Christopher Pare

IRON AND THE IRON AGE

The Introduction of Iron in Europe and Western Asia

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Chapter 1
Introduction

As the title suggests, this book has two main aims: to provide an up-to-date survey of the current state of knowledge on the introduction of iron in Europe and Western Asia, and to shed light on the concept of an 'Iron Age'. Although the introduction of ironworking is a classic case of technological innovation, attempts to review the spread of the new technology on a large geographical scale are uncommon. This lack of comprehensive studies can to some extent be explained by the complexity of the subject. The following two sections, on the production process and on the problematic nature of the archaeological sources, provide some insight into the difficulties involved in the undertaking. Despite these difficulties, in view of the large amount of new information which has come available in the last decades, a comprehensive, large-scale survey of the evidence promises a substantial advance in our knowledge.

The second focus of the study concerns the term 'Iron Age' and the question of periodization. The 'Iron Age' is a concept familiar to all archaeologists, and is constantly used in everyday practice and in academic publications. Surprisingly, the precise meaning of the concept, and its role in scholarly discourse and conventional schemes of periodization, is rarely thematized. As explained in the final section of the book, analysis of the conventional use of the term 'Iron Age' has far-reaching consequences for our understanding of the changes taking place around the turn of the 2nd and 1st millennium BC.

The chronological focus of the study varies greatly from region to region. The discussion of the earliest iron objects in the Near East considers archaeological and written sources reaching back to the start of the 2nd millennium BC, and in a few instances iron artefacts are even earlier. On the other hand, in most of Europe iron artefacts only appear in the archaeological record much later, and in some parts of the study area not before the 8th century BC. The study is largely based on published information concerning early archaeological artefacts. However, in the case of the Near East, a detailed discussion of the occurrence of iron in cuneiform texts is essential (see Chapter 2.1). The large geographical scale of the present study has some advantages: it goes some way to mitigate against the lack of published evidence from areas with a poor state of archaeological excavation and publication, and it enables us to detect some general regularities in the process of adopting iron (see Chapter 12.1).

This study also has a more ambitious, long-term aim. The period when the diffusion of ironworking was taking place is associated with profound economic and cultural change in many parts of the study area. I believe that these disjunctions and transformations between ca. 1200 and ca. 800 BC cannot be understood in isolation. By studying the diffusion of ironworking over a large area, these changes come more clearly into view. And by considering these regional cases together, it is hoped that a coherent narrative will eventually be possible, linking these socio-economic disjunctions and transformations together to form a coherent narrative. This study is written as a contribution to that endeavour (see Chapter 12.4).

Perhaps some words are necessary to explain the motivation behind the present study. Early in my academic career, I became impressed by the profound changes which are very apparent at the Bronze Age/Iron Age transition in Central Europe. The question how to explain these changes has remained with me ever since. That explains why, after writing a dissertation based on Early Iron Age material, I worked intensively on the relative and absolute chronology of the Bronze Age/Iron Age transition in Central Europe and northern Italy (1991; 1998; 1999). In 2000, this chronological work was followed by an analysis of the concept of a 'Bronze Age', which can be understood as a prequel to the present volume. The same interest in periodization led to a study entitled 'Archaeological periods and their purpose' (2008a). The present volume was also prompted by the monograph published in 2017 by Florian Miketta, who studied in detail the introduction of iron in Central and western Europe. The present study set out to complement Miketta's work and so allow an up-to-date survey of the introduction of iron in both Europe and Western Asia.

1.1 Iron and the production process

To understand the introduction of iron, it is necessary to understand the basic properties of iron and steel, and the principles of extractive metallurgy and ironworking.

One of the most striking properties of iron is its abundance. By weight, iron is the fourth most common element in the Earth's crust; copper, tin and other metals are much less readily available (see Table 1). However, iron only occurs very rarely in its metallic state in the Earth's crust. Apart from iron meteorites, the only other form is telluric ('terrestrial') iron. There is one very large deposit of telluric iron in Disko Bay in Greenland, and a second significant occurrence in Germany at Bühl near Ahnatal (Lkr. Kassel); telluric iron has also been reported from Siberia.[1] Despite the problems caused by corrosion, in recent years advances in archaeometallurgical analysis have made it easier to identify meteoritic iron.[2] As yet, no ancient artefacts of telluric iron are known from Europe and Western Asia. Otherwise, metallic iron can only be produced from iron ores by extractive metallurgy (smelting).

Table 1. Abundance of elements in the Earth's Crust. — After D.R. Lide (ed.) 2005. *CRC Handbook of Chemistry and Physics* (Internet Version).

