from a central circle which may either be incised or an omphalos base. On some vessels, this central circle may double both as a wheel axle and as a sun through the use of concentric circles or repeated small, incised dashes around the circle. The spokes of the wheel may also terminate in concentric half circles. In such cases, the decoration can be read as a combination of wheel and sun motifs. More rarely, this doubling up of motifs can be seen in the division of the central circle into quarters, turning the concentric circles of the sun into a wheel-cross. The wheel is particularly common as a motif on bowls in the Vatya, Transdanubian Encrusted Pottery and Szeremle-Bijelo Brdo groups, at first glance seeming less frequent in the Füzesabony and Gyulavarsánd groups where decorative traditions focus upon curvaceous rather than linear motifs. Nonetheless, here too the wheel is strongly present. On some Gyulavarsánd Swedish helmet bowls and on contemporary fine ware Füzesabony bowls with inverted rims, rather than ‘drawing’ the motif on the vessel, concentric circles at the centre of the base act as a sun/wheel axle, while the undecorated space between pointed bosses emerging from semi-circles placed at the quarter points of the vessel act as wheel spokes. In such cases the entire exterior of the bowl is turned into a wheel, the rim of the vessel acting as its margin. These
Figure 3.24 Swedish helmet bowls from a range of Middle Bronze Age cultural groups in the Pannonian Plain. a) Sun motifs: A. Vatya bowl from Cegléd-Öreghegy; B. Füzesabony bowl from Megyaszó; C. Füzesabony bowl from Gelej-Kanálisdlő; b) Wheel motifs: A. Vatya bowl from Kelebia; B. Encrusted Pottery bowl from Királyszentistván; C. Füzesabony bowl from Golop; D. Gyulavarsánd bowl from Gyulavarsánd-Laposhalom. Redrawn after Sofaer 2015.
vessels can therefore be read in two ways; through the ‘positive’ added embellishments and the ‘negative’ of the decoration (Sofaer 2015).

In these bowls the shape of the vessel is used as an integral part of these motifs. In other words, it doesn’t just facilitate it in the way that a flat surface might facilitate incised decoration, or frame it in the way that a picture frame might surround a painting, but rather the bowl shape is actively used to form part of the motif. The placement of the motif on the round base of the bowl both utilises and emphasises the three-dimensional qualities of the vessel through the deployment of design principles that work the motif into the pot in a new way (Sofaer 2015).

Late Bronze Age Decorated Bowls (1300–800 BC)

The Late Bronze Age saw the spread of the Urnfield phenomena through much of the Pannonian Plain, along with the continued development of the Belegiš group (Belegiš II) in parts of eastern Slavonia and Vojvodina (Ložnjak Dizdar 2011). Although there are changes in the ceramics over time, as well as regional variations and local ceramic forms (Dizdar, Ložnjak Dizdar and Mihelić 2011; Karavanić 2009; Szabó 2003; Vinski-Gasparini 1973, 1983), within the Urnfield Culture there is widespread similarity in vessel forms and decorative patterns (Szabó 2003). The Belegiš II forms part of an eastern Carpathian group of fluted wares (Ložnjak Dizdar 2011) but the ceramics follow a distinct trajectory with different attitudes to vessel form and decoration and will not be discussed here.

Within the Urnfield ceramics there are three main vessel forms: urns, bowls, and cups. In this restricted range vessel shapes become highly conventionalised, especially towards the end of the period. The proportion of decorated Late Bronze Age vessels is rather small in the early Urnfield phases but increases towards the end of the Urnfield period. There is also an increase in the standardisation of decorative schemes, both in terms of the motifs themselves and the application of motifs to specific vessels. When decorated, urns may have bands of incised horizontal lines, chevrons, or fluted bodies. Cups occasionally have twisted handles. Not all types of bowls are decorated. A very small number of pedestalled and biconical bowls have rather crude incised decoration on the exterior (see Vinski-Gasparini 1973: tab. 101). A relatively common variant, however, is the so-called turban rim bowl that has an inverted twisted rim.

The majority of turban rim bowls lack further elaboration although even on these vessels they frequently have either an omphalos base resulting in a circular raised bump in the centre of the interior of the vessel or an applied
boss in the centre of the interior of the bowl. These sometimes have an incised groove around them that draws the eye to this point. The bosses are mostly undecorated although there is a range of motifs that divides the boss into four quarters as, for example, incised triangles filled with slanting lines. When turban rim bowls are more extensively decorated they tend to have variations on the sun or wheel motifs on the interior (Figure 3.25). The sun motif is most obviously expressed through a series of incised concentric circles described around the central boss; it is also arguable that even when there is a boss without further elaboration, or a boss with a single incised groove around it, that this may simply be a pared down version of the motif. In all cases, however, the circularity of the vessel shape is drawn into the motif, thereby describing an additional sun circle. In the wheel motif, four, six, or sometimes more, spokes of the wheel made through applied decoration radiate from the central boss (the wheel axle) to the margin of the vessel interior (the wheel edge) turning the whole bowl into a wheel. For both the sun and the wheel the entire vessel becomes integrated into the expression of the motif. The motif and the bowl are a single entity in which the three-dimensionality of the vessel and the motif are intimately connected.

PRINCIPLES OF DESIGN

Throughout the Bronze Age, motifs on bowls were linked to cosmological themes, but between the Early and Late Bronze Age there were several changes in the ways that the relationship between the shape and decoration
of bowls were articulated (Sofaer 2015). In particular, there was a shift in emphasis from two-dimensional use of surface to three-dimensional use of the whole vessel in which the entire bowl eventually became part of the motif. This was allied to a change in the positioning of decoration on the vessel, with a move from decoration on the outside of the body, to the exterior of the base, and then to decoration on the inside. These changes over time should not be understood as reflective of some kind of straightforward typological evolution, especially given complex and shifting relations between different cultural groups in the region (Basler et al. 1983; Tasić 2003–2004; Visy 2003). Rather they indicate changes in design principles in terms of the ways that vessel shape and decoration were deliberately configured to work in relation to each other. Further analysis of the contrasting design principles of bowls from the different phases of the Bronze Age can be used to try to explore how the designs of the bowls work and thus the creativity embedded within them.

Modern design theory frequently suggests that good design revolves around the usability, aesthetics, and practicality of an object (Norman 2002). In creating a product a designer has many factors to consider including choice of material, manufacturing method, cost, practicality, and ease of use. There is, however, also an emotional side to design that may be more critical to a product’s success than its practical elements and which are interwoven through any design. These emotional aspects of design have been characterised as having three components (Norman 2004). The first has been termed ‘visceral design’ and is concerned with appearances. It is to do with whether we like how something looks and if it is visually appealing. The second is ‘behavioural design’ which is about the pleasure and effectiveness of use. The third is ‘reflective design’ which considers the rationalisation and intellectualisation of a product. In other words, what kind of meaning is attached to it. For example, can I tell a story about it? Does it appeal to my self-image or to my pride? Although such notions are firmly situated within contemporary design theory they may nonetheless be useful in understanding the Bronze Age bowls.

**Bowls and Visceral Design**

It is clear that in each phase of the Bronze Age the bowls do have a distinctive aesthetic. Indeed, one might suggest the archaeological response to this aesthetic is, at least in part, one aspect of how we recognise them today as belonging to the Bronze Age. The bowls are designed to appeal to the senses
and are deliberately made to be visual and tactile. In all phases they are frequently burnished and therefore shiny. Decorated fine ware bowls are often black or, as in the case of encrusted vessels, make use of colour contrasts (see Sofaer and Mihelić this volume). Not only do the decorative motifs draw the eye but the baroque additions of the Middle Bronze Age, in particular, also produce distinct and sometimes colliding sensory effects when touched, such as simultaneous sharpness and smoothness.

Throughout the Bronze Age decorated bowls were made to be displayed, indicating that they would have been something people wanted to show and therefore that they were regarded as visually appealing. In the Early Bronze Age display was facilitated through giving vessels pedestals, loops, or holes from which to hang or suspend the vessel. In the Middle Bronze Age vessels were specifically designed to hang on a wall with the decorated base turned towards the viewer; Swedish helmet bowls have a single small handle that is too small to hold the vessel and a flat rim so that the bowl fits snugly against the wall (Sofaer 2013). In mortuary contexts the base of a bowl could be viewed when it was placed upside down on top of an urn (Šimić 2000: 68). Late Bronze Age Urnfield turban rim bowls frequently have a single small lug placed on the exterior of the vessel below the rim. On some bowls these lugs are fully pierced, in which case the vessel was clearly designed to be suspended from a cord strung through the lug. On other vessels however, such as a number from the site of Vukovar Lijeva Bara in eastern Croatia, the lugs are pseudo-pierced (i.e. it looks like you could hang up the vessel but the hole does not go all the way through) or unpierced. The more elaborately decorated bowls tend to have the fully pierced lugs. Less elaborate vessels, such as those with a central boss but little else, often have either pseudo-pierced or unpierced lugs. These latter vessels are therefore made in such a way so as to deceive the casual observer into thinking that one could hang the vessel if one wanted to. In other words, the deceit is in the suggestion that one could hang it up to display it if you wanted but you choose not to – you choose to use it (Sofaer 2015). This creative ‘fakery’ in the design of the bowls acts to reinforce the importance and role of these vessels in visual display.

Bowls and Behavioural Design

Behavioural design is difficult to assess directly since we do not know exactly what many of these vessels contained. Nonetheless, the differing design principles of bowls through the three main phases of the Bronze Age do suggest
different possibilities or strategies in terms of the ways that they may have been deployed, particularly in relation to the possibilities for concealing or revealing motifs.

Motifs on Early Bronze Age vessels are continuously visible, no matter whether the vessel is in use or not; the decoration is on the vessel exterior and is positioned in such a way as to be viewed ‘in the round’. By contrast, the decoration on Middle Bronze Age bowls is frequently on the base of the vessel. This means that while the vessel is in use the motif is concealed. It is only visible when the bowl is either turned upside down or deliberately displayed by hanging it on a wall. Late Bronze Age turban rim bowls present a third set of possibilities for viewing motifs. The decoration on these vessels is visible when the bowl is displayed on a wall or when the bowl is empty and placed on its base. However, the positioning of the decoration inside the vessel allows for it to be concealed by putting something into the bowl and then revealed when things are taken out. This creates the opportunity for ‘playing’ or for surprise and pleasure in seeing the motif appear.

Bowls and Reflective Design

As discussed above, the motifs on Bronze Age bowls formed part of Bronze Age cosmology. They reiterate geographically and chronologically widespread motifs that are found in several different contemporary media and contexts, suggesting that they express cornerstone myths and beliefs prevalent throughout the European Bronze Age. On this basis it is possible to argue that the motifs on pots would have been familiar to Bronze Age people and that they stood for broader cosmological notions. In particular, the iconography of the sun and the wheel has been widely discussed in terms of a complex Bronze Age mythology of the sun and its voyage through different spheres of the cosmos where the Chariot of the Sun is drawn by a horse (Kaul 1998, 2005, this volume). In a pre-literate society it is therefore possible to imagine that the bowls may have had a role in reminding people of these myths in much the same way as stained glass windows in Medieval churches were used to convey biblical stories to people who could not read. On this level it is therefore plausible that Bronze Age people had an affective response to the bowls through their reflective or intellectual appeal.

It is also possible to suggest that an additional aspect of the reflective design of the bowls lay in their appeal as status symbols. Throughout the Bronze Age the overwhelming majority of decorated fine ware bowls from the Carpathian Basin are of extremely high quality and technically well
made, representing an investment of material as well as skill beyond that of regular household wares (c.f. Budden 2008; Tasić 2003–2004). Furthermore, although prestige has traditionally been ascribed to metalwork of this period, much of the metal comes from hoards. The quantity of metalwork from cemeteries and settlements in the Carpathian Basin is relatively small and in these contexts pottery is by far the most abundant material. For Middle Bronze Age cemeteries in particular, the relative quantities of metalwork and pottery has led to the suggestion that pots may be the primary means of displaying status (Vicze 2011). This may also be the case for vessels in settlements (Sofaer 2013).

CONCLUSION: CREATIVITY, DESIGN, AND MYTH-MAKING IN THE BRONZE AGE

Changes over time in the design principles of bowls can thus be understood as creative responses to culturally significant myths and to the materialisation of those myths. Furthermore, the emotional elements of design implicated in the changing relationship between shape and decoration promoted specific kinds of responses in each phase of the Bronze Age. These offered particular possibilities for the display, use, and meaning of decorated vessels, with changing opportunities for users to move from being observers of decoration in the Early Bronze Age to actively ‘playing’ with the objects in the Middle and Late Bronze Age by hiding or revealing the motifs. For the Nordic Bronze Age it has been suggested that when gold vessels were used at ritual feasts honouring the sun, by lifting them to the mouth the decoration would appear as a rising sun (Kaul 2009b). A similar concept might be applied to the bowls in the Carpathian Basin. In other words, by placing Middle Bronze Age bowls on their base, or by filling Late Bronze Age vessels with food or liquid, one could make the sun or wheel disappear and reappear. In this case the emotional response to the design might be enhanced because one could potentially tell and retell myths with the vessels as active parts in the story-telling. In this sense, the design of the pots can be understood as facilitating the telling of stories; they were literally portable cosmology. By the time of the Urnfield turban rim bowls of the Late Bronze Age when the entire bowl became the sun or the wheel, it is possible to suggest that the cosmology of Bronze Age society could be literally held in one’s hand!

Bronze Age vessels were part of a lived experience that was both functional and aesthetic (c.f. Dewey 1934; McCarthy and Wright 2004). Creativity in the design of bowls thus allowed them not just to be symbols to be ‘read’ but also
potentially to be objects used in the acting out of myths. As such, changes in the design principles of bowls in the Carpathian Basin over the Bronze Age may also have been linked to creativity in another aspect of human life – that of story-telling. In other words, the Bronze Age stories provided a framework or a stimulus for creative expression in clay.
This essay argues that the development of left–right logic during the Nordic Bronze Age provides an interesting example of how abstract ideas became materialised in a creative manner. The early part of the Nordic Bronze Age (1600–1400 BC) may be seen as a formative phase of Bronze Age religion and society in Scandinavia. At around 1400 BC there seems to be a culmination of a process of change, innovation, and creativity (Kaul 1998, 2004a and b) with the formation of an aristocratic elite and rich furnished barrow graves at the same time as a new iconography. At this time figurative art reappears in southern Scandinavia after several centuries, including motifs such as the ship, horse, fish, and probably the snake. The introduction of such clearly recognisable motifs should be regarded as something almost revolutionary; during the Neolithic of southern Scandinavia geometric patterns almost totally dominated the iconographic repertoire.

The ship motif seems to have appeared in Scandinavia shortly after 1600 BC. A bronze sword found at Rørby, Zealand, Denmark, dated to Montelius Period IB, c. 1600–1500 BC (Vandkilde 1996: 231–2) carries the earliest datable rendering of a ship. The shape is characterised by high stems turning inwards. Within a relatively short time span similar ship images spread over large areas of Scandinavia as evidenced by rock carvings. In its early appearance the ship was already asymmetrical, with either a lightly raised or horizontal keel.
extension fore and some kind of horizontal stabiliser aft (Kaul 1998, 2004b). This directionality of the ship gradually became more emphasised during the Bronze Age. Around 1400 BC the stems of the ships were equipped with a horse head, as seen on a large number of Scandinavian rock carvings and on the bronze horn from Vismar, north Germany (Kaul 2004b; Ling 2008, 2013). The horse motif itself seems to have been introduced in the decades just before 1400 BC. The ship and the horse were chosen as the most important ‘objects’ of symbolic value. The horse may have been regarded as the finest and most aristocratic animal, in addition to perhaps a certain tension between it being wild yet controllable by humans. The ship may have held associations with transport and long-distance contacts, and hence also access to bronze (Kaul 2005, 2010). The horse and the ship became the most important agents related to the mythology of the eternal voyage of the sun.

