Chapter 1

Introduction

1.1. The Bronze Age Combat Project

The Bronze Age Combat Project began in 2013 at Newcastle University. In that year, the annual British Science Festival was being hosted by Newcastle University and Andrea Dolfini used it as the impetus to establish an experimental archaeology project. Its aim was to carry out a series of combat experiments in order to explore Bronze Age fighting styles and to begin to create a reference collection of replica weapons exhibiting use from combat. At the time, Rachel Crellin (University of Leicester) was a PhD student at Newcastle with interests in the Bronze Age and metalwork wear analysis, and Raphael Hermann (University of Göttingen) was a MA student with a passion for Bronze Age swords. After a successful funding application, the project was born and we found ourselves with seed funding to purchase replica Bronze Age weapons. Over the next five years we carried out five sets of experiments with replica weapons, gained new understandings of how Bronze Age weapons can (and cannot) be used in combat, and used our knowledge to analyse original artefacts from the Bronze Age in museums across Britain and in Italy.

The project explored fighting styles and techniques by investigating the use of Middle and Late Bronze Age swords, spears, and shields through a combination of experimental archaeology and metalwork wear analysis. Our aim was to establish how different weapons could be used by skilled fighters, and in what types of weapon combinations. We also investigated what types of strikes were common and what types of bodily motion they implied. A key objective was to explore the possibility of linking specific marks on prehistoric weapons with specific weapon uses.

In the early phase of the project, we consulted with Kate Anderson, who had recently carried out an innovative set of experiments with Bronze Age spearheads (Anderson 2011) as part of her doctoral research; she offered us valuable advice and guidance. In 2013, we presented the results of the first phase of the experiments at the British Science Festival and Marion Uckelmann (Durham University) was in the audience. Her expertise in Bronze Age shields (Uckelmann 2011; 2012) and her recent experimental work creating a replica Bronze Age shield with blacksmith Neil Burridge (with funding from the British Museum) led to her joining the project; this provided the impetus for further experiments. Her connections with the British Museum also brought Quanyu Wang (now at Shandong University) into the project. Quanyu Wang is an archaeometallurgist with extensive expertise in metallographic and microstructural analysis (Wang *et al*. 2016; Wang and Ottaway 2004). Further experimentation followed as the project grew, first with Marion's bronze shield and later with a wooden shield made by Jake Newport. We also expanded our original experimental methodology to conduct a new type of experiment in collaboration with martial arts experts.

The project contributes to knowledge in three key areas: Bronze Age studies, metalwork wear analysis, and methods in experimental archaeology. Our overarching archaeological aim was to explore Bronze Age combat styles and techniques (see for example, Hermann *et al*. 2019; Hermann *et al*. in prep.), but this involved significant methodological research as we considered questions of experimental design (see, for example, Crellin *et al*. 2018) and the integration of data from experimental archaeology with data from the wear analysis of prehistoric metal artefacts from museum collections (Dolfini and Collins 2018). This book provides a catalogue of the experiments conducted by the team within the Bronze Age Combat Project. It shows the bodily motions involved in each experiment and the resulting marks left on the weapons.

1.2. Researching Combat

The emergence of spears and swords in the European Bronze Age has long been linked to discussions of violence, combat, and warfare in the period. The nature of Bronze Age violence is a subject of debate (see for example, Horn and Kristiansen 2018 and papers therein, particularly Anderson 2018; Georganas 2018, which dispute dominant views): does the emergence of metal weapons indicate an increase in real violence in the period? Or is it motivated by changes in the social display of aggression vis-à-vis the Neolithic and Chalcolithic periods? Bronze swords and spears form a key aspect of the material culture used to explore Bronze Age conflict alongside wooden, leather and bronze shields, arrowheads, daggers, halberds, knives made of both flint and metal, and stone battle-axes and axe-hammers. Skeletal remains, grave assemblages, and rock art all provide key additional data for researchers exploring combat and violence in the period. Interpreting this evidence, however, is far from straightforward.