Rank	**Element**	**Abundance (ppm)**
4	Iron (Fe)	56,300 mg/kg
26	Copper (Cu)	60 mg/kg
36	Lead (Pb)	14 mg/kg
51	Tin (Sn)	2.3 mg/kg
68	Silver (Ag)	0.075 mg/kg
75	Gold (Au)	0.004 mg/kg

In the ancient and recent past, many languages have distinguished between iron and steel (an alloy of iron and carbon). For blacksmiths, this distinction was always highly significant because steel, unlike un-alloyed iron, could be hardened by heat treatment. Traditionally, iron with more than 0.30% C was regarded as steel, whereas iron with less carbon, which could not be hardened by heat treatment, was termed iron or wrought iron.[3] The terminology used in modern metallurgy is different: mild steel contains less than 0.20% C; medium steel 0.30-0.50% C; hard steel 0.60-0.80% C; and very hard steel 0.90-1.70% C.

At temperatures over ca. 900 °C iron, in its austenitic state, absorbs carbon. This process, called carburization, can take place both during the reduction of ore in the smelting furnace and in the blacksmith's hearth. Charcoal is crucial for this process because during combustion it produces carbon monoxide, which then dissolves in the hot austenitic iron. Hardened steel, finally, is produced through the rapid cooling of the hot austenitic steel by quenching in water, which causes the metal to have a different crystalline structure (martensite). However, alloying with carbon not only increases the hardness of the metal, but also its brittleness. The crucial point for our understanding of the introduction of iron is that without carburization and heat treatment, wrought iron is likely to be worse, or at least not better than bronze for making tools or weapons. On the other hand, with the correct thermal and mechanical treatment, artefacts made of steel can be much harder and sharper (see Table 2).

Table 2. Vickers Hardness of various metals. — After Scott 1991; Pleiner 2000; 2006.

Pure copper, cast	ca. 50 HV
12% tin bronze, fully worked	ca. 250 HV
Mild steel, without heat treatment	ca. 100 HV
Medium steel, water quenched	ca. 550 HV
Hard steel, water quenched	ca. 800 HV

Owing to its higher melting point (1530 °C), iron is more difficult to smelt than copper (melting point 1085 °C).[4] Before the introduction of the blast furnace, the only method of smelting iron

[1] See Chapter 9.2.

[2] See, for example, Rehren et al. 2013; Jambon 2017; Hofmann et al. 2023; Rovira-Llorens et al. 2023; Jambon 2024; Jambon et al. (in press).

[3] See Pleiner 2006: 19; 21.

[4] The following description of the bloomery process is derived from the following sources: Pleiner 2000; Lehnhardt 2019: 19 ff.; and the data-sheets of the Historical Metallurgy Society.

Figure 1. Illustration of the processes involved in the bloomery process. 1 Mining iron ore. — 2 Roasting the ore. — 3 Pounding to produce lumps of ore of a suitable size. — 4 Production of charcoal in a kiln. — 5 Digging a slag pit and building the furnace shaft. — 6 Firing the furnace shaft. — 7 Filling the furnace with charges of charcoal and iron ore. — 8 Breaking down the furnace after completion of the smelting process. — 9 Removing the iron bloom. — 10 Reheating and compacting the iron bloom. — After Jöns 1997: 98 fig. 60.

was the bloomery process, which takes place at temperatures below the melting point of iron (see Figure 1). The process involves the reduction of the iron oxide in the ores by reaction with the carbon monoxide created during the combustion of charcoal. The bloomery process produces an iron-carbon alloy, not pure iron. The metal is relatively soft and low in carbon, it is heterogeneously carburized, and contains a considerable quantity of entrapped slag. Although the metal produced in the bloomery process is traditionally called iron or wrought iron, strictly speaking, in the terminology of modern metallurgy, it is a kind of low-carbon steel.

The bloomery furnace is designed for smelting oxidic ores (e.g. haematite, limonite, magnetite), and the process is only successful with iron-rich ores containing over 60-70% iron oxide. Before smelting, the ores normally require a certain amount of preparation ('ore-dressing'). As far as possible, the unwanted, non-metallic material ('gangue') is removed, and the higher-grade lumps of ore are selected. Roasting the ore at 400-800 °C served several purposes: iron carbonates or sulphides could be transformed to oxides, and the ores were rendered more porous and easier to break up. Finally, the ore was crushed to form lumps of appropriate size for charging the furnace.