The rich and complicated spiral decoration seen on cult objects like horned head gear, cult axes, and the Chariot of the Sun, on weapons such as swords, and on female ornaments like belt plates, is one of the many novelties appearing at this time. Even though the spirals are geometric rather than figurative, they may still have had a deep meaning communicating some basic concepts of cosmology. When following the spirals they move round and round, up and down, and towards right and left in an unbroken band, creating a pattern that may be related to the cyclical movement of the sun.

Another important novelty in south Scandinavia is the emergence of plastic figurative art, which had not been seen here since the Mesolithic. One example of this is the horse-head handles of the Bronze Age razor which was introduced just before 1400 BC (Kaul 2013a). It is found on approximately one hundred razors from Denmark, north Germany, Sweden, and Norway dating to Montelius Period II (1500–1300 BC). Although the plastic art is in miniature, the heads are often extremely well rendered, almost naturalistic, being elegant and delicate examples of skilful forming and casting. It can be argued that the symbolic value of the horse was related to its role in Bronze Age cosmology as the most important divine animal and helper of the sun during its cyclical voyage.

THE CHARIOT OF THE SUN: LEFT AND RIGHT

The special role of the horse is demonstrated by the Chariot of the Sun, a highlight of Danish Bronze Age art and casting (Drescher 1962), in which the sun horse pulls the sun (Figure 3.26). The Chariot of the Sun was probably produced a couple of decades after the introduction of the horse-headed razors. The Chariot of the Sun consists of three main parts. The first is the
plastic horse figure. The second is the solar disc decorated with concentric circles and complicated spiral patterns. The third is the chassis with six four-spoked wheels on which both the solar disk and the horse figure are placed. As Sophus Müller already noted in the original publication in 1903, it is important to distinguish between the horse and the solar disk on one hand, and the chassis with its wheels on the other hand. The horse and the solar disc illustrate the belief that the sun on its eternal journey was pulled by a divine horse, but the carriage was not itself part of this notion. Instead, the sun and the horse were placed on wheels in order to demonstrate (or control) the movement of the sun during Bronze Age rituals. On the rim of the sun disc can be seen the remains of a fragile eyelet, and a corresponding eyelet is found under the horse’s neck. A string must have passed through the loops to link the disc with the horse (Kaul 1998: 32; Müller 1903: 110). Thus, naming the object ‘The Chariot of the Sun’ is somewhat misleading. This term was introduced in Germany during the 1930s when Sonnenwagen was used to describe the object (Kaul 2010: 527; Sprockhoff 1936: 2). In the primary publication Müller did not employ the Danish equivalent (Solvognen), but instead referred to it as the ‘Sun image from Trundholm’ (Solbilledet fra Trundholm). Furthermore, Müller argued that what was represented by the sun image from Trundholm was the mighty, though non-personified sun, and that sun worship of the Bronze Age was not related to a personified deity (Kaul 2010: 524; Müller 1903: 14–115).
The two sides of the sun disc are not completely identical. Some differences in the layout of the spiral decoration can be observed. Most importantly, however, one side is covered with thin gold foil, and on the same side a row of short radial grooves can be seen running along the edge of the gold covering. The other side is not covered with gold, and there are no radial grooves. In other words there is no marked halo. When looking at the golden and radiant side of the solar disk we notice that the horse is facing to the right, moving from left to the right together with the sun in terms of the position of the viewer. This is the observable direction of the travel of the sun as seen from the northern hemisphere, when the spectator faces the sun. When we turn the sun image round so that we can see the darker, non-golden side of the solar disk without halo, then, if the viewing position is maintained, the horse is facing left and moving from right to left. These directions are not a matter of maps or geographical positions, but purely of left and right related to a static viewing body. Moreover, if you face the sun and keep the sun in your line of sight then you will see that during the day your eyes perceive that the sun moves from left to right.

Cracking the code of the left–right logic of the ‘Chariot of the Sun’ yields important evidence of how Bronze Age people may have creatively engaged with observations of the physical world and expressed these in material form. In modern understandings of the physical world the sun never moves to the left, but if in the Bronze Age the earth was considered to be flat – perhaps as a disk floating amidst a cosmic ocean, the heavens above, the underworld below – then these directions make sense. After sunset, the sun has to return to its starting point at sunrise by moving right to left, under the surface of the flat earth, through the darkness of the underworld, and where it travels in an extinguished state, not radiant. At sunrise, the sun changes back to its daytime direction, moving left to right. This cosmological understanding appears to be the first time in northern Europe that left-and-right logic is expressed and that a portable object is employed to represent it in a pedagogical and striking manner.

LEFT AND RIGHT ON LATE BRONZE AGE RAZORS

The large corpus of pictorial representations on the Nordic Late Bronze Age razors (1100–500 BC) gives further insight into cosmology and left–right logic. The razor should be considered a very personal object related to body care, and it is exactly from the directions associated with the body – left and right – that the cosmological order can also be read on the razors.
Matters here are, however, more complex than on the Chariot of the Sun. The sun horse was not the only helper of the sun on its eternal journey. The fish and the snake also played essential roles. Furthermore, the ship was the most important means of transport for the sun. In the north of Europe, stressing the sailing direction of the ship made it possible for left–right logic to be depicted in cosmological renderings. The Nordic ship was asymmetrical with a high keel extension marking the stem of the ship. This enables us to crack the code of the many images and to read the motifs as representations of different sequences within the cosmological narrative. Some ships face right while others are directed towards the left. More specifically, there are no ships sailing left in conjunction with a sun image, whereas there are more than fifty ships together with sun images sailing towards the right (Figure 3.27). This can be explained by arguing that a left-sailing ship without any sun motif is still the sun ship but that here the sun is dark and invisible during its nightly voyage. As with the ‘Chariot of the Sun’ it becomes clear that the motifs were structured in such a way that the direction of movement towards the right was related to the daytime voyage of the sun, whereas a direction towards the left was related to its nocturnal, underworld voyage. Within this cosmological order, right is associated with the heavens, up, day, and light, whereas left is associated with the underworld, down, night, and darkness (Figure 3.28).

The most illustrative example of the relationship between right and left, up and down, is seen on a razor without find provenance but probably from Jutland (Figure 3.29). Here two ships are depicted. The lower ship is sailing towards the left – being the night ship – while the upper one is sailing towards right – being
Figure 3.28 Motifs from Late Bronze Age Danish razors 1100–500 BC, showing different points of the cyclical movement of the sun: 1. Sunrise. The fish pulls the rising sun up from the night ship to the morning ship. 2. For a while, the fish was allowed to sail on with the ship. The fish is to be devoured by a bird of prey. Stylised sun horses (S-figures) are ready to fetch the sun. 4. Two sun horses are about to pull the sun from the ship. 5. At noon the sun horse has collected the sun from the ship. 6. In the afternoon the sun horse lands with the sun on the sun ship. Some time after the sun horse has landed the sun is taken over by the snake from the afternoon ship. 8. The snake is concealing the sun in its spiral curls. It will soon lead the sun down under the horizon. 9. Two night ships sailing towards left. The sun is not visible, extinguished and dark on its voyage through the underworld. 10. A night ship followed by a fish swimming to the left. The fish is ready to fulfil its task at sunrise.


Figure 3.29 Bronze razor without find provenance, probably Jutland, Denmark, c. 800 BC. Here a ship is sailing to the right above a ship sailing to the left, where a fish is seen pulling the sun upwards and to the right from immediately above the ship sailing to the left to the ship sailing to the right. Note the raised keel extensions that indicate the sailing direction of the ships.

Drawing: Bjørn Skaarup.
the day ship. From the stem of the left-sailing night ship, a fish is pulling the sun right and upwards, the direction of the morning sun. What we are looking at is a depiction of the rebirth of the sun at sunrise. Here the directions of night and day meet. The left-sailing night ship is working under the horizon-line and the right-sailing day (or morning) ship is working over the horizon. This arrangement is also seen on a razor from Eisendorf, Kr. Rendsborg, Schleswig-Holstein, north Germany, though here without the fish (Freudenberg and Kaul 2007).

On some of the razors of the Nordic Bronze Age some curious, fantastic animals appear. Among these are creatures that could be called double horses. On a razor from Sennels, north-west Jutland, three charming rocking-horse-like double horses appear in front of a ship with a triple horse-headed stem (Figure 3.30). The horses would seem to be running, though each pair of legs is running in different directions suggesting that they may be having difficulty in deciding in which direction to go. The double horses (sun horses) may be seen as an influence from the central European Urnfield Culture, where left and right is not marked in the iconography as in Scandinavia (Gelling and Davidson 1969: 119; Kaul 1998: 214–15). However, when considering the importance of left–right logic for Nordic cosmology, then a horse figure moving left and right at the same time may indicate that the sun horse worked both day and night. Perhaps we are dealing with a creative solution which conflates the message of the three-dimensional plastic representation such as seen in the ‘Chariot of the Sun’ with the ship iconography in a two-dimensional representation (Kaul 2004a: 254–5).

The left–right logic of northern Europe that seems to work well on portable bronze objects, such as the razors, is not easily applied to the rock carvings. Whereas left and right can be understood and interpreted in terms of the relationship of portable objects to the human body, matters are more complicated when considering rock art, where relations to landscape and actual geographical directions were of importance. Nonetheless, there are a couple of possible examples where
the same logic may have been expressed (Kaul 2009a: 91 ff.; Bradley 2009: 154 ff.). The Fossum rock carving, Tanum, Bohuslän, Sweden, seems to provide the best illustration of the left–right and up-and-down logic on the rocks. At the bottom of a large panel of rock carvings there are six ships, all sailing to the left. At the top of this part of the rock carving, just over the lower six ships, there is a whole fleet of ships sailing to the right. Between these ships of opposite directions, a number of solar symbols or solar images are seen. A sunrise situation may be shown; the sun rises in the cyclical transitional border marked by the left-sailing ships below and the right-sailing ships above (Kaul 1998: 266–7).

AN AFTERLIFE WITH THE SUN?

Notions about the afterlife are known to be of importance in any religion (Gräslund 1994). If it is accepted that the ships represented on the bronzes are ships related to a central myth of the Nordic Bronze Age concerning the eternal voyage of the sun, then we must seriously consider the meaning of the strokes or short lines on the images of ships as representing the crew. It does not seem unreasonable to regard these strokes on the mythological ships as the souls of the dead, perhaps humans ‘deified’ by death, or some ‘selected few’ given the honourable task of being part of the crew of the sun ship. A mutual dependency between the life-giving sun and the souls of humans may therefore have been created in Bronze Age mythology; the sun was dependent to a degree on assistance from the souls of human beings, but the souls were naturally deeply dependent on the divine sun. The souls shared the fate of the sun on its eternal journey right and left, up and down, round and round, through the sky and the underworld. Even on left-sailing night-ships the strokes representing the crew are clearly shown.

When suggesting such a mutual dependency, then such a so-called death cult could as well be understood as a life cult or a sun cult. If the dead were honoured in the right way, for instance in cult houses at burial mounds (Mikkelsen 2013), then it may have been that the souls of the dead could assist the sun in the best way, which could also benefit living humans on the surface of the earth. The souls of the dead thus may have themselves become a guarantee for cosmic order, securing the return and rebirth of the sun and of life (Kaul 2005, 2013b).

LEFT AND RIGHT IN CENTRAL EUROPE

In the Late Bronze Age and Early Iron Age of central and southern Europe (c. 1100–500 BC) we find an iconography that also involves the ship. The most important animal related to the sun in this context is the aquatic bird; this is
the central European sun animal, or manifestation of the sun. The aquatic bird may be envisaged as a ‘combi-animal’ that could follow or help the sun in all spheres of its cyclical voyage. It can swim and dive in water, it can walk on the surface of the earth, and it can fly in the sky. It could therefore follow the sun in the underworld during the night, as represented by the neck of the swan, the diving duck, or the grebe. It could control the surface of the earth, the horizon, and thereby sunrise and sunset, and it could master the sky when the sun reached its highest position at midday. The many qualities of the aquatic bird and its ability to work in every sphere, in any direction, might be one of the reasons for central European iconography being more uniform and not including so many figural elements as that in Scandinavia. The cosmological versatility of the aquatic bird may also provide the answer as to why the snake is virtually absent in the iconography of the Urnfield Culture although it is well-represented in the north, both on metal objects and on rock carvings, and in southern Europe for instance on geometric pottery. The chthonic qualities of the snake and its abilities as mediator between the underworld and the world above may have been substituted by the aquatic bird.

Just as the sun horse and the ship grew together in the north, where ships were being equipped with horse-headed stems, the aquatic bird and the ship grew together in the Urnfield Culture creating ships with stems in the shape of an aquatic bird. This is most beautifully and heraldically represented in the Vogelsonnenbarke (the bird-sun-boat) seen on bronze buckets such as the Hajdúbőszörmény buckets made in Hungary and Slovakia just after 1000 BC (Figure 3.31), or on bronze amphorae made a little later. In many cases huge solar images are seen on the central European sun ships. This motif is also represented on bronze shields probably produced in central Europe.

It is important to note that the central European bird-sun-ships do not mark any sailing direction: they are symmetrical. Here no left–right logic is at work. This marks a remarkable contrast with the sun ships of the Nordic Bronze Age which are asymmetrical. In the north of Europe a lot of emphasis was placed on rendering the sailing direction of the ships and on other iconographic features such as the horse, whereas in central Europe this feature was seemingly not of interest. Why was this? Was there another perception of the cosmos in central Europe? Did left and right not refer to the same underlying logic and meaning? Perhaps the symmetrical ships of the Urnfield Culture simply mark that the ship simultaneously depicted both a day ship and a night ship and so the ship of day and night was here the very same. If so, regional differences in the emphasis on left–right logic may then be just a matter of nuances rather than of different overall ideas. However, it is also possible that there were significantly different conceptualisations.
LEFT AND RIGHT IN BULGARIA: A LATE EXAMPLE

There are other instances in time and space, outside the Nordic Bronze Age world, where we find a pictorial substantiation of left–right logic with cosmological references. An evocative example has been revealed in Bulgaria, here from a time about 200 years after the end of the Nordic Bronze Age.

In 2004 and 2005, the large Golyama Kosmatka tumulus, near Kazanlak, central Bulgaria, was excavated. In the early third century BC, the Thracian king Seuthes III was buried in the inner chamber of a temple-like structure (Kitov 2005; Marazov 2007). The inner chamber was entered through a monumental marble door with a left and a right wing. The semiotics of the space of the doors yield an excellent example of left-and-right logic. The left wing (here also the western wing) was painted black, and the right wing (the eastern wing) was painted red. Black marks the kingdom of darkness and death, whereas red is the sign of light and of life, of the coming day or morning. The meaning of these colours is emphasised by the decoration of the wings. On the left wing a Medusa-head with snake-hair is seen, Medusa being associated with the boundary between the worlds, and she is guardian in the ‘black

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Figure 3.31 Detail of Hajdúböszörmény bucket, found at Siem, North Jutland, Denmark. The decoration is seen from inside the bucket. 
Photo: F. Kaul.
kingdom’ of Hades. On the right wing a face with marked halo, the sun-god Helios, is seen. Left, the side of Medusa is identified with sunset, descent, night, darkness, and below. Right, the side of Helios represents sunrise, day, light, above (Marazov 2007: 15–17). The doors of other Thracian royal tombs of the area demonstrate the same left-and-right logic, the black wing always to the left, and the red wing to the right; sometimes solar symbols are seen on the right wing.

Also among the ancient Greeks one can find evidence of connections between the right and left directions, and up and down, light and darkness. In the eschatological myth Republic the souls of the men are imagined as divided by their judges into two groups: the just travel to the right, upwards, through the sky, and the unjust go the left, downwards, into the earth (Lloyd 1973: 171).