Human skeletal remains arguably provide one of the strongest lines of evidence to explore interpersonal violence in the European Bronze Age (Brinker *et al*. 2018; Dočkalová 1990; Fyllingen 2003; 2006; Gentile *et al*. 2018; Jantzen *et al*. 2011). Skeletal trauma often provides unambiguous evidence that can help us interpret the nature and frequency of interpersonal violence. However, there are a great many injuries that would leave no skeletal signs of trauma but would have caused significant pain, wounds, and potentially death. Furthermore, in parts of

Europe, such as Britain and Ireland, inhumation (and even cremation) burials are rare in the later Bronze Age, thus limiting the amount of evidence available to researchers.

In continental Europe, the emergence of both representations of warriors on rock art and stelae as well as so-called warrior graves, where individuals are buried with weapons, has provided the evidential stimulus for narratives that argue that the rise of a warrior class was a key aspect of the European Bronze Age (see, for example, Harrison 2004; Kristiansen 1998; Kristiansen 2018; Kristiansen and Larssen 2005; Treherne 1995). Kristiansen (2018), in particular, has argued that the growing trade in metals and other goods and the establishment and growth of chiefdoms led to the emergence of a warrior class. In his opinion, these warriors were second-sons who would not inherit family farms and therefore went to seek their fortune defending chiefs and their trade routes (Kristiansen 2018). This view has been disputed both theoretically and on the basis of the archaeological evidence (see, for example, Anderson 2018; Brück and Fontijn 2013; Diaz-Guardamino 2014; Jiménez 2018). Did a real warrior class exist in the Bronze Age or is this a projected (rather than lived) image and status? Was it the case that violence was prevalent or, for example, might swords and weapons have formed an elaborate kind of male jewellery (Harris *et al*. 2013, 74–8)? Do rock art images project the reality of life in the Bronze Age or are they more of an artistic endeavour?

The Bronze Age Combat Project turns to the material culture of violence itself to shed light on these questions and debates. We seek empirical data regarding use from the surfaces of prehistoric weapons held in museum collections. We argue that this type of data offers direct evidence of how weapons were being used in the Bronze Age (Dolfini and Crellin 2016). Our work sits within a growing field of research, which combines experimental martial arts approaches seeking to explore how Bronze Age weapons could have been used, and metalwork wear analysis, which explores the evidence for use left on the surfaces of prehistoric objects (see for example, Anderson 2011; Brandherm 2011; Bridgford 1997; 2000; Gentile and van Gijn 2019; Horn 2011; 2013; 2014; Kristiansen 2002; Mödlinger 2018; Molloy 2004; 2007; 2008; 2010; 2011; 2018; O'Flaherty 2011). The aim of the project is to provide another line of evidence to help researchers explore the nature of combat and violence in the European Bronze Age.

1.3. Metalwork wear analysis

Metalwork wear analysis involves the macro- and microscopic study of the surfaces of metal objects to observe traces that are informative about the use history of the objects (Dolfini and Crellin 2016). The method is a form of use-wear analysis holding much in common with sister techniques applied to flint, ground stone, bone, and shell (see, for example, Hayden 1979; Odell 2004; Semenov 1964; van Gijn 2010; Vaughan 1985). Metalwork wear analysis had a relatively late disciplinary start compared to the analysis of other materials, as a result of fears that the combination of recycling, re-sharpening, and corrosion would make marks hard to observe on the surface of copper-alloy objects (Roberts and Ottaway 2003, 120). The method relies on a combination of experimental work with replicas (to create a reference collection of marks linked to known actions in controlled experiments) and the observation of the surface of the metal objects to search for comparable marks (Dolfini and Crellin 2016).