The purpose of the bloomery process is to convert the ore into metallic iron and liquid siliceous slag. The furnace is made of clay and other materials and can have a domed or cylindrical form. It provides an enclosed space, allowing a sufficiently high temperature and a reducing atmosphere to be maintained. An air inlet (blowing hole) is positioned close to the base; the furnace can also be provided with an opening to allow the removal of slag. Temperatures in the furnace can vary from as little as 500 °C at the top to as much as 1300 °C at the base. The furnace is charged with alternating layers of charcoal and iron ore. The smelting of iron requires large quantities of charcoal, which serves as an energy source to generate the heat required to melt down the ore, and also as a reducing agent to remove the oxygen from the iron oxide, resulting in metallic iron. To reach a high temperature, air is pumped into the interior of the furnace by using a bellows. The tip of the bellows is protected from the heat of the furnace by a clay nozzle (tuyère).

As mentioned above, the iron oxides in the ore are reduced by the carbon monoxide generated during the combustion of charcoal. At temperatures over 1000-1100 °C, the slag melts and gradually flows down towards the base of the furnace. The metallic iron, which remains solid, collects around the level of the blow-hole. The iron is mainly low in carbon, because the carbon dissolved in the iron tends to be oxidised by the air pumped into the furnace by the bellows. However, to a certain extent the carbon content of the iron can be regulated by changing the air supply and the ratio of charcoal to iron ore in the furnace. The iron formed in the furnace, called the bloom, is mixed with considerable amounts of slag and ash. For archaeologists, the slag produced in the smelting process is an important indicator for iron production, because it survives almost indefinitely in the ground. Apart from the gangue of the ore and other remnants from the combustion process, the slag contains a large quantity of iron. Considering that the slag can still consist largely of iron, bloomery smelting is clearly a rather inefficient process. It is important to appreciate that bloomery slags can easily be confused with slags from copper smelting, which also often have a high iron content.

When removed from the furnace, the bloom is a spongy mass of iron mixed with slag. Before it can be worked by the blacksmith, it must be refined by forging to remove the slag and weld together the particles of metal. In the so-called reheating process, the bloom is brought to over 1000 °C in a charcoal hearth, at which point the iron is in its austenitic state (allowing welding) and the slag is molten. To produce a relatively pure wrought iron billet, the bloom is repeatedly heated and hammered. In the course of the reheating process, a considerable amount of iron is oxidized, resulting in the formation of post-reduction slag.

Five main techniques are essential in the work of the blacksmith: cold working, hot working, welding, carburization, and heat treatment.[5] As its name implies, cold working – which slightly hardens the iron – takes place at low temperatures. To remedy the brittleness caused by cold hammering, the smiths gradually heat the metal to ca. 600-650 °C, a process called annealing. In hot working, at temperatures between 700 °C and 1200 °C, the metal becomes soft and easy to hammer into a new shape. Welding pieces of iron together requires similar temperatures, generated by burning charcoal in the blacksmith's hearth and using bellows.

[5] For the following description of the work in the blacksmith's forge, see Pleiner 2006; and the data-sheets of the Historical Metallurgy Society.

To produce a hard and sharp steel, for example for the cutting edge of a knife or axe, the smith uses the process of carburization.[6] This is achieved by heating the implement for a long period of time in the charcoal hearth, allowing the iron to react with the carbon monoxide produced during the combustion process. To achieve the most advantageous properties of the resulting steel, the implement requires heat treatment. When the steel has reached its austenitic stage by heating above 900 °C in the hearth, it is rapidly cooled by plunging it into a vat of cold water (or another cold liquid). In this way, the crystalline structure of the steel is transformed to the very hard and brittle martensite. Finally, by heating the steel up to 500-600 °C ('tempering') a pearlite-based crystalline structure is attained. The steel is slightly less hard, but also less brittle than the quench-hardened metal. The result is a hard, tough and sharp steel implement. The work in the blacksmith's forge also produces slag. The most characteristic form of this so-called smithing slag is hammer-scale. These flakes of slag are formed by oxidization of the surface of the iron objects caused by contact with the burning charcoal.

It need hardly be emphasized that this multi-stage process, involving both extractive metallurgy and blacksmithing, is highly complex. The requisite skills took many generations of craftsmen to perfect. The production process was not a sudden discovery, but the result of a long process of experimentation and learning from experience.

1.2 The archaeological sources: problems and potential

It is important to appreciate a number of basic problems and pit-falls involved in studying the introduction of iron, which should be kept in mind when using this book.

One of the most obvious problems is the susceptibility of iron to corrosion. Usually, iron artefacts from archaeological contexts are found in a severely corroded state; quite often, hardly any metallic iron is preserved. This often makes iron artefacts unattractive, and in early excavations they were sometimes discarded. Restoration of iron artefacts is difficult, and it is not uncommon for them to be published in an unrestored or semi-restored state, making it difficult to reconstruct the details of their original appearance. The corroded state of most iron artefacts makes it difficult or impossible to conduct detailed typological studies.