It is fascinating to realise that the same cosmological, structural programme, even though expressed in very different media, is seen on earlier Nordic Bronze Age bronzes, where left can be associated with down and the underworld, and right can be associated with up and the heavens.

CONCLUSION

Movement was crucial in Bronze Age cosmological thinking and a consequential directionality was stressed in the iconography of northern Europe. The ship – a pictorial metaphor for movement – was the paramount symbol of the eternal voyage of the sun. If the movement of the sun should be stopped or terminated during its nocturnal voyage it would be the end of the world. Darkness would rule. If the sun stopped, then time would stop. In this general eschatology of the world, its end would be a timeless darkness without growth and life. In their rituals, Bronze Age people may have tried to control the voyage of the sun in order to ensure its continued movement, the sun being helped by divine agents such as the sun horse, the fish, the snake, and the sun ships with their crew. The creativity expressed in the bronzes was not therefore just a matter of the development of the motifs themselves but of the ways that they were constructed and deployed in order to tell the myth of the sun and ensure that the sun would continue its daily journey.
Textiles served direct basic needs in prehistory for clothing, soft furnishing, or carrying-items (Grömer 2010: fig. 145). Within these, tradition and functionality must have played a great role, but sometimes we get a glimpse of creative decisions to include special effects – both visual and haptic – in a textile. Textiles thus went beyond the utilitarian to serve visual and sensory purposes.

Textiles were made to attract the attention of observers through mechanisms discussed by Peter Wells (2008: 42–6). Based on studies by neuroscientists, social scientists, anthropologists, and art historians, he analysed the visual qualities of objects, and the perception and reception of things by humans. He pointed out that surfaces, texture, decoration, edges, glitter, colour, and lighting are elements of visual quality (as well as pictures, faces, and shape references) and that these structure visual experience. Surfaces can be plain and flat with little texture, or afford the possibility of decoration. The perception of textile patterns, like other images, depends on the creativity of the makers as well as that of the viewers and responders.

Bronze Age people were not only surrounded by different visual effects, but also by a broader range of haptic impressions such as the smooth surface of stones, ticklish grass, or rough sand. In the design of textiles people tried to take these natural impressions into other aspects of their environment by playing with the possibilities of the material. Creativity was embedded within
the generation of textiles as haptic objects, and sensory perception was an integral part of a textile through its pattern, surface structure, and decoration. The haptic experience of textiles has also been described by Sophie Bergerbrant (2007: 63–4) in her description of Bronze Age dress in Scandinavia as the ‘effect of touch’. She noted that the warm softness of wool clothing contrasts with shining cold metal. As Scandinavian Bronze Age women had more metal dress accessories than men, the outfit of a person and, with it, the physical sensation of touch, depended on their gender. Wealth also played a role regarding both amount and quality of metal and textile dress pieces. Textiles thus often served as ‘background’ for other objects, such as when they were used as clothes with attached bronze jewellery. Just like other artefacts, however, textiles have a surface with specific textures. Surface texture is the second aspect of an object that we perceive after its shape (Wells 2008). If a creative textile producer wants to make viewers focus on an object, he or she will employ highly textured surface structures. Importantly, such surface texture can not only be seen but also felt, and this is especially relevant for textiles as they are often in contact with the body – for example when used as clothes or blankets – and thus the haptic aspect of the surface is an integral part of its experience.

WEAVE PATTERNS, STRUCTURES, AND TEXTURES

Making textiles means long planning and even longer performance, starting with a conscious choice of fibres and spinning technique to get a textile with a specific effect (see Bender Jørgensen this volume). When a craftsperson starts to make a textile they must know the basic process and have a design in mind, although there are some points where variations can be made easily inviting them to improvise (see this volume Part II). The degree of pre-planning and choices involved in making textiles in the early stages of the chaîne opératoire, and the process of weaving, means that for textiles it is difficult to separate pattern and texture; the former leads inevitably to the latter.

Woven fabrics are compositions made by the interplay of two thread systems – warp and weft – crossing each other and as such creating a large and flexible piece (Figure 3.32). Tabby is the basic weave, where one thread system interlaces as much as possible with the other, always going over one thread and under the next. This primary weave can be varied in different ways, resulting in special effects and in decorative weaves. Repp has a very dense structure where one thread system is completely covered by the other. As an effect, it is very durable, retaining its shape well and resistant to deformation, but it is not very elastic resulting in a relatively stiff haptic effect. One grave at Middle Bronze Age Schwarza (Farke 1993) contained a very dense repp band with 24
warp threads per cm, made with plied yarns. Other variations are basket weave, made by 2 wefts crossing 2 warps, which gives a cubiform texture, different to the plain and structureless impression of tabby. Half-basket weave has paired threads in either warp or weft.

The creative play with different possibilities of textile structures, resulting from different interlacing methods between the two thread systems, may have been derived from older mat-making techniques. Since the Neolithic, mats were produced with interesting interlacing patterns which look like complex twill variants, as finds from Michelstetten in Austria (Grömer 2010: fig. 64) or in Poland, Hungary, and the eastern Baltic littoral demonstrate (Bender Jørgensen 1992: 85; Richter 2005, 2010; Rimkutė 2010). They were made completely by hand, and the handling of single elements during mat-making allows a lot of creative variations. But how to translate those design principles into weaving? A new type of loom had to be invented where more than one heddle was used. Threading a warp-weighted loom with two or even more heddles requires creative and three-dimensional thinking. The heddling of the loom structures the movements of the threads in the fabric, and it also limits the possibilities in terms of how to move single elements. Some of the earliest examples for this kind of weave in Europe were found in Hallstatt about 1500–1200 BC.

Simple twill creates diagonal lines, while zigzag twill shows wave-like structures. Twill changes the character of a wool textile from a firm textile to a more elastic one. Furthermore, twill is very decorative. It also invites the maker to play with different colours in warp and weft, which results in differently coloured impressions of the front and back for 2/1 twill. Apart from using
weave structures, creative design is possible by weaving in different densities. It becomes possible to design a textile which is translucent, or one which is firm and completely opaque. With the use of a translucent textile it is possible to show and hide something simultaneously. Very open weaves, such as ‘Schleiergewebe’ (veil-like fabrics) are not only translucent, but also very flexible in themselves and adhere closely to the body when worn, showing its form even while covering it. In contrast, very dense, stiff weaves cover and hide a body by forming a separate outer shell that does not follow the form under it completely. Both translucent and opaque fabrics are known from grave finds such as Schwarza (Schlabow 1958: tab. LIV). It is clear what they were used for from their position in the grave: the translucent veil formed a charming frame for the face. The dense, stiff fabric was found on the body and may have been used as a warm, wind- and waterproof mantle. Both kinds of fabrics also offer different experiences of touch. Other structural effects including structural stripes or a ribbed surface are possible through the creative use of different kinds of threads, as known from Late Bronze Age (HaA) Staré Město in the Czech Republic. It has fine structural stripes as a decorative effect made with alternating z-twisted and Z-plied yarns in one system. The plied yarn is made of three yarns plied together, a very unusual process showing the extra effort invested into the design effect. For these structural effects and textures, creative action takes place during the decision-making process in terms of which threads to use for the intended kind of textile, as well as in the first steps – the set-up of the loom. The actual weaving work done after that is not creative, but rather a repetitive crafting process.

The structure of the textile surface may sometimes be changed by fulling or felting to make it wind- and waterproof – advantages that skins and furs have over unfulled textiles. For fulling, the cloth was put through a process that caused a shrinking of the fabric as well as felting the fibres together into a wind- and waterproof sheet. This was done by scouring the cloth, followed by pounding or trampling the cloth so that it thickened. It is the same process that is done even now to make the famous Lodenmantel, which is part of the national costume of the Salzkammergut region in Austria, where the Bronze and Iron Age site of Hallstatt is situated. Felting can also occur naturally through usewear. Textiles either fully or partly felted were found in Hallstatt and Schwarza (see Schlabow 1958), where the archaeological evidence clearly shows that those items were used as clothing.

A very special haptic experience can be obtained with additions to the two-dimensional fabric such as looped threads on the surface. This creates a strongly three-dimensional effect by forming a fabric with a pile, resembling a shaggy fur. Loop-pile fabrics are known from the Nordic Bronze Age,
where some men’s cloaks and caps have pile decoration. For example, long and coarse threads were stitched into the ground weave of the male oval cloak from Trindhøj. On one of the two caps from the grave an exceptional, very dense pile of extremely thin threads ending in small knots was used to create a surface with a furry look (Broholm and Hald 1940: 18–19; Mannering et al. 2012: fig. 3.8). In central Europe, this kind of three-dimensional decoration first appears in Iron Age Hallstatt (Grömer 2010: fig. 95). Creating a pile fabric of good quality and density is a huge amount of work, raising the question as to why such an effort was made to imitate the appearance of fur. One explanation is that a dense and coarse weave with pile is clearly warmer than one without a pile. Additionally, the fabric can be washed, which is not possible very easily for fur. Finally, textile lends itself better to colour decoration than furs, offering more design opportunities.

Fringes on the borders of textiles are clearly a stylistic element with a Neolithic tradition (compare Vogt 1937: fig. 87: Robenhausen, and figs. 100–4: Lüscherz). For the Bronze Age, we know of fringed textiles from Molina di Ledro, where a sash was decorated with elaborated fringes on the ends. From Lucone di Polpenazze, four pieces of linen with knotted fringes were found, formed by variously twisted or braided threads (Bazzanella et al. 2003: 188).

Marta Bazzanella (2012: 208) argues that the occurrence of fringed borders on the textiles may have a symbolic significance, as suggested for the fringed rectangles depicted on the rocks of Ossimo and Borno in Valcamonica.

The circumalpine lake dwellings bear treasures of organic finds, especially textiles, which originate from waterlogged contexts. In a long tradition dating back to the Neolithic in the fourth millennium BC, we also find patterned linens, decorated in a creative way with floating threads, either by changing the basic weave or by adding supplemental threads. They can form stripes or even move in different ways over the surface of the textile. Early Bronze Age examples clearly tie in with this Neolithic tradition (compare Rast-Eicher 2005). A good example of these sophisticated textiles was found in the pile dwellings of Molina di Ledro. It was a rolled-up bundle that proved to be a narrow linen band, 209 cm long and 6.8 cm wide, dated to 2100 BC. The ends are decorated with a woven pattern of concentric and touching lozenges (Bazzanella and Mayr 2009: 36–40). The diagonal lines of the lozenge design were formed by picking out and floating the warp threads. This complex technique is a creative interaction of the weaver with the fabric. Though it creates a pattern much the same as in twill, it required extra effort and action; twill was not yet woven as the basic weave. The earliest twills in Europe are four pieces from Middle Bronze Age Hallstatt, one of which has been radiocarbon dated to between 1371 and 1117 BC (Grömer et al. 2013a: 189, 309).
The design principles of the Molina di Ledro find with floating warp lozenges can also be seen on contemporary iconography (Figure 3.33). The anthropomorphic stelae from Sion in Switzerland, dated to the Beaker phase around 2400–2200 BC, display people with clothing, belts, and pockets (Rast-Eicher 2005: 125 f.). The depicted clothing is of interest because it shows patterns such as lines, triangles, and rhomboids. The patterns clearly echo that on the sash of Molina di Ledro, which is just slightly younger. A girdle with a loop at the end was found from the same site. Such an object is also depicted on the Sion grave stones, forming a strong argument for the realism of these images.

EDGES AND CONTRASTS

Wells (2008: 43) points out that edges serve to guide our eyes over surfaces, to direct us to where we should be looking to see what is essential. A woven fabric often has accented edges of different kinds; this is part of the weaving process and is technically necessary. Design-wise, the borders and selvedges offer a contrast to the main weave, combining different weave structures in one object. Elaborate borders on textiles were a favoured feature
in the Bronze and Iron Age (Grömer 2010: fig. 60) (Figure 3.34) but are also found in the Neolithic pile dwellings in Switzerland (Vogt 1937).

The borders are usually produced by a different technique to the main body of the fabric. The borders stand out either by a change in the number of warp or weft threads or the use of a different weave type. Starting borders with a ribbed effect were produced separately before weaving the actual fabric, as a part of the set-up process (see Hoffmann 1964: 64–7). A very interesting piece from Bosnia–Herzegovina is the large tabby weave from Pustopolje, accentuated with 2:1 repp at one border and a twined line and 4:1 repp on the other end (Bender Jørgensen et al. forthcoming). Several examples of plaited borders are known from Scandinavia (Broholm and Hald 1940; Sundström 2010). They could serve as either a starting or end border and create a decorative and secure ending of a fabric. The plaiting was done by hand using two threads: alternate pairs of threads continue to form the tabby weave, while remaining pairs of threads end in a loop at the transition from plait to weave. In some cases, it is clear that the plaiting must have been done before weaving began, as an alternative to a woven starting border.

COLOUR PATTERNS

Textiles were decorated with structural and geometric motifs, which are inherent in the textile production process. From metal and ceramic objects, we know of many other different motifs (including figurative motifs) used for
decoration in the Bronze Age, but for textiles these motifs are usually lacking. Textiles, however, offered particular possibilities with regard to the use of colour. The impact of wool and the possibilities to add colour to it had ramifications for creative expression in Bronze Age textiles (see also Parts I and II of this volume). The option to have colourful cloth had a deep influence on how textile material was used. Before the invention of dyeing, natural shades like off-white, grey, brown, and black were used for colour patterns but brightly dyed yarns in red, blue, or yellow made ‘signal patterns’ with much higher visibility possible. Patterns and structures could be worked that attract the eye much more than natural shades, even if the cloth itself was a monochrome blue surface area or background for attached bronze objects.

From the Early Bronze Age, colour design was an important aspect for textiles, starting with the use of natural shades of wool fibres. Stripes break up the otherwise monochrome surface of a textile; they define edges, and channel the viewer’s attention in special directions. The use of striped patterns is known from the Neolithic; however, the Neolithic striped textiles were not made as colour stripes, but rather as structural stripes, using thicker or floating wefts to form the effect. Such a striped textile from Wetzikon-Robenhausen, dated to 3650 BC, was patterned with supplementary threads in twill-like design, inserted by hand into the tabby ground (Rast-Eicher 2005: 124; Vogt 1937: figs. 84–6).

Stripes can be made very easily in weaving, either during loom set-up or during the weaving process. During warping, threads of different colour can be included in the warp. When mounted on the loom, this pattern cannot be changed during weaving. For an alternative method, weft threads of different colour are inserted during the weaving process. Choosing weft threads of different colours or thicknesses in this method is an on-going creative process as they can be varied very easily during textile fabrication. Early examples of textiles with colour stripes are based on the use of weft stripes. An early striped textile from the Early Bronze Age site of Franzhausen dated to c. 2000 BC (Grömer 2010: fig. 84) was found in grave 110 with a young woman (Figure 3.35). The rich grave goods and jewellery, as well as the textiles found there, show extraordinarily fine work. The textile of the headdress matches the high quality of the other goods. It is a very fine ribbed tabby with a thread count of 17/7 threads per cm (i.e. it is 17 warp threads and 7 rows of weft per centimetre) made of fine plied yarn (0.4 mm S-plied yarn) in flax. The interesting thing here is that it has been woven with stripes. There is a light ground weave, discoloured due to the metal in the grave, with a decoration in the form of dark brown composite stripes. The poor state of conservation of the dark threads, however, did not permit fibre identification. A similar find is from the tumulus of Dietzhausen in Germany (Farke 1993: 109 and fig. 13),
which belongs to the Middle Bronze Age. A fine ribbed tabby was also found there with stripes made by a groupwise change of light paired yarns (s-spun; 52 threads) and dark Z-plied yarns (2 or 4 threads), forming a pattern of narrow dark bands on a light background. The raw material of this example was sheep wool in light brown and blackish-brown natural shades. In both cases it is supposed that the decoration was obtained by using the natural colour of the fibres. Thus, the decorative effect was probably achieved by a combination of strongly pigmented wool and naturally white flax in one case and pigmented and white wool in the other.