Like its sister methods, metalwork wear analysis is able to identify not only use marks but also marks that are indicative of production and deposition processes (including intentional destruction; Knight 2019)—as a result, it is often implemented to create object biographies (Appadurai 1986; Gosden and Marshall 1999; Joy 2009; but see Jones *et al*. 2016 and Joyce and Gillespie 2015). When combined with the compositional and typological analysis of objects, as well as contextual investigations of depositional practices, metalwork wear analysis enables the elucidation of detailed histories of metal artefacts. We can use this combination of empirical data to increase our understanding of the multiple, complex, and changing ways in which both individual objects and categories of objects were used in the past.

In the past two decades, metalwork wear analysis has begun to have a significant impact in archaeology, particularly in Bronze Age studies. The method has provided important direct evidence for how objects were used in the past, allowing us to move beyond educated guesswork (Crellin *et al*. 2018). One key contribution to the discipline has been the questioning of narratives presuming that early metal tools and weapons lacked functionality, and instead primarily served ritual and symbolic purposes (Harding 2007). On the contrary, the analysis of multiple categories of bronze tools and weapons has shown that the ancient objects display clear signs of (often sustained) use. In a similar way, experiments with replica tools and weapons have elucidated the ways in which the objects could have been used (see, for example, Brandherm 2011; O'Flaherty 2007; 2008; 2011 on halberds; Anderson 2011; Horn 2014 on spearheads; and Kristiansen 2002; Molloy 2008; Mödlinger 2011 on swords). When used in combination with one another, metalwork wear analysis and experimental archaeology have had a fundamental role in overturning long-held assumptions where the form of certain weapons had been used to presume their functions. An excellent example of this kind of assumption is the time-honoured belief that Middle Bronze Age rapiers were primarily designed for stabbing, whereas later swords were more effective slashing weapons. Instead, use-wear analysis has provided clear evidence that both rapiers and swords display similar wear marks, while experimental archaeology has demonstrated that both could be used effectively to slash and to stab (Clements 2007; Molloy 2007; 2008; 2011).

1.4. Experimental design

The Bronze Age Combat Project began by designing an extensive experimental protocol (further discussed in Chapters 4 and 5 and Crellin *et al*. 2018). The idea was to break down combat sequences into single moves that could be executed using two weapons that would come into contact—for example, a sword-on-sword clash, at shoulder height. We designed our experiments specifically to produce wear—the idea was not to fight in the style of a re-enactor but to create a reference collection of wear marks that could help us directly link an individual mark to an individual combat move (we later christened these experiments 'Controlled Weapon Tests'). The experiments were to be carried out in the field by people proficient in handling and using swords and spears (rather than by machines in laboratories), as we wanted to consider the importance of bodily engagements to Bronze Age combat practices. In each step of the experimental protocol, one combatant was identified as the attacker and one as the defender—in part so that it was clear what the combatants were actually going to do in each strike (thereby increasing the safety of the experiments), but also so that we could consider whether wear marks have a different appearance if they form offensively or defensively. Once we had a basic protocol of types of weapon clashes, we expanded on it to consider additional variables. In particular, the majority of weapon-on-weapon tests were designed in three key formats (discussed in Chapter 4). In the first, the defending weapon was held static (static parry); in the second, it was allowed to move in response to the force of the attacking weapon (kinetic parry); and, in the third iteration of the experiment, the defence was fully active as the defender dynamically responded to the incoming attack (dynamic parry)—the latter, we surmise, is more akin to what would happen in true combat where both fighters are actively participating in the encounter.

Whilst we used people, not machines, in our tests, and our experimental design placed a high value on the embodied nature of combat, we sought to execute experiments that were as controlled as possible. After each clash, the weapons were recorded in detail so that we could directly link each mark with each combat move. Clashes were recorded and photographed to provide additional data about the actual (as opposed to planned) nature of each individual test. We had planned an extensive experimental protocol with repetitions of experiments to increase the validity and reliability of our data.