The difficulty in defining the provenance of iron objects is a serious deficit. There are some intractable reasons for the dearth of successful scientific provenance research. Apart from the effects of corrosion, which often makes it difficult to obtain samples of metallic iron, the main reason is the sheer quantity of iron ores in the Earth's crust; furthermore, in a given region a variety of different types of iron ore might occur. The abundance of iron ores makes it much more difficult to conduct provenance studies on iron compared with other metals such as copper, lead, or silver. For almost all the iron artefacts discussed in the following chapters, it is impossible to be sure if the iron came from a local source, or was obtained by trade in the form of raw material (iron billets).

Corrosion also poses problems for studying the technical properties of iron artefacts. As most or all of the metallic iron can suffer from oxidation, metallographic studies are sometimes conducted on corroded iron, in which 'ghost structures' can be observed; these can be difficult to interpret. Metallographic study, crucial for studying the level of carburization and possible heat treatment (quench-hardening, tempering), requires cutting a section through the artefact, and it is understandably difficult to gain permission for this irreversible damage to archaeological artefacts. Unfortunately, the results of some early metallographic studies on iron artefacts have been questioned in more recent publications. For all these reasons, reliable information on the technical properties and the methods of production is only available for a very small number of early iron implements. This is a serious problem for our understanding of the reasons for adopting iron. As explained above, without hardening (carburization

[6] The carburization in the blacksmith's forge can also be called 'secondary carburization', as opposed to the primary carburization which took place in the bloomery furnace.

and heat treatment), the technical properties of iron are no better than bronze; unfortunately, for the great majority of early iron artefacts relevant information is lacking.

Another aspect which applies specifically to iron is again caused by the sheer abundance of the metal. In densely populated areas, the topsoil contains a surprisingly large quantity of iron remnants, as anyone who has used a metal detector can confirm. These are often recognizable as medieval or modern, but it is equally common that the rusty iron fragments are impossible to date. Iron objects of this kind can easily find their way into archaeological contexts, for example by processes of bioturbation, or if an excavation has not been conducted with sufficient care. The problem of such intrusive, later objects is most severe when considering the earliest stages of the introduction of iron. Enrico Lehnhardt has drawn attention to another aspect of the abundance of iron in the Earth's crust.[7] Naturally occurring ores and other compounds, such as pyrite (FeS_2), chalcopyrite ($CuFeS_2$), haematite (Fe_2O_3) and magnetite (Fe_3O_4), can sometimes be confused with corroded metallic iron; furthermore, iron oxides in soil or water can potentially form incrustations or layers on other objects, making them look like iron artefacts. This might explain some claims for very early 'iron artefacts' which, in fact, are not made of metallic iron at all.

Unfortunately, remains of installations relating to the production process dating to the early stages of ironworking – roasting and reheating hearths, smelting furnaces, blacksmiths' forges – are almost completely unknown. Clearly, this is a serious obstacle to a better understanding of the development of the methods of production. And it makes it very difficult to tell whether the introduction of iron involved the transfer of technological expertise (extractive metallurgy and blacksmithing), or merely the result of trade.

The different kinds of iron slag (reduction, reheating, smithing slag) can potentially provide valuable information on iron extractive metallurgy and blacksmithing techniques. However, reliable interpretation requires detailed scientific analysis conducted by a specialised and experienced archaeometallurgist. It is most unfortunate that detailed analyses of slags are still extremely rare. As mentioned above, without scientific analysis it is even difficult to distinguish between slag from copper and iron smelting. In the archaeological literature, it is often claimed that iron slag was found during excavations, but without appropriate analyses it is difficult to be certain if the slag truly derived from iron production (smelting or smithing). For this reason, vague mentions of iron slag from early archaeological contexts have been treated with due caution in the present study.

Source criticism is of fundamental importance for all archaeological studies, but especially pertinent to the analysis and interpretation of the earliest iron artefacts. It is often the case that the sources appear to have a distinct bias. A common case of source bias is when particular types of artefacts are (almost) only found as grave furnishings; and the spectrum of iron artefacts from graves can be completely different from the spectrum from hoards or settlements. The problem of source bias will be encountered frequently in the following chapters and requires careful discussion and interpretation.

Finally, the very uneven state of research in the various regions of Europe and Western Asia is another major obstacle. In the following chapters, I have not referred repeatedly to the stark differences between research in different countries. However, this is obviously a very significant factor which has a profound effect on the quantity and quality of information currently available.

1.3 Technological innovation and social context

Considering the serious problems and pitfalls specific to the study of the introduction of iron, it is understandably difficult to develop broad generalisations and far-reaching theories about the innovation process. Indeed, the emphasis of this book is chiefly on the evaluation and analysis of the available

[7] Lehnhardt 2021: 41.

published evidence, rather than on theoretical models. Nevertheless, it is necessary to draw attention to some basic theoretical issues.