The early striped fabrics highlight the more or less muted colours of the textile world of the Bronze Age. But from 800 BC onwards, textiles in central Europe became more and more decorative, including colourful stripes and checks as well as monochrome spin patterns (Grömer 2010: figs. 85–92). Band weaving techniques and tablet weaving created even more patterns, such as chequer-board motifs. In particular, tablet weaving offered a lot of design possibilities and was a playground for creative and active design. More complex patterning such as triangles, diamonds, or meanders became possible by
using differently dyed warp threads. In this technique, certain movements and sequences of movements are important. Their correct and conscious use define the appearance and quality of the end product. It seems as if Hallstatt society especially valued innovation and creativity in handcraft and design.

**SHADOW/SPIN PATTERNS**

Colour patterns can be seen clearly from a distance, but there are other techniques of patterning including spin patterns that are only visible from close up (compare Wells 2008: 60–4). In a spin pattern the difference in spinning direction could be exploited to provide decoration; otherwise identical s- and z-spun threads laid side by side will catch the light differently and give a subtle tonal pattern. This created a special visual effect. Presumably a lot of thought and design work was spent on planning them.

One of the earliest examples is a piece from the Mitterberg copper mine in Austria dated to the Early–Middle Bronze Age transition (1600 BC) (Figure 3.36). It is a finely made woollen repp band (warp-faced) made with plied yarn. The special effect of the band is caused by the irregular, groupwise change of S- and Z-twisted plied yarns for the warp. The number of finds with this kind of pattern increases in the Middle Bronze Age. Usually Bronze Age spin patterns are worked in wool with alternating 1–2 threads s- and z-yarn in one thread system. Spin-patternning is known in central Europe from

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*Figure 3.36 Textile from Mitterberg, Austria (number FNr4). Photo and drawing: K. Grömer.*

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Hallstatt, and in several finds from the Nordic Bronze Age, including Borum Eshøj grave A, Grevenkrug, Jels, Melhøj, Mølgaard, Rolandshøj, and Skallerup (Ehlers 1998: 99 and 124). In more complex versions we can see stripes or bands caused by alternating bands of groups of s- and z-spun threads. A wool sash from the female burial Borum Eshøj grave C was woven in warp-faced repp and appears to have three diagonally ribbed stripes. The two running along the selvedges are slightly darker (Broholm and Hald 1940: fig. 63). Spin-patterning was the main type of effect in the Hallstatt period (Bender Jørgensen 2005), a hint to creative choices of pattern effects in the central European region.

GLITTER: GOLD ELEMENTS

Even metal elements were used for the embellishment of cloth in the Bronze Age. Wells (2008: 45) indicates that the sparkle or shininess of an object can be an important aspect of attracting and holding visual attention. The effect of glitter, especially of gold, dazzles viewers who see it in bright light, whether direct sunlight or the light of a large fire, and forms a contrast to the interaction of the textile with light. Using gold threads is clearly a choice related to showing status, but it can also be a creative choice in how to enhance materials for which there are issues regarding their advantages or disadvantages in use together with textiles. Gold stays flexible, glittery, and shiny as opposed to bronze; gold does not become brittle or tarnish during use. Bronze used as textile decoration glitters like gold when the item is brand new, but once the piece gets older it will become tarnished brown or greenish.

In the Late Bronze Age there are some finds of gold threads which may originally have been integrated into textiles. They appear in modern Austria and Hungary and were found in cremation graves together with ceramic urns, such as a small assemblage of loose gold threads in three graves from Vösendorf (Talaa 1991: fig. 33), as well as in gold hoards in settlements. From Óbuda in Hungary (Barth 1988/89), we know of a hoard from the eleventh century BC with gold threads (the base textile has disappeared), larger gold plates, gold hair ornaments, and gold discs. This can be understood as the remnants of a high-ranking person’s vestments. During the recent excavation of a Late Bronze Age hill fort at Várvolgy in Hungary, a gold hoard was found containing thin gold ribbons produced by sophisticated technology (Müller 2012). The heavily coiled bands were probably used on a garment.

This phenomenon is also known from the eastern Mediterranean and Near East (see Gleba 2008b). Gold threads were incorporated into fabrics and gold bracteates or appliquéés were sewn onto garments by Assyrian or Babylonian gold weavers. Several of Tutankhamun’s tunics were richly decorated with
gold sequins (Vogelsang-Eastwood 1999). Early literary sources such as the Old Testament (Exodus 39.3) or Homeric epics speak of gold textiles. The Odyssey praises the golden robe of Eos (Hom. Od. 14.468–502) and the Iliad (a composition which historians date to the end of the ninth century BC) mentions the hundred golden tassels on Athena’s aegis (Hom. Il. 2.530). The latter, more or less contemporary with the Vösendorf find, suggests what those threads may have been used for. The find from Vösendorf shows golden strips wound loosely around an organic core which did not survive. The core must have consisted of relatively thick cords, as proved by the windings of gold that survived. Sometimes the gold strips were wound around broader elements, such as textile bands or leather strips of 7–8 mm width as in finds from Óbuda, Varvölgy. This could be woven into a textile or attached to a finished woven piece.

These early techniques of attaching gold strips or threads to textiles differ from later ones. In the Hallstatt period, gold strips were clearly used as a (possibly supplemental) weft thread. They were woven in, as seen for example in a textile from the site of Grafenbühel (Banck-Burgess 1999: fig. 10). In the Graeco-Roman world the vast majority of textile finds with gold threads were made with gold strips known as ‘Lahn’ twisted around an organic thread core of wool, linen, or sometimes silk (Gleba 2008b). Other techniques involved the use of drawn gold wires which were twisted around a fibre core, and the use of gilded membranes. Lahn was made either by beating drawn gold threads or by cutting thin gold sheets into narrow strips. This technique was very efficient in terms of material and time expenditure for the resulting product. Depending on how tightly the gold strip was wrapped around the core, one can talk about ‘open’ gold thread where the core is still visible (as in the Bronze Age finds from Vösendorf and Óbuda), or ‘closed’ when the core is completely covered by metal.

Gold threads were used for weaving, sprang, embroidery, and twining techniques. They were even used as warp or weft. An early example comes from the royal tomb in Vergina (fourth century BC), where a purple textile was decorated at both ends with gold-and-purple tapestry (Spantidaki and Moulherat 2012: 195–6, fig. 7.17). Whatever their function, gold textiles were extremely expensive and would have been available only to the very top strata of society.

APPLIED DECORATION

Applied decoration differs from decoration woven into the fabric by allowing a much freer design process. Whereas woven patterns depend on the geometric system of warp and weft, applied elements can also be used to
create non-geometric designs. Applied decorations include both embroidery and other kinds of sewn-on elements such as beads. Such decorations create complex surfaces which catch attention. The more complex the surface of an object, with decorative patterns, curved shapes, three-dimensional features, and multiple colours, the more time and attention the brain devotes to examining it and figuring out what it is (Wells 2008: 33 f.). It is definitely a possibility to be considered that textile creativity resulted in similar visual complexity to contemporary bronze objects, thus getting similar attention.

The site of Molina di Ledro offers interesting examples of applied decoration. For example, one textile has embroidery using running loops to form the design on a fine open weave tabby (Bazzanella and Mayr 2009: 58–9). There is, however, only one Bronze Age textile found so far with a more complex pattern. The richly patterned fabric from Pfäffikon-Irgenhausen in Switzerland was found in the lake dwelling at the beginning of the twentieth century (Rast-Eicher 2012b: 381; Vogt 1937) (Figure 3.37). In older publications, it was attributed to the Neolithic, but new radiocarbon

![Image of complex applied decorative patterns on the fabric from Pfäffikon-Irgenhausen, Switzerland.](https://www.cambridge.org/core/terms). https://doi.org/10.1017/9781108344357.028

Figure 3.37 Complex applied decorative patterns on the fabric from Pfäffikon-Irgenhausen, Switzerland. a), c), e) sewing sequence; b), d), f) the pattern on the front of the textile. Redrawn after Vogt 1937.
dating indicates that it is much younger, belonging to the Early–Middle Bronze Age transition (1685–1493 BC). The fine linen was woven, then decorated with rich embroidery. The pattern consists of what may once have been colourful chequer-board patterns, triangles and stripes on a natural white linen ground weave (Rast-Eicher and Reinhard 1998: 288). This is a very sophisticated piece and a good example of creative textile decoration. Similar motifs can be found on contemporary objects made in other media, such as the clay figurine from Kličevac in Serbia, dating to the same period of around 1500–1400 BC (Müller-Karpe 1980: tab. 326). It shows how textiles with such patterns could have been used. The figurine depicts a female person with a wide skirt. The seam of the skirt as well as the belt/apron area are decorated with triangles and a chequer-board pattern similar to those on the Irgenhausen textile.

This outstanding Irgenhausen fabric gives us a glimpse of the beginning of a trend towards more complicated textile decoration which can also be observed in the Mediterranean world. Besides the richly decorated textiles from Tutankhamun’s grave from the late fourteenth century BC (Barber 1991; Vogelsang-Eastwood 1999), some remnants of embroidery or floating thread work are known from Akrotiri in Greece, an ancient town preserved under the ashes of a volcanic eruption in the middle of the seventeenth century BC (Spantidaki and Moulherat 2012: 187). Nonetheless, visually complex, decorated textiles had a long tradition in central Europe and are thus probably not a Mediterranean influence; the complex Late Neolithic textile from Murten in Switzerland (Vogt 1937: figs. 62–4) is a case in point.

Embroidery has also been found on a number of Bronze Age textiles from northern Europe: a blouse from the female oak-log burial at Skrydstrup, Denmark, was extensively embroidered around the neck opening and on both sleeves (Broholm and Hald 1940: 91–4); similar decoration was found in two other female burials from Denmark – Melhøj and Emmedsbo Mark (Bender Jørgensen 1986; Fossoy 2012: 49–50) – and in a female burial from Flintbek in Schleswig-Holstein, northern Germany (Ehlers 1998: 422–5, tab. 29). Simpler variations decorating the edges of garments have been found in four male burials from Denmark (Fossoy 2012: 50–3) and on a garment found with a male bog body from Emmer-Erfstehdenveen, the Netherlands (Comis 2003: 194–6).

Textiles with sewn-on elements very rarely survive in the archaeological record. In the lakeside settlement of Molina di Ledro a fine, regular plain-weave linen was decorated with tiny seeds of Lithospermum (Bazzanella 2012: 206)
sewn on like beads in some design that is no longer recognisable. It is similar to an earlier fragment from Murten in Switzerland (Vogt 1937), confirming that the Neolithic lake-dwellers practised beadwork using seeds. Sewing all manner of beads, sequins, and platelets onto garments seems to have been common in prehistoric Europe as far back as the Palaeolithic. For example, rows of shell beads were sewn onto some sort of cap in the Gravettian Grotte des Enfants (see Barber 1991: 172). It appears that women of central Europe, especially in the Bronze Age and Hallstatt Culture, were fond of such organic and metal appliqués on garments (Grömer 2010: 184–6, 335–9). In a few cases, decoration went beyond beads and sequins and became tiara- or crown-like bronze headdresses, such as the two richly furnished female burials from Franzhausen, Austria and Henfštädt, Germany (Grasselt 1999; Neugebauer 1994).

**CONCLUSION**

Bronze Age textiles are not usually decorated with motifs of a kind known from pottery or bronze artefacts. Thus on textiles we do not generally find curved lines or naturalistic motifs like birds or horses. The reason for this may be the way that textiles are made, with warp and weft forming a very strict underlying geometric system. From 2000 to 500 BC, decorations and patterns of textiles were usually planned and carried out during the weaving process. A range of decorative techniques resulting in different structural compositions and textures, fringes, colour and shadow patterns, glitter and applied ornamentation can, however, be observed. Interestingly, texture can look very different depending on the vantage point (Wells 2008: 44). For textiles this means that most of the textures like zigzag twills or repp made as monochrome cloth would look like a simple, plain surface from far away but, closer to the piece, the lines of the twill or the ribbed structure of the repp can be seen. The same holds true for textiles with spin patterns and other subtle tonal patterns. Thus, the elements requiring the most skill can only be appreciated in close proximity to the object. The creative expertise of the maker is demonstrated at an intimate, personal level, not at a distance.

Within the textile production process there are only a limited number of opportunities for creative decisions. Much of the process is repetitive and is a matter of executing decisions made in the pre-planning stage. Decisions made at the different stages of the textile chaîne opératoire, however, influence the quality, structural patterns and effects of the final product, including its aesthetics and what the product can be used for (see Grömer 2010: fig. 12, Bender Jørgensen this volume, and this volume Part II). In this sense, all decorative
techniques are a form of creative exploration of the possibilities of the materials (see Part I this volume). Furthermore, some of the patterns, decorations, and structures apparent in Bronze Age textiles show freedom in the expression of individual creativity through improvisation, especially with floating thread techniques and in patterning with tablet weaving. Within the social context of the European Bronze Age, the value of skill and creative design began to be important in textile production.
PATTERN, COLOUR, AND TEXTURE IN ENCRUSTED CERAMICS IN THE CARPATHIAN BASIN

Joanna Sofaer and Sanjin Mihelić

Elaborately decorated so-called ‘encrusted ceramics’ are striking examples of the use of pattern, colour, and texture in Bronze Age pottery. Characterised through the distinctive use of white inlay, most commonly on black vessels and more rarely on buff or orange vessels, these objects have a range of complex abstract decorative patterns including zigzags, hashing, lines, dots, circles, net, and herringbone patterns that occur either singly or in combination (Bóna 1975; Šimić 2000; Kiss 2012a; Reich 2006; Roberts et al. 2008). The decoration is typically filled with the inlay resulting in elaborate, visually striking, and sometimes quite theatrical vessels.

Although the term ‘encrusted ceramics’ gives its name to the Transdanubian Encrusted Pottery group of the Hungarian Middle Bronze Age (c. 2000–1500 BC), inlaid pottery is widespread throughout much of the Bronze Age in the Carpathian Basin. It features in the ceramic assemblages of several different contemporary cultural groups to a greater or lesser extent including the Szeremle and Dalj-Bijelo Brdo groups (the south-east extension of the Transdanubian Encrusted Pottery group found in Croatia), and the Dubovac-Žuto Brdo and Gârla Mare groups in the south-east of the Pannonian Plain in Serbia and Romania. The inlaying of ceramics was part of a long-standing regional tradition. It is also found in the Early Bronze Age Kisapostag group (c. 2100–2000 BC) and at Eneolithic Vučedol sites (c. 3000–2400 BC) where
elaborately decorated inlaid ceramics have been documented (Balen 2005; Dimitrijević 1977–78, 1979; Durman 1988; Schmidt 1945; Sofaer 2014; Sofaer and Roberts 2016). The decoration of Bronze Age ceramics in the Carpathian Basin using inlays was therefore a widespread practice that transcended individual cultural units.

As a technique, inlaying offers the potential to create striking effects through the contrast between the inlay and background material. On a wider level, this potential appears to have been exploited by using inlays to decorate a range of objects throughout the continent using a variety of materials. In central Europe, Bronze Age ceramics were occasionally inlaid with tin, as, for example, at the Late Bronze Age settlement site of Hauterive-Champêvéryres in Switzerland, while the Caergwrle bowl in Wales was made of shale inlaid with tin wrapped in gold foil (Green 1985). A series of wooden vessels decorated with tin tacks arranged in bands and with a star on the base have been found from Early Bronze Age Denmark and northern Germany. There are also rare examples of damascened objects (metal objects inlaid with another metal) (Berger et al. 2013; Berger et al. 2010). Bronze Age encrusted vessels in the Carpathian Basin are, however, distinctive among inlaid objects. This arises in large part from their particular combination of pattern, colour, and texture.