1.5. From experimental design to experimental reality

As we moved from experimental planning and design to experimental reality, we faced some significant challenges. The first round of combat tests proved far more damaging to the replica weapons than we had expected. In particular, the sword-on-sword clashes that we executed, especially those where the defence was dynamic, resulted in significant bending of the swords, often in multiple directions. This made it unsafe for us to carry out as many experiments as we had originally planned in our protocol, as the bent swords could not be relied upon to behave in predictable ways during clashes. It also resulted in us being able to carry out fewer repetitions of the same tests than originally planned.

As the project grew, we came to develop a more iterative method of weapon testing. We would design experiments specifically to try and recreate the marks observed on archaeological specimens from museum collections that we were previously not able to replicate. Therefore, the wear analysis of archaeological weapons came to inform the experimental tests with their replicas and vice versa, as the twin aspects of the project began to strengthen each other. An early critique of our work, received from historic re-enactors who were in the audience at the British Science Festival when we presented some of our early results, was that our experiments were unrealistic by design. The critique had two aspects: first, that we had broken down the flow of combat into individual moves, thus oversimplifying the complexities of embodied fighting practices; and second, that the way in which our experiments were designed (i.e. to recreate marks on the weapons rather than to recreate combat moves) made them unrealistic because, in a real fight, the combatants would be working to minimise weapon-on-weapon clashes and to control the amount of damage produced. Both critiques were ones that we anticipated and in some ways rejected—the experiments were designed to be single-move stances, and to produce marks on the blades, because their purpose was not to recreate accurate Bronze Age combat (something that would be very difficult to achieve on a great many levels), but to create a reference collection for wear analysis.

Over time, as we carried out more experiments, we decided to engage more directly with the historic re-enactors' critique and in 2015 Raphael Hermann began training with the Hotspur School of Defence, a Historic European Martial Arts (hereafter HEMA) academy in Northumberland, Northeast England. His aim was to learn more about the realities of historic sword fighting and to bring this knowledge back into the project. The methodological implications of this process are complex (and discussed in more detail in Chapter 5). One of the main limitations of this approach is that HEMA practitioners would fight using historic sources that describe specific combat sequences, sometimes in great detail. These sources do not date to the Bronze Age and were not written with Bronze Age weapons in mind—rather, they were designed to be carried out using steel weapons that differed from Bronze Age weapons in form, weight, strength, balance, and other properties. On the one hand, this collaboration ran counter to some of the principles behind the project: namely that Bronze Age combat needs to be understood on its own terms, using the archaeological evidence, rather than by projecting medieval and post-medieval texts back to the prehistoric past. On the other hand, we felt that they helpfully complemented what we had already done and offered important insights into combat as an embodied

practice. Therefore, in February 2017 we carried out a new set of experiments, in which skilled HEMA fighters from the Hotspur School of Defence fought using Bronze Age replica weapons. In these experiments, which we dubbed 'Actualistic Weapons Tests', the HEMA combatants completed extended 'plays' of sword fighting drawn from a medieval written source. In these, both combatants were actively defending and attacking at the same time and deliberately allowed their weapons to come into contact with one another, if necessary. All plays were photographed, and video recorded, and after each play the recreated marks were analysed with stereo-microscopes.

Taken together, the two sets of experiments produced different results and have taught us different things about the uses (and, occasionally, the abuses) of Bronze Age weapons. The results of both types of experiments are discussed in this book.

1.6. The book: an overview

The book offers the reader a catalogue of both our experiments and the resulting marks left on the replica weapons, which can be used as a reference collection in metalwork wear analysis. We have learned much from studying the images from the experiments of other researchers (see, for example, Anderson 2011; Bridgford 1997; Molloy, 2008; 2009; 2011; O'Flaherty 2007; O'Flaherty *et al*. 2011; Roberts and Ottaway 2003; Soriano-Llopis and Guitiérrez-Saéz 2009) and hope that this book may offer a similar resource to colleagues. We have also called for the complete publication of reference collections as a necessary standard in the discipline of metalwork wear analysis (Dolfini and Crellin, 2016: 85; Hermann 2018)—this book partly meets that call. Dolfini and Crellin (2016) called for such catalogues to be open access online; this has not been possible within this project due to funding constraints, but is certainly a goal for the authors in future experiments. The book also details how we conducted our weapon tests including details of the experimental protocol, something that Dolfini and Crellin (2016, 84) also called for. The descriptions of the experiments should be read alongside Crellin *et al*. 2018, which offers further details on the design of our tests, as well as a self-reflexive critique of their strengths and weaknesses.