When discussing the history of technology, it is customary to distinguish between invention and innovation. As archaeologists, we cannot hope to detect the precise moment when a particular technique was first discovered and successfully implemented. Indeed, the idea of an invention happening at a discrete moment is surely an over-simplification. As a rule, it is preferable to envisage invention not as a single event, but as a continuously evolving process. Unfortunately, in the case of iron production – the development of extractive metallurgy and blacksmithing techniques – the available evidence is scarce and difficult to interpret, as explained above. For these reasons, it is understandable that research generally concentrates on innovation – the "social and spatial process of accepting inventions".[8]

In everyday usage, inventions and innovations are often equated with the concept of technological progress. In our case, progress consisted in the (gradual) discovery of the intrinsic properties and potentialities of iron, and the development of the expertise necessary to exploit these potentialities. Techniques had to be developed to extract metallic iron from particular ores, and craftsmen had to understand and realise the advantageous technical properties (e.g. hardness, tensile strength, malleability) of certain kinds of iron and steel. With this conception of progress, it is seemingly self-explanatory that such technological advances would tend to spread rapidly throughout and between human populations. This evolutionist way of thinking is familiar from the spread of an advantageous adaptation within a species.

However, modern assumptions concerning progress and the advantageous intrinsic properties of metals should be treated with caution. The essentialist belief that particular technical properties are innate in a metal does not necessarily have universal validity: the conceptualization of the properties of a metal can be understood as a social or ideological construct. Colin Renfrew warned against the idea that advantageous cultural traits spread 'automatically'; he referred to this idea disparagingly as the Infection Model.[9] Renfrew's argument has been concisely summarized by Helle Vandkilde: "technology does not develop by itself (how could it possibly?); it has evolved due to human choices ... One might therefore say that technology gains meaning only from its social context, and although we distinguish analytically between technology and social practice, this separation is hardly real".[10]

The inappropriateness of the simple equation of innovation with technical progress can be appreciated by considering the introduction of copper, which has been studied much more intensively than the case of iron. Today, it is clear that the earliest copper implements, for example axes, cannot simply be understood as embodying a technological advance. In fact, contemporary stone axes were harder and could hold a sharper edge than copper examples. There were clearly other reasons, not technological, for the introduction of copper. This has been discussed by a number of authors in the recently published volume *Contextualizing Ancient Technology*.[11] It transpires that copper was initially used for prestigious items, for which qualities such as novelty, aesthetic appearance and exoticness were of primary importance. The production of efficient tools and weapons from copper was not a major concern and began considerably later. The diffusion of copper through Western Asia and Europe was a slow process, lasting millennia. Indeed, in the case of copper and iron the rate of the geographical expansion of the innovation process is an aspect which demands consideration. The ('irresistible') spread of ironworking at such remarkable speed in the vast area between the Atlantic and China in the period between ca. 1200 and ca. 800 BC is surely significant, and suggests that there are fundamental differences between the innovation processes of copper and iron.

[8] For this definition of innovation, see Kristiansen 2005: 152. For a useful review of research on the processes of innovation, see Burmeister and Müller-Scheeßel 2013.
[9] Renfrew 1978: 91 ff.
[10] Vandkilde 1996: 262.
[11] See, for example, Frieman 2021; Klimscha 2021; Klimscha and Renn 2021. See also Hansen 2013: 137; 160.

Diffusion is the generally accepted model for the geographical expansion of ironworking; this is the idea that knowledge of iron was transmitted outwards from an earlier zone of iron-use located in the Near East. The diffusion model has two obvious advantages: not only does it provide a coherent and easily understandable account; it is also readily falsifiable. As far as possible, I attempt to present and analyse the available data for and against diffusionism objectively, to enable scholars to develop alternative explanatory models if deemed necessary.

In the case of ironworking, it is important to consider the two fundamentally different mechanisms of diffusion: on the one hand the introduction of iron by exchange or trade in the form of raw material (iron billets) or finished artefacts, on the other hand the transfer of the technology of iron production (expertise in smelting and smithing). As a rule, the initial motivation to innovate was presumably triggered by acquaintance with and desire for artefacts which were not made locally; the manufacture of iron artefacts and the smelting of locally available iron ores would have followed later.