PATTERN

Considerable attention has been paid to identifying and classifying the decoration on encrusted ceramics, primarily in order to develop chronological schemes and identify cultural boundaries in the Carpathian Basin (e.g. Kiss 2012a; Reich 2006; Şandor-Chicideanu 2003; Šimić 2000). Despite the apparent complexity of decoration on encrusted vessels, in fact they employ a restricted range of individual elements including dots, circles, lines, swags, triangles, and short tapered dashes (so-called ‘flames’). Although some of these were specific to particular groups or phases, others were shared. In particular, dots and circles, as well as lines and triangles, were common to almost all groups (Šimić 2000). For example, Kisapostag pottery has horizontal and vertical straight-lines and zigzag bands running around the vessel (Kiss 2012a). Triangles were a common element either placed opposite each other to create a zigzag or as ‘hanging triangles’ (Kiss 2012a) that give the appearance of teeth on horizontal bands. These elements were also part of the Transdanubian Encrusted Pottery group (which on this basis has been seen as a development of the Kisapostag group), but were supplemented by hatched triangles and a net or grid-like motif (Kiss 2012a). In the northern area of the Transdanubian Encrusted Pottery group, punched dots combined with thin lines. In the southern area of the Transdanubian Encrusted
Pottery group dots were replaced by concentric circles (Kiss 2012a). In the late phase of the Transdanubian Encrusted Pottery group dots were grouped together to form horizontal lines with downward curved ends, along with thin zigzags, triangles, and ‘flames’. The latter are also found in the Szeremle group. In the Szeremle, Dubovac-Žuto Brdo and Gârla Mare groups there are elaborate combinations of lines, circles, spirals, curls, swags, zigzags, triangles, cross-hatching, and dots. In the Dalj-Bijelo Brdo group the dotted horizontal lines with curved ends seen in the late Transdanubian Encrusted Pottery group were also sometimes placed vertically on the vessel (Šimić 2000). In general, the further south-east and chronologically later the vessel, the more complex the combination of elements (Figure 3.38).

The most striking aspects of encrusted pottery are not necessarily the individual elements, many of which were shared, but the ways that they were used to build up a range of motifs through the combination and patterned repetition of elements in different ways (Figure 3.39). For example, at a basic level, dots were used to build up horizontal and vertical lines, triangles to make zigzags. Lines were bundled together or swags combined to make garlands. Such basic combinations followed two sets of principles in terms of the combination of elements into motifs. The first was the creation of running bands around the vessel. In these cases the motif has no distinct beginning or end but is a continuous repeated pattern. The second is the creation of a unit of motif where elements are combined to create a discrete symmetrical pattern as in the combination of circles and dotted lines, or combinations of circles, lines, and triangles. Sometimes the same combination of elements was orientated differently, thereby creating further variation. For instance, dotted horizontal lines with curved ends were placed horizontally on the vessel in the late phase of the Transdanubian Encrusted Pottery group, and both vertically and horizontally in the Dalj-Bijelo Brdo group (Šimić 2000). A common pattern in

Figure 3.38 Encrusted pottery from the Carpathian Basin. a) Sherd from Kaposvár, Hungary in the northern Transdanubian Encrusted Pottery group; b) Sherd from Gârla Mare, Romania. Photo: J. Sofaer.
the north of the Transdanubian Encrusted Pottery group was made by placing concentric circles at the terminal of groups of parallel vertical lines but elsewhere such suites of lines can also be horizontal or slanting.

Individual motifs were therefore patterns composed of the repetition of elements. These motifs were in no way figurative but some may have been abstract representations. It has been suggested that particular patterns represented the human face (Kiss 2012a; Palincsă 2010). Concentric circles may have stood for the sun (Kiss 2012a; Kristiansen 2010; Pásztor 2009; Sofaer 2013), and circles with incised lines for spoked wheels (Sofaer 2013). The dotted lines with
curved ends show a striking resemblance to ship motifs elsewhere in Europe; these appear upside down when vessel is on its base but can be understood as ships when viewed from the top down, as when lifting the vessel up to drink or to pour. In cemeteries of the Transdanubian Encrusted Pottery group there may also be a link between choice of motif and gender. At the site of Bonyhád in Hungary, pottery associated with female burials tended to have zigzags and vertical bundles of lines, while that with males had a net motif (Szabó and Hajdu 2011). Other researchers have discussed how lines made of dashes may imitate stitching on clothing and have pointed out that some motifs echo those of ornaments (Kiss 2012a; Palincaș 2010).

Motifs were turned into patterns through repetition around the vessel; units of motifs were most frequently placed at half or quarter points. For example, in so-called ‘multi-story’ pots of the Dubovac–Žuto Brdo group either the same vertical motif is repeated four times around the upper part of the vessel or two different motifs are alternated twice (Šimić 2000). Frequently, both running bands and units of motifs were combined, resulting in complex combinations of symmetrical compositions. It has been suggested for eastern Slavonia that the more complex the vessel shape, the greater the surface of the vessel covered by ornamentation (Šimić 2000). This does not, however, necessarily hold true for all groups with encrusted wares. In the Transdanubian Encrusted Pottery group, for example, relatively simple shapes such as cups and small bowls may be highly elaborated.

There nonetheless appear to have been distinctive principles of organisation in relation to the placement of the motifs on the vessel. Particular motifs and pattern combinations were located in specific zones of the vessel such as the rim, neck, shoulder, upper body, lower body, and base (Kiss 2012a; Reich 2006; Šimić 2000). While symmetry around the vessel was an important principle, the concept of symmetry did not extend to vertical orientation; decoration on the upper part of the vessel does not seem to have been mirrored on the lower part. Different areas of the vessel therefore seem to have been conceptually distinct. For some vessels, in particular some kinds of fine ware urns, as well as small and larger deep bowls, it has been suggested that there may be a link between the zonation and orientation of the decoration and the human body; particular zones of the vessel may have corresponded to parts of the body such that the vessel took on properties of the person (Szabó and Hajdu 2011). On some shallow bowls the circular shape of the base was integrated into the motif such that the whole vessel became a four-spoked wheel or the concentric circles of the sun (Sofaer 2013, this volume). In these cases the pattern was linked to the circular shape of the vessel base. Such arrangements served to accentuate particular parts of a vessel but were also a matter of understanding its
geometry and exploiting this to convey a narrative (Sofaer 2013, this volume).
In making an encrusted ware vessel potters thus worked from a repertoire of established local and regional elements, and with principles of symmetry and repetition that were largely shared by different Bronze Age groups throughout the Pannonian Plain to create and organise their own distinctive patterns.

Nonetheless, no two vessels are exactly the same and the combination of motifs is highly variable. Attempts to classify individual motifs and their position on a vessel, while useful, thus often prove challenging in respect of understanding the complexity of decoration since they fail to capture the true variability of decoration on the vessels as a whole. Rather than attempt to force the issue, instead it may be useful to acknowledge that attempts to find consistency and repetition in the application of pattern between vessels is an impossible task; that there is no rigid pattern in encrusted ware decoration over and above a more general series of principles. It appears that patterns were assembled through a structured bricolage (Derrida 1966). They were collages of elements and motifs borrowed from a shared regional heritage, reflecting the originality and creative agency of the potter. In this sense the decoration on individual vessels may have emerged during the process of making such that potters ‘find their way as they go along, so that the novelty of their patterns is apparent only when they have finally arrived rather than prior to setting out’ (Ingold 2007b: 49). Thus the decorative design of any individual vessel may not have preceded its execution. If so, creativity emerged during the process of making the pot such that the final decoration was evident only when the object was virtually complete (see Ingold 2007b: 48). Such a process may be envisioned as similar to that of a painter ‘who stands back between brushstrokes, looks at the canvas, and only after this contemplation, decides what to do next’ (Turkle and Papert 1992: 13).

COLOUR

The inlays of Bronze Age encrusted vessels in the Carpathian Basin are overwhelmingly white. The colour of the inlay arises from the materials chosen to make them and their manipulation. Studies of prehistoric inlaid sherds dating from the Neolithic to the Iron Age in Hungary and elsewhere in central Europe indicate a range of possible inlay materials including birch bark, crushed calcined bone, plant fibres, shell, limestone, kaolin, and chalk, held together with unidentified binding agents (Csengeri 2001; Gherdan et al. 2003; Roberts et al. 2008; Sofaer et al. 2013b; Sziki et al. 2002; Trachsler 1966; Uzsoki 1959; Wosinsky 1904).
In the Carpathian Basin, recent analyses of Middle Bronze Age inlays from the northern and southern areas of the Transdanubian Encrusted Pottery group in Hungary, and its precursor the Kisapostag group, indicate that bone (hydroxyapatite) was the most frequently used material for making inlays (Roberts et al. 2008; Sofaer and Roberts 2016). Bone was heat treated and crushed to create the white colour before being mixed with a binding agent. It is not currently possible to say whether the bone came from humans or animals, although given that a common burial rite of the Transdanubian Encrusted Pottery group was cremation this finding raises some intriguing possibilities. These bone-based inlays sometimes contained trace amounts of calcite (calcium carbonate) and quartz. Calcite-based inlays were also used although less frequently. Notably, where calcium carbonate was the dominant material, inlays did not contain hydroxyapatite and the chemical signature of the inlays did not correspond to that of shell (Roberts et al. 2008). Inlays from eastern Slavonia and Baranja in north-east Croatia belonging to the Szeremle group and the Dalj-Bijelo Brdo group were likewise most often made of bone and only rarely of calcite. When the Szeremle group and the Dalj-Bijelo Brdo inlays did include calcite they had quite a heterogeneous composition, also containing hydroxyapatite and quartz, suggesting the deliberate mixing of materials to create novel and complex inlay recipes (Sofaer et al. 2013b; Sofaer and Roberts 2016). In some cases, the Szeremle and Dalj-Bijelo Brdo bone-based inlays contained more than 5% quartz suggesting that this was a purposeful addition to create the inlay recipe (Sofaer et al. 2013b; Sofaer and Roberts 2016). Similarly, inlays of the Gârla Mare group were made of bone with quartz additions (Sofaer 2014; Sofaer and Roberts 2016). It has been suggested that quartz may have had particular symbolic associations in Bronze Age Europe based both on its colour and its electrostatic properties (Bradley 2005).

This variation in the composition of inlays on vessels within the Carpathian Basin – some clear cut and some more subtle – was not related to local surface geology. For example, there does not appear to be a relationship between the use of calcitic inlays and readily available outcrops of chalk or limestone. Nor is there a link between the addition of quartz and local quartz outcrops although this may have been obtained from river pebbles. Furthermore, while there are tendencies to particular kinds of inlay composition within individual sites, there is also variation within sites that sometimes goes beyond that which might be expected between the production of different batches of inlay. In general, the vessel fabrics correspond well to the local geology of the site at which they were found, suggesting local production.
recipes was therefore a matter of local, and perhaps individual, experimentation and creative decisions that resulted in several different ways to create the colour white.

Just as a trip to the modern-day paint shop presents the would-be decorator with an array of whites with different light-reflecting properties or sheen (matte, semi-gloss or gloss), so a closer inspection of these inlays suggests that these ‘whites’ were not all the same. In particular, calcitic inlays are extremely matt and result in a very flat effect while the addition of quartz to a bone mixture, even in relatively small proportions, results in a more reflective, sparkly colour. The shininess of the inlay also affected the level of contrast between the inlaid pattern and the body of the vessel. Contrast was created by the difference in colour and brightness between the inlay and the background colour of the vessel. In the Transdanubian Encrusted Pottery group inlays were applied to a wide range of vessels including thick-walled domestic vessels and storage vessels. The majority of these vessels were black but some were orange/red or buff in colour. In the Szeremle, Dubovac-Žuto Brdo and Dalj-Bijelo Brdo groups, however, inlaid vessels are overwhelmingly black. In the Gârla Mare group inlay is found on buff or grey low-fired vessels found in cemeteries as well as on buff, red, and black figurines. The degree to which the white inlaid patterns stood out against the body of vessels thus varied between groups in the Carpathian Basin and sometimes within these. In all cases, however, fire clouding on inlaid vessels is rather infrequent. This suggests a deliberate attempt to create a single block of background colour against which the inlaid decoration would stand out. The consistency of firing, particularly evident in the full reduction of black vessels, indicates the investment of considerable effort and resources as well as sophisticated control of pyrotechnology during the firing process.

Elsewhere in Bronze Age Europe it has been suggested that colour, especially white and red, may have had cosmological significance (Bradley 2005). More widely, colour has been seen as a metaphor or code that stands for substances, such as red for blood or white for semen, and that offers a means of creating and elaborating order (Tilley 1999; Jones 2002; Jones and MacGregor 2002). Such structuring principles cannot be ruled out in respect of the Bronze Age encrusted ceramics in the Carpathian Basin. It is easy to point to the opposition on the vessels between white and black, light and dark, and to suggest that this may have had significance. However, given the cosmological meanings attached to many of the motifs and their repeated iteration on vessels, in order to understand the impetus behind the making of bi-coloured vessels it may also be useful to consider colour as a ‘presence rather than a sign’ (Taussig 2009). In his book What Color Is the Sacred? (2009) the anthropologist
Michael Taussig explores how colour is sacred, theatrical, and mysterious. He draws upon Victor Turner’s work with the Ndembu-speaking people in central Africa in which Turner describes how their three primary colours – white, black, and red – were conceived as ‘rivers of power … that tinge the moral and social life of mankind with their peculiar efficacies’ (Turner 1967: 68). He goes on, ‘It is not the rarity of the pigments that makes them prized but the fact that they are prized for magic-religious reasons that makes men overcome all kinds of difficulties to obtain or manufacture them’ (Turner 1967: 87). Far from being symbols distinct from their referents, colours are those referents in a deeply organic sense (Taussig 2009: 8). Here the idea of a colour code in a semiotic sense is inappropriate. It is, rather in Taussig’s words, ‘a brutal gesture towards containment’ (Taussig 2009: 8) since colour is fundamentally involved in the making of culture. In this sense the creativity of encrusted ware potters in their consistent and considerable efforts to create bi-coloured objects can be understood as part of a wider cultural obsession with colour in which potters found ways to ‘illuminate the backdrop of myths’ (Taussig 2009: 8) and ‘force the object to release hidden meanings’ (Escobar 2007: 66).

TEXTURE

Texture was created on encrusted ware vessels in a number of complementary ways. On one level these were related to the methods used for ensuring the adherence of the inlay to the pot and the preparation of the inlay itself. On another they were the product of design decisions that produced particular sensory (tactile and optical) effects.

The inlays were applied into a bed that had previously been incised, impressed, stamped, or cut out while the clay was damp, creating a ‘negative’ of the eventual decorative scheme. One widespread method for making the bed, particularly on Kisapostag and Transdanubian Encrusted Pottery vessels, was the so-called ‘rolled-stick technique’ in which a stick wrapped with a cord was pressed into the soft clay thereby creating a series of ridges and dips into which the inlay could be applied (Kiss 2012a; Méri 1942; Torma 1971, 1978). Similarly, on some vessels in eastern Slavonia the surface of the clay appears to have been rouletted using a tool rather like a modern pastry cutter. In other cases, several small individual wedges were made in the clay using the end of a stick or a bone shaped like a triangle or narrow oval to create a similar series of impressions. The additional surface area created by the ridges may have been a way of ensuring the inlay adhered to the vessel and did not flake; where large bands of inlay were applied without roughing up the surface beneath they can sometimes be observed to have flaked quite badly. Methods of preparing the
bed, however, also sometimes resulted in an uneven surface once the inlay had been applied. Although the surface of inlays were ‘smoothed off’, the ridges and dips in the bed still sometimes remain in the profile of the inlay, even if this is somewhat subtle. Their visibility depends on the level of light and the angle at which it illuminates the vessel. Such undulations are more visible at lower light levels such as might have existed in Bronze Age houses lit by firelight. Methods for the preparation of the inlay bed were, however, varied. For instance, in the case of narrow incised lines, impressed dots and circles, or even the thumbnail impressions that were occasionally used to create the bed, there was presumably neither space nor perceived need to roughen up the vessel surface prior to application of the inlay. In some cases, particularly where there are small dots, inlay may have been applied in a manner similar to tattooing (c.f. Curtis et al. 2010). Where the surface of the inlay bed is flat this tends to result in a smooth exterior surface to the inlay.