In Chapter 2, we offer an overview of previous combat experiments; we consider experiments with swords, spears, and shields, which are directly relevant to the work presented in this book. We also review the halberd experiments conducted by O'Flaherty (2007; O'Flaherty *et al*. 2011). These early weapons date to the Early Bronze Age and are therefore chronologically outside the scope of the Bronze Age Combat Project, which focused on Middle and Late Bronze Age weaponry. However, they not only provide a wider context for our own work, but also directly informed the design of our weapon tests. Chapter 3 explores our own approach to combat experiments. It details the equipment we used and the general methodological framework that we applied to our tests. In Chapter 4, we introduce our Controlled Weapon Tests—these are the experiments that focused on the execution of a single combat move followed by its complete recording. This chapter includes sword vs sword, sword vs spear, sword vs shield, spear vs spear, and spear vs shield experiments. Each individual experiment that we have completed is listed here, detailing the bodily moves and objects involved. Extensive images of the combat in progress are presented alongside images and micrographs of the resulting marks on the weapons, as well as descriptions of the marks. The chapter ends with summative comments on how the different weapons performed in the experiments and the types of marks that were left on them as a result. Chapter 5 describes the Actualistic Weapon Tests—that is the experiments that were done in collaboration with HEMA experts with the aim of producing more realistic flows of combat rather than the singular moves of the Controlled Weapon Tests. These experiments were based on the *Commentary by Andre Lignitzer on Sword and Buckler* from folios 80r-80v, Codex 44.A.8, by Peter von Danzig from 1452 (Farrell 2012). Each of the *Commentary*'s five 'plays' is described in detail, as are the marks that were produced on the weapons. Chapter 6 discusses the material properties of our replica swords, spears, and the bronze shield as revealed by a host of scientific methods including SEM-EDX analysis, hardness testing, and microstructural analysis. It also provides a detailed empirical assessment of the weapons and comparisons with select archaeological artefacts. Finally, Chapter 7 offers a critical evaluation of the experiments as well as our closing remarks.

As the book is part of a broader suite of publications concerning the Bronze Age Combat project, certain aspects of our research are not addressed within it. Firstly, the book does not discuss the comparison of the experimental marks to the marks observed on prehistoric weapons (see Hermann *et al*. 2019; Hermann *et al*. in prep; and future forthcoming papers). We also avoid extended discussions of experimental design, which are detailed elsewhere (Crellin *et al*. 2018). Finally, the book does not address the overall interpretations of Bronze Age warfare and combat, which we have been able to reach as a result of the project. This is being achieved through a series of journal articles that will be published in the near future (Hermann *et al*. in prep; and other forthcoming papers).

This book is one of the key legacies of the Bronze Age Combat project. We sincerely hope that it not only provides a novel resource for research, but also offers a starting point for further experimentation with, and analysis of, prehistoric metal and non-metal weapons. High-quality Bronze Age replica objects are expensive to make or purchase, and the experiments completed with them are complex to design, require careful health and safety planning, and are time consuming. We therefore wish that the publication of this volume allows others to build on our work and expand it in new directions. We see several potential avenues for future research stemming from this book. For example, we would be interested to

see our own experiments repeated by others using replicas with different alloy compositions and work treatments. This would provide useful insights into the general applicability of our test results to Bronze Age metal weapons. We also see the potential for other researchers to design experiments that complement and extend our own, perhaps using different weapon types, or different bodily motions. Perhaps most importantly, we see this book as a resource for wear analysts and a 'call to arms' for further experimental research in archaeology.