A study by Everett Rogers on the diffusion of innovations, published in 1962, has been influential and is frequently cited.[12] He emphasized that without effective communication channels, the transmission of innovations is unlikely to be successful. Furthermore, certain individuals and social groups, the so-called 'innovators' and 'early adopters', are of crucial importance in the introduction of new ideas and technologies into a social system. After the new technology had been introduced and established by the 'innovators' and 'early adopters' (the 'tipping point'), the spread of the innovation to the rest of the population has the character of imitation or emulation. By implication, imitation, emulation and the social value of an innovation are important factors in the diffusion process. Rogers also discussed the essential question of the compatibility of an innovation with existing cultural, economic and technological practices. In a similar fashion, modern studies in economics differentiate between sustaining and disruptive innovations. We must keep in mind that the introduction of a new technology can have both intentional (sustaining) and unintentional (disruptive) consequences for a given social group.

1.4 Notes on the structure of the book

Chapters 2-11 provide a survey of the present state of research in each of the various countries and regions of the study area. In each chapter, the aim is to discover when iron first appears in the archaeological record, and how the new metal was first used – for example for prestigious objects, costume accessories or utilitarian implements. The contexts and chronology of the earliest iron artefacts are examined in detail and critically reviewed. The structure of these chapters is mostly self-evident, but there are places where particular questions have been given special emphasis. Written sources only play a major role in Chapter 2, where the information from cuneiform texts is discussed. The Hittite texts are most significant, and are crucial for the evaluation of the earliest stages of iron production. The spread of the alphabet is discussed in Chapter 2.4, as a comparison for the introduction of iron.

Otherwise, attempts at interpretation focus mainly on the archaeological evidence. For example, the transition from bronze to iron weaponry in the Submycenaean and Protogeometric Aegean is analysed in detail in Chapter 4.3-4. And evidence for trade between the Iberian Peninsula and the central and eastern Mediterranean is discussed in Chapter 11, as a potential context for the early diffusion of iron to the western Mediterranean. In Chapter 9, the focus of attention turns to the conceptualization of bronze at the time of the introduction of iron. The discussion concentrates on bronze hoards (Chapter 9.4) and the collapse of the Standard Bronze value system in Central and north-west Europe (Chapter 9.6). A comprehensive model is developed for the Bronze Age/Iron Age transition in the central and eastern Balkan Peninsula and Central Europe (summarized in Chapter 9.7).

When using the book, it is important to realise that Chapter 12 was written after Chapters 2-11 had been completed. Whereas the latter chapters are based on published research in individual countries or

[12] Rogers 1962.

regions, Chapter 12 takes account of the whole study area together. Ideally, Chapter 12 should be read first, before consulting the detailed critical analysis of the data in the previous chapters. The main results of the study are summarized and discussed in Chapter 12.1-2; this includes a very brief review of the introduction of iron in Central Asia and China.

In Chapter 12.3, the discussion is on a different level, and concerns the concept of an 'Iron Age'. Two main conceptions can be distinguished in scholarly practice: the transition to the Iron Age defined as a technological stage, and the transition to the Iron Age defined in terms of culture-historical change. The latter usage of the term 'Iron Age' is especially interesting, as it focuses attention on an important series of socio-economic disjunctions and transformations which occurred at the time of the diffusion of ironworking. Four great, over-arching areas in which significant changes took place at the Bronze Age/ Iron Age transition are identified: the downfall of the palatial system (system collapse) in the Near East; the process of Mediterraneanization; the end of the Standard Bronze value system (system collapse) in Central and north-west Europe; and the pre-Scythian phenomenon in the North Pontic steppe. These conclusions are discussed in Chapter 12.4.

Chapter 2
The Near East

The introduction and development of iron use in the Near East is discussed in this chapter in three sections. The first two sections examine the philological and archaeological evidence for the period before the destruction of palatial centres during the 'crisis years' around 1200 BC. The main focus lies on the question of the introduction of veritable wrought iron production by smelting iron ores. The third section concentrates on the archaeological evidence from the 13th century BC until the 10th century BC. In the course of the discussion, it will become clear that the 13th century BC seems to have played a crucial and pivotal role in the innovation process.

In previous studies of the introduction of iron in the Near East, three distinct interpretative positions can be distinguished.