Texture also arose from the qualities of inlays themselves depending on the manner of their preparation, in particular how finely the materials used for the inlay were ground up. For instance, inlays on Eneolithic vessels from the sites of Vučedol and Sarvaš are much more granular in visual appearance than Middle Bronze Age inlays from eastern Slavonia such as Bijelo Brdo (Sofaer and Roberts 2016) (Figure 3.40). While individual fragments of inlay can easily be picked out by eye in the Eneolithic inlays rather like grains of sand on a beach, the Bronze Age inlays have a more powdery appearance. Just as sandpapers are graded according to their abrasiveness, so inlays look and feel differently gritty. These contrasting textures reflect light in different ways; the former appear both rougher and more glittery, whereas the latter are smoother and more matt. Variation in textures of inlay can also be seen between Bronze Age vessels as a result of the homogeneity of the material and the extent to which it has been powdered. At a finer level, investigations using scanning

![Figure 3.40 Contrasting inlay textures. a) Granular inlay on a Copper Age vessel from Sarvaš, Croatia; b) Fine inlay on a Middle Bronze Age vessel from Bijelo Brdo, Croatia (x50). Photos: J. Sofaer.](https://www.cambridge.org/core/terms).
electron microscopy (SEM) suggest that variation in texture in Bronze Age inlays made of bone may be the result of the use of different species or skeletal elements that have differing proportions of cortical or cancellous bone (diaphyseal vs non-diaphyseal bone), or that the age of the bone material prior to cremation may have varied resulting in different crystallinity (Roberts et al. 2008). The age of the bone on heating, as well as temperature and duration of heating, can influence the morphology of crystals formed and ultrastructural changes since the bone tissue of persons (or animals) aged between infancy and young adulthood is thermodynamically more unstable than mature bone (Holden et al. 1995). It is, however, difficult to definitively attribute the variability in texture to these explanations.

Inlaying also highlights texture by creating textural contrast between the smooth burnished surface of the vessel and the rougher texture of the inlay. Encrusted ware vessels are frequently decorated in such a way that handling them requires contact with both kinds of surface. This results in a tactile experience that is somewhat unusual in modern contemporary western life where we are used to contact with single homogeneous surfaces. The sense of touch doesn’t quite know how to process two contrasting textures together, resulting in a slight feeling of dislocation or sensory confusion.

Textural effects were also produced through the ways that pattern acted to create texture on the pot surface. For instance, lines, circles or dots grouped together in formation create texture. Similarly, triangles filled with finer incised lines also give an effect of texture (Wells 2012). The same effect happens when you look at a tree; if you look closely you can see the pattern of leaves that make its surface but if you back away you lose awareness of the individual leaves and instead notice the texture of the leaves on the tree. On objects with complex decoration over much of their surface, such as the multi-storey pots of the Dubovac–Žuto Brdo group or Gârla Mare vessels and figurines, the density of inlaid decoration means that it is difficult for the eye to take in individual motifs, especially if they are not viewed close up, thereby changing pattern to texture for the viewer.

CONCLUSION

Although it is analytically useful to distinguish pattern, colour, and texture, it was the combination of these three factors that resulted in the distinctive Bronze Age encrusted vessels of the Carpathian Basin as each was related to the other. Thus pattern gave rise to texture, texture was linked to colour and reflectiveness, while colour highlighted pattern. Throughout the region, potters making encrusted ceramics worked within a genre in which a repertoire
of common elements were assembled to create patterns at the level of individual motifs and through the repeated use of motifs around vessels. White inlays were produced through a range of recipes with subtly different visual and textural qualities that stood out against the background colour of the fired vessel. Texture was created through the application of inlay, the composition of the inlay itself, and optical effects generated through plays of pattern.

Yet despite shared relationships between pattern, colour, and texture that worked to produce the Bronze Age encrusted ceramic genre, vessels varied over time and space. Furthermore, no two vessels are identical. Potters thus explored the dynamic between pattern, colour, and texture but such creativity was not a matter of unadulterated freedom or the spontaneous production of novelty as has frequently come to be understood in modernity (Ingold 2007b; Nakamura 2007). It was, instead, a matter of the assembly and reassembly of different kinds of knowledge – of materials, technologies, cosmology, and meaning – some long-standing and some distinctly Bronze Age, that were given material expression.
The term *Litzenkeramik* refers to vessels with a distinctive type of decoration characterised by the presence of cord, or cord-like, impressions, found in the western and south-western areas of the Pannonian Basin and the fringes of the south-eastern Alps. Although the internal chronology and origin of the Litzenkeramik phenomenon are debated, some researchers see it as the signature pottery of an independent cultural group (Kiss 2012b). It is generally accepted that vessels decorated using this technique emerged at the end of the Early Bronze Age in south-east Austria, east Slovenia, and north-west Croatia. Use of this decorative technique was subsequently adopted further south in parts of Hungary, east Croatia, and west Serbia during the course of the Middle Bronze Age (Črešnar 2010; Guštin 2005; Karavanić 2007; Kiss 2012b; Marković 2003; Probst 2011). Within the region, the use of impressed cord decorations was not limited to a single vessel type; it was certainly an effect with widespread appeal. The textural contrast offered by such cord impressions may have offered improved grip to users of the vessels, but the range of ways in which it was articulated, the variety of positions on the vessel, and the diverse vessel types to which it was applied suggest that cord impressions also held aesthetic or visual allure.

The use of twisted cord decoration is not in itself a Bronze Age innovation. The Corded Ware phenomenon stands out in terms of the widespread use...
of this decorative technique on ceramic vessels during the third millennium BC (e.g. Beckerman 2013; Buchvaldek and Strahm 1992; Grömer and Kern 2010; Larsson 2008). Patterns of matting, braiding, and weaving are found on a range of diverse materials including pottery, stone, and architecture from the Neolithic to the Early Medieval periods (Rast-Eicher 2012b). Cord may also be used as a functional as well as decorative element on bronzes, for example in order to add grip to the hilt as on a Late Bronze Age sword from Čeradice, Czech Republic (Grömer and Mödlinger 2005). Cord was also used to bind bronze tools and their wooden handles. Even when new types of axes were developed, the old style of fixing handles with cord remained as decoration, such as on a late Early Bronze Age shaft-hole axe from Gemeinlebarn in Austria (Neugebauer 1993: 71, 1994: fig. 74/1). What is interesting to consider in the context of Bronze Age creativity is the potential interplay between the development of new technologies of textiles and bronze, and established ceramic practices. Given that the Bronze Age was a period of dynamism, Litzenkeramik pose the question as to whether decoration, in particular the cord impressions, were thought about and articulated in ways that responded to other developments in Bronze Age materials. In the production of Litzenkeramik, we can clearly see elements of different craft practices; those related to cord-making and to ceramic manufacture. At this intersection, where different forms of knowhow meet, opportunities for creativity may open up through the deployment or modification of techniques developed in one material to create effects in another. Under these circumstances the conditions for novelty may be particularly dynamic through experimentation, combination, and mixing of different forms of material expression. With this in mind, in this essay we want to explore the variety of ways in which cord impressions were produced and how they were related to other Bronze Age materials.

LITZENKERAMIK VESSELS IN LOWER AUSTRIA AND EASTERN SYRMIA

In order to capture variability in the production of effects in a wide range of Litzenkeramik, our case studies are drawn from the two temporal and spatial poles of the phenomenon. These are the classical Litzenkeramik sites of Böheimkirchen and Pitten in Lower Austria, and the site of Surčin in Eastern Syrmia, 15 kilometres west of Belgrade in Serbia, dating from the advanced stage of the Litzenkeramik decorative tradition. The latter material is now held in Zagreb Archaeological Museum, Croatia.

Litzenkeramik vessels from the settlements of Guntramsdorf and Böheimkirchen and the cemetery of Pitten in Lower Austria (Neugebauer 1994: 141–3) represent what is usually considered a ‘true’ and independent
CASE STUDY: EFFECTS IN LITZENKERAMIK

Litzenkeramik culture (Neugebauer 1994: 141–3; Probst 2011; Urban 2000). They date from the end of the Early Bronze Age through to the late Middle Bronze Age (c. 1800–1600 BC). Vessels of Litzenkeramik type from the Austrian sites are primarily jugs with linear cord impressions around the neck and sometimes curved ornaments on the shoulder (Figure 3.41a). Amphorae and bowls are also decorated with parallel lines of cord bands beneath the rim, but on the shoulder we find straight parallel rows of band impressions. The imprints are visible very clearly and were made carefully. The vessels usually have a hard, shiny, and highly burnished surface of black or dark red colour. Sometimes remains of a white paste are still attached in the impressions.

The vessels from the cemetery of Surčin represent the incorporation of Litzenkeramik cord decorations into an idiosyncratic decorative style attributed to the first phase of the Belegiš culture (Belegiš I) (Tasić 2002). This was part of a reshuffling of material affiliations characterising the late phase of the Middle Bronze Age in the southern portion of the middle Danube region (Tasić 2004). Middle Bronze Age ceramic material from this site comprises mostly cups and cremation urns. The vessels with cord-impressed decoration are generally large urns, dated to c. 1400 BC (Tasić 2002) (Figure 3.41b).

Similar to the other closely related cemeteries of the Belegiš culture such as Karaburma, Kaluderske Livade and the eponymous site of Belegiš, the most prominent type of urn at Surčin is the amphora: a tall vessel with biconical body, four tunnel handles on the belly, a long cylindrical neck, and everted rim. Cord-impression in the Litzenkeramik tradition is the dominant means of decoration but alongside this, incised, stabbed, and stamped decoration also feature prominently within the ceramic assemblage (for a more detailed discussion of decoration and motifs at Surčin, see Coxon this volume). These latter techniques, however, echo the motifs and patterns of cord impressions traceable to aspects of the classical Litzenkeramik repertoire of motifs. For example, a bordered zigzag line motif echoes the wavy line motif seen on pots from Böheimkirchen or the site of Koprivnički Ivanec-Piškornica in northern Croatia (Marković 2003).

Figure 3.41 Examples of Litzenkeramik. a) Böheimkirchen, Austria; b) Surčin, Serbia. Photos: a) K. Grömer; b) Archaeological Museum in Zagreb.
A CLOSER LOOK AT CORD IMPRESSIONS

Clay is a plastic, additive medium and all ceramic vessels exhibit traces of how they were produced (Budden and Sofaer 2009). The cord impressions on the surface of Litzenkeramik vessels act as technological signatures that not only inform about how the cord was employed as a tool to create patterns on the vessel surface, but importantly they also offer details about the cord itself. This includes the raw material used, how it was fashioned, and the quality of the cordage work (Grömer and Kern 2010). Our method of investigation focuses upon identifying the technical signatures of different kinds of corded decoration. This is supplemented by further experimental work in order to understand the specific practices employed in the decoration of corded vessels, and thus the effects that were aimed for in their decoration. The results of the experimental archaeology presented here have allowed us to illuminate the decisions embedded within the making of the cords, whilst ascertaining how these cords were subsequently used in the potting manufacturing sequence.

Identifying Materials Used to Make Cord Impressions

In order to identify the materials used to make the Bronze Age cord impressions, a reference data set of cord impressions was made using known fibres so that the technological signatures of these could be compared with the prehistoric impressions. Fibres used for the reference data were chosen according to the likelihood of them being available in the Bronze Age and from preserved cord finds in Alpine lake dwellings dating from the Late Neolithic to the Middle Bronze Age (Bazzanella et al. 2003). More specifically, this included lime bast (Tilia), grass (Gramineae), and flax (Linum usitatissimum) known from Early Bronze Age lake dwellings from Switzerland (Schibler et al. 1997), as well as sheep wool (see Bender Jørgensen and Rast-Eicher in this volume), and hair. The latter was horsehair taken from the tail, as well as human hair. For each of these materials, cords 1–1.2 mm thick and bands the width of typical Litzenkeramik impressions were made; the latter were produced using a simple band loom. Single cords of each material were pressed onto soft clay plates, some of which were open fired (Figure 3.42). The resulting cord impressions were examined using a scanning electron microscope (SEM) in order to identify the specific microstructures of the impressions resulting from the use of each material.

The results of the SEM analysis revealed that the imprints for each of the raw materials had distinct microstructures (Grömer and Kern 2010). For example, the microstructure of flax and horsehair is much finer than grass and lime.
hap. Hair has a very even and regular imprint, whereas the single fibres of grass and lime bast are more irregular (Figure 3.43). The reference data was then compared to the microstructures of the Bronze Age Litzenkeramik from Böheimkirchen, Pitten, and Surčin. The results showed that when cords were used to make decorations, the Bronze Age impressions were likely to have been made using cords of lime bast or grass. Interestingly, the microstructure of impressions on a small number of vessels from Surčin did not, however, match any of the organic reference samples. Upon further investigation these impressions were found to have been made by twisted metal wires, similar to those used in Bronze Age ornaments (Figure 3.44). On other vessels at the site, potters combined the use of cord impressions with incised decoration, perhaps using incised decoration as a solution to finishing off the decoration when the handling of the cord did not go to plan because the surface was too dry to obtain a good cord imprint (Figure 3.45). Elsewhere, at the site of Ilandža in Serbia, a Belegiš vessel with cord-like impressions was made with a three-pronged comb (Coxon 2015), showing that variation, experimentation, and improvisation in the production of cord-like decoration was not limited to a single site.

The way in which the cord was fashioned contributes to the overall visual effect produced by its impression. In order to examine this, technical data relating to thread thickness, twist direction, twist angle, and the width of band-like imprints with three or more cords in a row was recorded for the Bronze Age
material. On the Austrian Litzenkeramik vessels fine cords about 1–1.5 mm in diameter were used. Sometimes even thinner ones were employed to make the impressions. S-twist seems to have been the standard. The cords were made in a very regular and even manner. There is just one example from Guntramsdorf where the twist angle and thickness changes within one cord resulted in an irregular impression.
Similar threads were used for the patterns on vessels from Croatia and Serbia. The cord imprints from Surčin were made by S-plied cords of 0.8–1.8 mm thickness (most frequently 1.2–1.5 mm). Usually, three or four cords were used to obtain bands of 4–6 mm width. The single cords are placed very close to each other. The cords were well-twisted with a twist angle of about 30–50°, causing a well-recognisable impression of the cord structure. For Surčin vessel number 20706 two different cords were used to make the decorations on different parts of the vessel. For Surčin vessel number 20710 the impressions were not done carefully, especially those on the shoulder; the points of the zigzag line are very irregular. There may therefore be slightly more variability in the use of different kinds of cords and the manner of their application in the Surčin material than in the chronologically earlier ‘true’ Litzenkeramik from Austria.

Cords as Tools for Decoration

In contrast to the earlier Corded Ware vessels where the cord impressions are frequently single or in spaced rows (Grömer and Kern 2010), Litzenkeramik patterns often consist of rows of cord impressions that are so tightly placed that they resemble woven bands. The question therefore arises as to how these were created; whether by pressing single cords onto the vessel multiple times, by using bundles of cords, or with narrow woven cord bands. Examples of
the latter are known from Mitterberg in Austria and Schwarza in Germany (Grömer 2006b), both contemporary to Litzenkeramik. Consequently, in order to explore how the material used to make the impressions was handled when used to decorate a vessel surface, experiments with pressing single cords, as well as bundles of parallel cords, and woven bands of each material onto clay were carried out. For this experimental work a flax band was woven using heddles. A lime-bast band and a horsehair band were made by hand without a heddle. These were impressed onto flat clay plates replicating the curved motifs seen on Litzenkeramik vessels. The technological signatures were again subsequently compared with imprints on the original finds (Figure 3.46). The results revealed that rather than using woven bands, the Litzenkeramik from Böheimkirchen, Pitten, and Surčin all displayed impressions from single cords or bundles of lime bast or grass cords that were grouped together to create an illusion of a single woven band.

After the test series with flat clay plates, a vessel from Böheimkirchen was reproduced using a flax cord. It was noted that it takes a different set of skills to create cord impressions on a three-dimensional vessel rather than a flat clay plate. In particular, positioning bundles of single cords as curved lines on the vessel body required greater levels of skill to ensure neat impressions when making an evenly impressed curved motif on the pot. During our reproduction this proved extremely tricky when carried out by one person alone. It was much easier when one person held the cord bundles with both hands in the right position and form, while another made the imprint by pressing with the hands both from out- and inside the vessel to keep the vessel’s shape. Furthermore, the lime-bast and grass cords were easier to handle than the flax cords, suggesting a reason for the selection of these raw materials to make impressions.

Some Bronze Age vessels suggest that prehistoric potters may sometimes also have found the neat application of cord impressions challenging. For example, vessel 20710 from Surčin shows unevenness in the cord decoration. Due to
the delicate nature of the decorative process, it may be possible that where precision was desired, this stage of the potting sequence may sometimes have involved two people and therefore that the decoration of Litzenkeramik vessels was a collaborative effort. Furthermore, other Belegiš vessels with incised decoration from Surčin have technological traces that point to more than one potter being involved in the decorative process (Coxon 2015). Recent ethnographic work has also shown that pottery manufacture can be a collective effort (Crown 2007).

The importance of the timing of the application of decoration to the vessel in order to create desired effects also became clear during the making of the reproduction vessel. Cleaner neater impressions could be produced when the clay was wet and soft. When the clay was too dry the impressions tended to become rough and more difficult to administer; there was a point at which the clay became too dry and creating impressions was no longer achievable. For this reason, the decoration had to be done quickly. The importance of timing in decoration may be a reason for the complementary use of incised techniques, alongside the cord impressions, visible in the Surčin assemblage.

CONCLUSION: CROSSING CRAFTS AS THE INSPIRATIONS FOR EFFECTS

It is evident that the use of single cords and cord bundles played an integral role in the decorative design of vessels from Guntramsdorf, Böheimkirchen, Pitten, and Surčin. These were, however, applied in such a way as to produce the effect of woven bands, rather than themselves being woven. The decoration on Litzenkeramik vessels may therefore have been inspired by developments in textiles but the relationship between textiles and ceramics was not straightforward. Rather it was a matter of potters taking on the idea of woven textile and aiming to produce this using cordage. Furthermore, when impressing with cords, the materials that they used – lime bast and grass – were easily accessible, and may also have been chosen for their long-standing familiarity (Grömer and Kern 2010), as well as practicality, and ease of handling. Creativity may therefore have been simultaneously both stimulated and modulated by the materials potters chose to deploy.

The relationship between crafts is further complicated by the fact that on close inspection a small number of ‘cord’ impressions do not, in fact, appear to have been made using cord. The impressions on some of the Surčin vessels do not conform to the microstructure expected of an organic material. Instead these seem to have been made using a twisted metal wire. In these cases potters seem to have aimed for a corded effect but using a very different material.
This suggests that despite their preference for established materials when using cords, potters were not afraid of experimenting with effects using a new material. The variation, experimentation, and improvisation in the production of cord-like decoration was not limited to a single site but can also be found in Belegiš ceramics from elsewhere. This variation in practice in the production of ‘cord’ decoration suggests that the overall effect to which potters aspired was more important than how it was created. Cord decoration was thus an aesthetic ideal with potters drawing creatively upon a range of familiar and novel practices, both on their own and in combination, in order to create the desired optical and tactile corded effect.

NOTE

1 SEM analysis was carried out with the kind cooperation of the Vienna Institute for Archaeological Science.
CREATIVITY AND EFFECTS: REFLECTIONS

Joanna Sofaer, Marie Louise Stig Sørensen, and Lise Bender Jørgensen

In Part III we have examined the ways that Bronze Age people explored effects as a means not only of elaborating objects but also of using this elaboration to develop new kinds of haptic and interpretive engagements; they did this through experimenting with materials, in the process profoundly affecting people’s perceptions of the world. It is almost unimaginable today to think of living without soft draping garments, bright colours, or elaborate metalwork, yet it was the creativity of Bronze Age people that brought these effects into being. The observations and essays in Part III point to creativity being channelled in several ways. A number of themes emerge through which we can explore the location of creativity in the generation and deployment of effects.

AESTHETICS

Aesthetics refers to the creation and appreciation of beauty, here explored in a sensory–emotional sense rather than as an objective value. Such shared aesthetics are the signatures of particular cultural milieu resulting from common cultural norms and expectations. We propose that in the Bronze Age such aesthetic effects are most clearly observed in the development of distinct styles which were reached through specific preferred combinations of shapes, motifs, colours, patterns, and textures. These developed in response to specific materials and objects, as well as local and regional genres. The outcome was
striking objects in different materials, and the vibrant exploration of the effects available demonstrate that a desire for beauty was often a source of creativity.

HAPTIC INVOLVEMENT

The sensory, including tactile, feeling of objects is a very fundamental aspect of human experience. In the Bronze Age this became an explicit interest that led to the development of novel effects, such as the new handle, drape, and feel of woollen textiles. Surfaces of objects became sites of interaction, being exploited as mediator between the object and the body. We suggest that the exploration of variety, finding new ways of haptic involvement, would have been a major source of creativity amongst craftspeople. This creativity expresses itself in the continuous changing forms, experimentations with novel solutions, and the substantial variations through time; in terms of haptic involvement, standardisation and agreed recipes were not always the end result but part of a development leading to new effects that may be understood in terms of the emergence of a concept of ‘fashion’ and to be fashionable.

COSMOLOGY

On another level, a notable feature of the Bronze Age is the way that cosmological narratives created a structure or format that directed the aims of these effects. The materialisation of cosmology gave form to abstract ideas – a project of searching for and making the world meaningful. In the Bronze Age, there is a particular conjunction of new worldviews, new materials, and innovations that provided a very dynamic context for creative expression, and effects were explored as an explicit means of formulating these changes. Thus the deep embedding of cosmology within the use of effects on certain Bronze Age objects reflected understandings of the cosmos in historically and contextually novel ways. This is particularly visible in the logic underpinning the selection, orientation and direction of motifs, the creation of pattern, and the deployment of these in larger decorative compositions. We can therefore conclude that cosmological principles became design principles, with Bronze Age motifs in themselves being creative bridges between ideology and materiality. Effects therefore moved beyond the ‘decorative’ to explore other kinds of experience incorporating cultural signs and meanings (c.f. Adamson 2007: 30).

TRANSLATION AND ABSTRACTION

A distinctly Bronze Age approach to design reveals creativity as a matter of the translation of ideas and intentions through the development of new effects
and their uses (c.f. Bitard and Basset 2008). However, the creation of effects also built upon existing notions (Chimero 2012), resulting in abstraction as a means of condensing existing meanings. This is seen, for example, in the reduction of the common figurative motif of the bird into an S-shape on bronze objects, or in its referencing on ceramics where the shape of the body communicates that a vessel represents a bird without necessarily representing it faithfully. Translation further acts as a dynamic through which objects respond to each other, leading to the echoing of effects within and between materials. Creativity thus emerges from familiarity with existing principles and pushing of their boundaries.

Not all effects were, however, used creatively as there was substantial emulation once particular effects had been brought into play. The challenge in our analysis of creativity has therefore been to identify where creativity lies; this is not always easy. The case studies in Part III have sought to address this by identifying turning points at which there were step changes in the use of effects, but also by examining variation within attempts to create the same effect. In both cases there was a dynamic between creativity and constraint in terms of the exploration of established boundaries or ways of doing things.

Investigating creativity through effects involves a different scale of practice than those explored in Parts I and II. What clearly emerges are specificity and nuances in terms of the many levels at which effects could be part of creative explorations. This kind of specificity is not just a matter of spatial and temporal location, not does it result solely from the materials, although it is linked to these. Rather it was far more individualised in terms of craftspeople and communities, and may have to be thought about in terms of human aspirations and motivations; the desire and willingness to diverge from established practices and norms, and a searching for novel ways of combining new and familiar elements. In this process creativity flourished resulting in numerous effects and diverse ways of using these.
CONCLUSION

Joanna Sofær, Marie Louise Stig Sørensen, and Lise Bender Jørgensen

The exploration of creativity in the European Bronze Age is a challenging task. In this volume we have tried to address questions that do not have easy answers. What is the nature of creativity in the Bronze Age? How is it expressed? If creativity is in some way special and not all objects or actions can be considered creative, where does creativity reside? How can we identify creativity and address it methodologically in the deep past where, in contrast to many contemporary studies of creativity, the makers are not present?

Our response to this challenge has been to seek the articulation of creativity through three key Bronze Age materials: textiles, bronze, and ceramics. We have explored our questions through these materials, the production processes, and different aspects of the finished objects. In particular, we have investigated the ruptures of existing practices as expressed through how people made decisions, experimented with and learned to deal with new materials, ideas, and conditions, and how in turn they eventually created new standards, recipes, and routines. We have also paid attention to how social and ideological concerns may inspire and engender creative responses; in particular we have seen how cosmological notions frequently came into play in both the production and effects seen on Bronze Age objects. In other words, we have focused upon material expression as a means of investigating creativity. Rather than see creativity as some kind of abstract force, we have investigated objects in terms...
of both processes and outcomes of creativity that can be accessed through archaeological data.

However, working with different materials and objects has also taught us that creativity is not a constant feature of all human actions. Thus, for example, once in place the establishment of design principles on the bronze razors were widely reproduced without further creative development. This observation raises the analytical challenge of separating and arguing for creativity in contrast to highly competent and routine practice. In response, we have pursued analyses that take a comparative approach in order to be able to pick out points of difference and change, such as when routines or recipes were modified, altered, or added to. This attention to the dynamic between standardisation and change is important because there is an inherent bias in contemporary Western assumptions about creativity to equate it not only with novelty, but also with high quality. It is important to point out that creativity and quality do not necessarily go hand-in-hand, and that quality is a specific aspect of particular kinds of creativity.

We have found creativity to be multi-faceted and to be expressed in several different aspects of the making of objects. There are, however, four main forms of creative engagement that stand out. First, we have found it as innovations and changes in practices following from the development of new materials. New materials not only offered solutions to existing problems but also generated unknowns that had to be responded to in ways where the outcomes were not necessarily predictable. In such cases, experiments and attentiveness seem to play a central role in developing novel ways of making things. In the case of woollen textiles and bronze these seem to have proceeded through distinct material-specific stages from initial encounter where the outcome may be rather rough, to later more refined and controlled products. A parallel for this process may be found in the ways that modern architects work through the difference between an emerging idea and the established form. The first sketch for a new construction is drawn with a thick pen in order to capture the idea and a sense of the construction, rather than producing the details. Later, as the project proceeds finer pens are successively used, filling in and refining the original idea but working within it. This is not meant to be an exact analogy for the Bronze Age but rather aims to capture a sense of dynamism and successive refinement.

A second aspect of creativity is connected to the striving towards desired outcomes, it is thus explicitly about intentionality. In these cases creativity is a matter of motivation rather than an open-ended response to possibilities. It required decision-making and an anticipation and prediction of results. It
can be seen, for example, in the deliberate planning of objects, such as in the tailoring of some kinds of garments. This kind of creativity is possible within a knowledge-rich environment. It includes the combination and recombination of existing and familiar materials and decorative practices where the motivation seems to be to change the appearance of things. This can be understood in terms of playing with known properties to bring out particular kinds of effects and facilitates cross-material inspiration in the Bronze Age. For example, instances of the use of metal thread to create new effects in textiles, the development of recipes for inlays in pottery, or the use of different materials including metal to decorate Litzenkeramik vessels.

A third source of creativity is cosmology and connected narratives or storytelling which were a key part of the Bronze Age social milieu. Here creativity was about giving form to the abstract and making it real. This was not necessarily a matter of the particular properties of materials but was rather about using them in conscious and deliberate ways to manifest cosmological ideas and to infuse objects with cosmological meanings.

A fourth aspect, and one that is extremely difficult to pin down, is related to the notion of aesthetics in terms of the creation and appreciation of beauty. This is a distinct quality separate from the other areas of creativity; it may exploit these but it is not dependent on them. Aesthetics are independent of innovations in either the materials or in practices, although they often stretch technical possibilities to their limits. They are therefore rather about the quality of the execution of the making process and the confidence that lies within this. This means that two objects that are made using the same technique may nonetheless have very different aesthetic qualities. Aesthetic quality is a result of composition and the understanding and play with forms. It is not, however, the same as complexity or degree of elaboration, as simple objects can be aesthetically very pleasing. It is therefore a complicated feature of human–object interaction, and one that is fundamentally connected to how we respond to, and aim at, sensory impressions, in particular visual ones.

The aspects that we have highlighted here are not meant to be exhaustive but in terms of the Bronze Age they emerge as key areas. Nor are they necessarily mutually exclusive. Thus experimentation can be linked to problem solving and to the combination of materials and decorative practices. Nonetheless, in highlighting these four potentially interlinked aspects of Bronze Age creativity we have attempted to go beyond the identification of ‘invention’ or ‘innovation’ to explore human actions, perceptions, expressions, and motivations.
CREATIVITY AND KNOWLEDGE: BETWEEN THE KNOWN AND THE UNKNOWN

Addressing creativity in prehistory has demanded that we look at Bronze Age materials and objects anew. At the most basic level, such an approach has necessitated an initial understanding of how people explored the nature of materials with which they worked. In other words how they moved between what they knew and what they did not.

We have examined how throughout the continent people generated, manipulated, and developed the potentials of new kinds of raw materials with regard to textiles and bronze. In contrast, for clay, local developments built on existing knowledge. We have found that for all three materials experimenting as well as recombination or ‘playing’ with materials took place, albeit in different ways and with different temporal and regional characteristics. For instance, experimentation with copper alloys lasted several thousand years until alloy recipes for compositions that produced predictable desired qualities were reached. Thereafter no further experimentation took place. For pottery, on the other hand, there were a range of small alterations and changes taking place throughout the period, often within a limited region. Here creativity was primarily about working within the known and extending its boundaries.

The development of familiarity with materials, production processes, and ways of creating effects is a matter of the accumulation of knowledge. Familiarity is a matter of repetition, routines, and of affirmation about the predictability of materials rather than new discoveries. It is about ‘that x will happen if I do y’. It is about knowing that results are not one-offs and are repeatable. It is not therefore static but a matter of interaction. Bronze Age creativity therefore sits between the known and the unknown in the exploration of the potentials that arise in that conceptual space. The accumulation of knowledge is linked to attentiveness towards materials, learning to listen and observe, and to understanding materials as distinct and responsive. As Arthur Koestler (1968: 235) put it, ‘Creativity is a type of learning process where the teacher and the pupil are located in the same individual’. It is also a matter of human curiosity (Maslow 1954). It is not obvious that initial experimentation always had any functional reasons. This is most strikingly illustrated by the early use of native copper and sulphide ores, where the attraction apparently was the extraordinary colours. It could be argued that in the early stages of metallurgy people made it knowable by making objects that were similar to those made of other materials, while at the same time becoming familiar with its unknown properties. The new fields of knowledge and accumulated
understandings obtained about the material formed the foundation for thinking through, designing, and making new kinds of objects.