The 'diffusionist' (or 'Anatolia First') model for the spread of iron has been the dominant interpretative model, and is founded both on textual sources and archaeological finds. Based on archaeological evidence, Nathaniel Erb-Satullo recently argued that Anatolia was the original homeland of iron metallurgy.[1] Based on textual sources, Fritz Schachermeyr and Gordon Childe believed that the Hittites initially enjoyed a monopoly over iron production; and in a similar manner, Roger Moorey proposed a 'decentralization' of Hittite iron producing skills around the time of the collapse of the palace economies ca. 1200 BC. According to Hilda Lorimer and Vincent Desborough, the end of the Hittite monopoly allowed the spread of iron metallurgy from Anatolia to Cyprus and Greece.[2] And the supposed transmission of iron metallurgy to the southern Levant by the Philistines is also part of this diffusionist/migrationist tradition.[3]

The 'gradualist' model envisages a very different course of events, postulating a process of gradual and parallel development of iron metallurgy over a long time-span and a wide geographical area. Jane Waldbaum, the most important proponent of the 'gradualist' model, believed that iron smelting was already practised in the 3rd millennium BC, and she listed as many as 150 iron objects (both meteoritic and terrestrial) which she dated to the Bronze Age.[4] She argued against diffusionism, believing that the technology of iron production was already widely available in many parts of the Old World in the Bronze Age. Radomír Pleiner was another important advocate of the gradual introduction of iron in the Ancient World. Like Waldbaum, he also believed that wrought iron was already produced in the 3rd millennium BC, and he considered that around 100 iron artefacts could be dated to the time-span between 1600 and 1200 BC.[5] In her recent doctoral dissertation, Joanna Palermo also argued for a "continuous development of a low-level industry" throughout the Bronze Age.[6]

The third major approach, which can be called 'critical' or 'sceptical', has been introduced in a recently published article published by Enrico Lehnhardt. He demands a radical reappraisal of all the philological and archaeological evidence previously accepted for the early introduction of iron.[7] Lehnhardt doubts that iron was smelted anywhere in the Old World before the 13th/12th century BC; furthermore, he questions the currently accepted translations of words for 'iron' in the cuneiform texts.[8] Lehnhardt's critical

[1] Erb-Satullo 2019: 559; 573 f. and fig. 6: extractive metallurgy (smelting) began in Anatolia shortly after 2000 BC and spread first to the Levant and East Mediterranean, slightly later to Mesopotamia, then to north-west Iran and finally to Transcaucasia.

[2] Schachermeyr 1938; Childe 1942: 182 f.; Moorey 1995: 66; Lorimer 1950: 113; Desborough 1972: 315. For a good discussion of the question of the 'Hittite monopoly', see Zaccagnini 1970.

[3] This interpretation is based on a passage in the Old Testament: 1 Samuel 13: 19-23. The idea of the Philistines transmitting iron metallurgy to the southern Levant, and having a monopoly of iron production, is seen for example in Snodgrass 1980: 355 f.

[4] Waldbaum 1980: 88; 1999: 28; 43. Following the publication of her monograph in 1978, Jane Waldbaum was for many years the most respected authority on the introduction of iron metallurgy, which explains the influential role of the 'gradualist' model.

[5] See for example Pleiner 2000: 7 ff.; 19 ff.; 21 fig. 4.

[6] Palermo 2018: 264.

[7] Lehnhardt 2021.

[8] This 'sceptical' view of iron finds dating to the Bronze Age is found in other recent publications suggesting a late introduction

approach calls for a rigorous and meticulous examination of the available textual and archaeological evidence. Lehnhardt concludes that it is impossible to define a regional origin of iron metallurgy, suggesting that it could equally well have taken place in Anatolia or in the (southern) Levant or Cyprus during the 13th/12th century BC.[9]

One aim of this chapter is to provide an overview of recent publications on the subject of early iron in the Near East in the 2nd and early 1st millennium BC.[10] There is an impressive amount of new research, based both on written and archaeological sources. In view of the fast rate of publication, which will hopefully continue apace, any results proposed today necessarily have a provisional character. One final word of warning is necessary: it is important to appreciate that the quantity and quality of available information is far from uniform throughout the Near East. We still rely heavily on results achieved in particular countries, regions or sites, while large areas remain almost completely unknown. These words of caution should be kept in mind while reading the following pages.

The structure of the chapter reflects my efforts to assemble and analyse the written and archaeological sources. For an easier understanding of the following sections, I recommend the reader first to read the conclusions at the end of the chapter.

2.1 Evidence from textual sources during the 2nd millennium BC

When discussing the textual sources, two distinct problems have to be addressed. Firstly, the identification of the terms used for metallic iron, as opposed to other ‘iron-like’ materials. And, secondly, the distinction between meteoritic and smelted, wrought iron. In the following treatment, as far as possible the textual evidence will be treated in chronological order, in an attempt to detect changes in the production and consumption of the metal. As might be expected, the earliest evidence is more difficult to interpret, while by the 13th century it becomes evident that iron was produced on a relatively large scale – at least in some areas.