The ways these understandings were acquired and developed were, however, different for each of our three materials. On one level they were related to the contrasting dynamics embedded in how people dealt with organic versus inorganic materials. We have discussed how the desire for new and better quality fibres led to specific choices in the breeding of sheep, and how at some later point a desire for white wool led to further selective breeding. The key point here is that these selective pressures could be exercised because they were applied to an organic material. This selectivity makes sense in the context of a developing interest in a new material for textile production and then subsequently an interest in expanding on its specific qualities. For the inorganic materials of metal and clay, dealing with them required the extraction and combination of minerals and finding solutions to mechanical challenges with regard to already existing raw materials. Here the development of recipes was all-important in bridging the known and the unknown. This involved understanding the components both as separate materials and through their combinations. For example, clay had to be cleaned and then tempered to become potter’s clay with specific qualities in terms of how it would behave during forming, firing, and use. The decisions behind such combinations of materials rest on knowledge and ingenuity, a sense of possibilities and accumulated experiences. To do this, however, also asks for ideas and imagination, and the ability to project these into the making process. It requires a moment of willingness to step outside a comfort zone, or move into ‘uncharted territory’, by doing something new with potentially unpredictable consequences.

This perspective raises the question as to under what circumstances creative events take place. If, as we have suggested, one aspect of Bronze Age creativity can be located in the attempt to understand materials and hence to control them, under what circumstances does it become important for control to be achieved or mastered? One way of thinking about this is by looking at the flip side of control. In other words, the fear or danger that something might slip out of control. It might be suggested that in moments of flux, the attempt to regain control might become particularly important. Although social instability is not necessarily a precondition for creativity, it may provide part of the explanation for its flourishing in particular social contexts. Seen in these terms, the fundamental reshuffling and establishment of a new social order in the Bronze Age – often referred to in terms of the ‘development of complexity’ (Earle 2002) can be understood as potentially threatening and dislocating as well as offering new possibilities. The Bronze Age saw the emergence of new understandings of the ways that the world is constructed. Creativity, and the emergence of
new materials as well as a reworking of existing ones, was thus linked to social and political change in a complex manner over the longue durée. It also had consequences in providing the material means by which status, power, and social categorisations could be expressed. We have not explicitly explored these links in this volume, but our work points towards this as an avenue for future research.

CREATIVITY AND CHOICE: BETWEEN POSSIBILITY AND ACTUALITY

Another way of discussing Bronze Age creativity is by thinking about how choices are made, allowing us to unpick the decision-making embedded within creative processes and to work backwards from objects to creativity. In this volume we have examined production processes by exploring the chaîne opératoires of each of our three materials. This allowed us to highlight where and how choices were made that led to differences between finished products. The kinds of choices and their potential impact on outcomes were quite different for each material leading to distinct decision-making processes by Bronze Age craftspeople and separate creative ‘pathways’ for each material.

Investigating the chaîne opératoire is not, of course, unique to this volume. It has been used to consider the manufacture of a range of different kinds of objects and materials in many different periods and places. Typically, however, it lacks attention towards the dynamic that sits between possibilities of action and what was actually done, as well as reflecting on the impact of what was not done. In this volume we have sought to include some of these dimensions when addressing production processes as the means by which creativity was orchestrated and the framework in which it took place.

Our focus on creativity has provoked us into viewing the chaîne opératoire differently. We have tried to explore its temporality in textiles, bronze, and ceramics by highlighting the moments at which people can intervene at different stages within the process. In other words, we have aimed to look at the points at which deviation from established practices was possible and in which the creativity of makers could be invested in the object through their actions. For example, for vessels made in highly standardised ways creativity may still be expressed through their decoration using novel techniques or with different combinations of motifs. In textiles, thread diameters are fundamentally affected by choice of spindle whorls and the repertoire of available tools. Developments in tools in an otherwise established set of procedures thus have the potential to alter outcomes. Such an approach implicitly recognises that not all points in the chaîne opératoire offer equal potential for creative engagement; not all actions or outcomes are equally creative, or indeed creative at all.
This volume has accordingly revealed a tension between creativity and habit or repetition within production processes. For example, in the mounting of the warp important decisions about the final textile were made, thereby reducing the options open to the weaver later in production. In addition, making textiles involves a long process in which much of the work is repetitious, inserting weft after weft. For this stage skill is needed but not necessarily creativity.

We have also tried to identify which points in the chaînes for each material are related to other points; where actions or outcomes are dependent on earlier decisions, and where are they independent; or where it is possible to jump stages or go back to earlier stages. This is a matter of the temporality of the production process. This reveals ways in which the chaîne opératoires for textiles, bronze, and ceramics might not function in a perfect linear manner. In other words, our analysis shows how craftspeople could use or manipulate stages of production flexibly in order to structure the making of objects in new or different ways. In making ceramics, for example, the potter can choose to move between various levels of wet and dry states of the clay. This may be of particular importance if building a large vessel that cannot be completed at a single sitting, or for the timing of decoration or firing. In such cases, creativity is dependent on the timing of actions.

Aesthetic considerations that manifest themselves in the form and elaboration of objects were also nested within choices of ‘how to do’ things. Sometimes these choices were very constrained in terms of timing and technical requirements, as for instance in the burnishing of pots. In other cases we can see choices in how to do things being flexibly explored as a range of potential means to an end. In Litzenkeramik, for example, makers of these vessels clearly wished to generate particular kinds of visual (twisted cord) effects and deployed a variety of ways of creating them including bast fibres and twisted metal. Here the effect was more important than the means of making it. Similarly, there was a potential range of recipes to make the white decorative inlays in ceramics. Bronze Age explorations of effects thus responded to the possibilities presented by the qualities of materials. This was done through exercising particular kinds of decisions within production practices in order to create objects with distinctive shapes, colours, patterns, and textures.

There is, however, one distinct area of creative practice where the choices exercised in the creation of effects had little to do with the possibilities presented by materials themselves: the choice and composition of motifs. Choice of motif is not, in theory, limited to particular kinds of materials yet it is clear that there were conventions regarding what motifs could be used on particular materials in the Bronze Age. Thus, for example, whereas birds are a common motif on bronze, they were differently expressed in clay and have not so far...
been found on textiles, at least in Europe. In addition, a notable aspect of Bronze Age decorative schemes is the emphasis on repetition of abstract elements and motifs. The structure of these compositions in some cases developed hand-in-hand with object shapes, rather than materials per se. This is well illustrated by fine ware ceramic bowls in the Carpathian Basin. Here the relationship between the shape and decoration of objects was explored by Bronze Age potters. In contrast, on Nordic Late Bronze Age razors there was little change in the shape of the object (except for the handle), but there were changes in how to condense and represent cosmological themes on the razor blade.

CREATIVITY AND THE MATERIALISATION OF MEANING: BETWEEN ABSTRACT AND CONCRETE

A particular feature of Bronze Age creativity is its apparent close connection to abstract ideas, especially religious and cosmological concerns. We have explored how aspects of creativity were grounded in the human imagination and, indeed, in the need and desire to share and give form to major existential concerns. Imagination is a creative force; it enriches the material world and is enriched by it. Thinking about the cosmos is a particular form of imagination – how the world hangs together, how day follows night, one season after the other, and what forces are involved with these processes. This kind of imagination commonly leads to various kinds of religious explanations, ritual activities, and cosmological narratives, and as these are all projections, creativity becomes a means of expressing them.

In this volume the link between the abstract and the concrete has been explored from several angles and within all three materials. A range of motifs at various levels of abstraction were widely deployed to decorate objects. Within this apparent richness it is clear that some were carriers of specific meanings and could be combined to represent complex narratives, for example related to the story of the ‘eternal journey of the sun’. These particular motifs are the bird, horse, boat, sun, and wheel found throughout Europe from the Aegean to Scandinavia. These motifs are well-known signatures of the Middle and Late Bronze Age but our studies have shown that their use was based on a creative manipulation of elements resulting in various effects such as a sense of direction and movement, visual distortions, and optical illusions. This shows a sophisticated exploitation of visual media that allowed complex abstract ideas to take concrete form by becoming present yet still elusive. The creativity we can identify within these practices was a matter of making thoughts and ideas about the world manifest and material. This meant that such expressions were ripe with possibilities.
This widespread cosmological focus simultaneously opened up and restricted the possibilities for expression by Bronze Age craftspeople. While taking inspiration from familiar cosmological themes and working with widely accepted and understood conventions, it is also clear that Bronze Age craftspeople in some ways generated new challenges about how to create ways of reproducing the same story. Here creativity was channelled towards new ways of producing similar narratives. Particular object types were also implicated to different degrees in the expression of such narratives. Furthermore, while Bronze Age motifs form a distinct canon of decoration, the ways in which they were articulated were also regionally specific, revealing that they could be modulated according to local tastes.

The dynamic between the abstract and the concrete in the material expression of cosmology also offered new possibilities for interacting with objects by providing deliberate sensory and narrative experiences. Bronze Age objects thus provided opportunities for creative encounters through their use. For some kinds of metal and ceramic objects in particular they both told, and were used to tell, cosmological stories. They not only carried images but incorporated them into their design in such a way that they became narrative vehicles. Through creative solutions, shape and decoration were sometimes linked together in such a manner that provided sensory and interactive opportunities to experience cosmological notions. These objects offer a glimpse into the ‘poetics’ of the Bronze Age. To understand such creativity is not a matter of ‘reading’ material culture to access its pre-existing meaning but of understanding objects that were deliberately made to be haptic. Bronze Age objects were experienced not just visually but also through touch and sound, and it was through these experiences that abstract ideas were ‘activated’ to become part of reality. This phenomenology of objects implicates the body in the experience of creativity.

In addition to the importance of interaction between objects and decoration, the work within this volume also shows that in some cases cosmological concerns underwrote perceptions of the right and wrong ways to make objects and to prepare materials. The emphasis on direction seen in metalworking also seems to have been expressed in the twisting of yarns in a sunwise direction. If cosmology thus infused objects from the process of fabrication to the final object, then there was enormous potential for creative responses both in their making and use.

CREATIVITY: BETWEEN THE INDIVIDUAL AND THE SOCIAL

It is clear that Bronze Age creativity was not a matter of absolute freedom and individual response in the manner that is often attributed to creativity in twenty-first-century Euro-American societies. Instead the range
of shapes and decorations of objects often seem to have been regulated in order to make them socially acceptable at particular times and places. Creativity can be a source of conflict since the new is never guaranteed to be accepted; the new has the potential to disrupt and even subvert existing order. Creativity was therefore a negotiation between the individual and the social that can be recognised on different temporal and geographical scales. It is implicated in the formation of traditions and to what degree departures from these are allowed. Over the longue durée, creativity expressed itself in the unfolding of new social, as well as material, possibilities such as the use of costumes to describe particular categories of people or razors to shave the face. Yet the creativity involved in making objects was potentially fleeting or momentary acts.

While there is room to recognise individual decisions and actions in the making of objects, it has become clear that these do not exist in isolation. Objects are the outcome of accumulated knowledge passed down through generations and webs of social interactions. The sharing of knowledge between people allowed developments in crafts to spread spatially and temporally, and to be locally adopted and adapted in different ways. Furthermore, more than one person may be physically involved in the making of an object or in obtaining raw materials. Changes in production processes may therefore imply social negotiation and responses in which the act of making must have been embedded within changes to labour organisation and demands. In this sense, creativity was socially grounded and creative processes may have potentially involved many people, as well as being located in individuals. It is, however, extraordinarily difficult to go beyond such general notions of ‘the individual’ and ‘the group’ to consider who was creative in the Bronze Age and the dynamic between individual and group for a particular object. In other words, it is not always possible to disentangle the role of individuals and to explore their relationships. Thus, while the study of the Bronze Age implicitly questions models of creativity that see it as the province of lone individuals and their moments of genius, future work is required to move beyond such general statements in order to more precisely articulate the nature of those relationships. This forms a new and significant challenge to future studies of creativity.

FINAL THOUGHTS

Creativity in the Bronze Age is full of dynamic tensions. It sits between the known and the unknown, possibility and actuality, abstract and concrete, the individual and society. It also embraces acceptance and rejection, serendipity
and design, the local and the regional, the particular and the general, the con-straining and the enabling, freedom and regulation. Indeed creativity requires these tensions in order to be expressed. It thus precludes a single definition, origin point, or form of expression. It was a synthesis of material possibilities, processes, aesthetic ideals, and beliefs that moved the existing into new direc-
tions. This complexity does not mean that it cannot be interrogated. Rather it recognises its richness and dynamic nature as reflecting the reality of human life. This is what makes creativity so challenging and yet exciting to explore.

Such an endeavour is of relevance to the present since we owe much to our Bronze Age inheritance. The Bronze Age witnessed the development of important materials – woollen textiles and bronze – and effects including colour, pattern, and texture that we take for granted today. It also sheds light on creativity as a fundamental human quality that both bridges and differentiates ‘us’ and ‘them’. For modern society, dominated by the hegemony of the written word, a focus on the Bronze Age reaffirms the expressive capacity of objects and reinstates them as a means of stimulating creativity and of making real the imaginative. It argues for an understanding of objects as the connective tissue of society.

In this volume, we have sought to make creativity archaeologically accessible by focusing upon its material expression. We have aimed to open up creativity as an authentic and important lens through which to understand the European Bronze Age. Rather than approaching our study with a definition or preconception of what constitutes Bronze Age creativity, we have instead aimed to explore a range of ways in which it was articulated. The various case studies in this volume have shown the importance of the material properties themselves. This relates both to how creativity may result from the overcom-
ing of material restraints and the pushing of boundaries, as well as attentive-
ness and intimate engagement with materials. This perspective highlights the importance of skill and learning in creative practices, how it may be linked to particular materials, and the social conditions under which it takes place. We have shown how creativity was embedded within production processes, and how the chaîne opératoire may offer opportunities to access creativity through analysis of material-specific options and choices. We have explored the manipulation of effects as forms of creative practice, and cosmology as a source of creative inspiration.

The study of creativity is an invitation to rediscover and rethink the Bronze Age on a human level that incorporates human motivations, desires, curiosity, risks, mystery, aesthetics, and novelty. Without the sense of wonder that the study of creativity brings, it is all too easy to accept that the objects of the Bronze Age were somehow normal or inevitable. A focus on creativity reminds
us that things might have been otherwise: that choices and understandings were not inevitable and that human history might have developed in other ways. By the same token, it also means that our investigation of creativity and its outcomes are only the beginning.

NOTE
1 A tunic beautifully adorned with woven-in waterbirds was found in Tutankhamun’s grave, and falcons and vultures decorated other items of his clothing (Vogelsang-Eastwood 1999).
REFERENCES

REFERENCES


Barth, F. E. 1986. Der urzeitliche Bergbau im Grüner Werk des Salzberges Hallstatt. Hallstatt:


Cattin, F., Villa, I. M. and Besse, M. 2009. ‘Copper supply during the Final Neolithic at the Saint-Blaise/Bains des Dames site (Neuchâtel, Switzerland)’. *Archaeological and Anthropological Sciences* 3: 161–76.


CinBA textile database: http://cinba.net/outputs/databases/textiles/.


REFERENCES


REFERENCES


Maier, U. and Schlichterle, H. 2011. ‘Flax cultivation and textile production in Neolithic wetland settlements on Late Constance and in Upper Swabia (South-West Germany)’. *Vegetation History and Archaeobotany* 20: 567–78.


REFERENCES


REFERENCES


REFERENCES


REFERENCES


forthcoming. ‘In the Beginning was the Fibre’. In J. Sofaer (ed.) Considering Creativity. Creativity, Knowledge and Practice in Bronze Age Europe. Oxford: British Archaeological Reports.


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