We will start with the archives from the Old Assyrian trading colony of Kültepe/Kaniš. At Kültepe, the role of iron has been discussed by a number of authors, often with widely diverging results.[11] In philological studies, four terms are often claimed to have the meaning ‘iron’: the logogram KÙ.AN, Old Assyrian *amūtum* and *aši’um*, and the earliest attestations of the Akkadian term *parzillum*. The word *amūtum* occurs most frequently, accounting for more than 80% of the cases, followed by KÙ.AN and *aši’um*; *parzillum* is only found three times.[12] These terms are found in at least 200 texts dating between the mid-20th century and the later 18th century BC.[13] In his recent review of the metal trade at Kültepe, Hakan Erol estimated the total quantities of metals itemised in the texts: ca. 315,000 kg of copper, ca. 70,800 kg of tin, ca. 7,000 kg of silver and ca. 482 kg of gold. The four terms supposedly referring to ‘iron’ only add up to ca. 15 kg.[14] These impressive figures provide a valuable insight into the relatively insignificant quantity of iron handled by the trading colony.

The traders obtained the four materials not only from various sources in Anatolia, but also from the ‘City Office’ at Assur.[15] They were much in demand, but normally only small amounts – weighing up to 20 shekels – were available. Larger quantities are only rarely mentioned: 1 mina in the case of *amūtum*, and

of iron smelting. See for example Jambon and Doumet-Serhal 2018: 82: “Les découvertes archéologiques indiquent que la métallurgie du fer est probablement apparue vers 1200 BCE quelque part au Proche-Orient, l’Age du Fer ayant commencé très peu après lorsque la pratique métallurgique se fut bien établie. Des analyses récentes d’objets en fer de l’âge du Bronze ont effectivement montré que tous ces objets étaient constitués de fer météoritique.”

[9] Lehnhardt 2021: 39; 42.

[10] The meagre evidence for iron before the 2nd millennium BC has been discussed in Lehnhardt 2021.

[11] See, for example: Maxwell-Hyslop 1972; Reiter 1997; Dercksen 2005; Veenhof 2016; Cordani 2016b; Papadopoulos 2018; Erol 2019.

[12] Bebermeier et al. 2016: 167; Reiter 1997: 387.

[13] According to Hakan Erol, the great majority of the texts date to the first half of the 19th century BC. See Erol 2019: 781; 796.

[14] Erol 2019.

[15] Dercksen 2005: 28; Veenhof 2016: 13.

2½ and 4⅓ minas in the case of KÙ.AN.[16] All four of the materials were much more expensive than silver, and often more expensive than gold.[17]

The four materials were normally traded as raw material, in the form of 'lumps' or 'pieces'. But in some cases, finished artefacts are mentioned, indicating that they were normally destined for use as jewellery or ornaments: a pin, a sun-disc and cups/goblets of KÙ.AN;[18] a ring of *parzillum*;[19] and rings (one wrapped in gold), 12 earrings, toggle-pins and 'diadems' of *amūtum*.[20] The four materials were mainly sold to Anatolian rulers or court dignitaries.[21]

As mentioned above, the identification of KÙ.AN, *amūtum*, *aši'um* and *parzillum* has often been discussed, and various solutions have been suggested. However, it is fair to say that their translation is still by no means straightforward, and interpretation remains difficult. As we have seen, it is abundantly clear that all four were very valuable and difficult to obtain. It is more difficult to judge which of them refer to metallic iron. The following considerations are important for the discussion:

i) Most authors agree that the Sumerogram KÙ.AN is probably synonymous with *amūtum*. However, as Karin Reiter explained, the equation of the two terms, based on the text BIN 4, 50, while it seems plausible, is not absolutely certain.[22]
ii) The logogram KÙ.AN is also known from Sumerian and Old Babylonian texts. In late Sumerian texts from Nippur, KÙ.AN is itemised in large quantities (up to ca. 36 kg) and is relatively cheap, with 10-14 shekels of KÙ.AN corresponding to 1 shekel of silver.[23] In Nippur, at least, owing to the large amounts quoted, KÙ.AN cannot have referred to meteoritic iron. Furthermore, it seems rather improbable that the cups/goblets of KÙ.AN mentioned in the Kültepe texts could have been made of iron.
iii) The terms *amūtum* and *aši'um* seem to refer to similar or related materials.[24]
iv) In text Ka 975, the terms *amūtum* and *parzillum* apparently refer to two different materials.[25] Considering that *parzillum* is known to mean 'iron' in later texts (see below and Table 3), and is related to the word for iron in other Semitic languages, this seems to indicate that *amūtum* refers to some other metal or mineral.
v) Because the term *amūtum* was used in the texts most frequently, there is more information on this material. In the texts, *amūtum* occurs in greatly varying degrees of purity, quality and price. An important text (CCT 4, 4a) describes how a lump of *amūtum* was heated to check its 'purity', and to see if it would change to 'non-*amūtum*'. In the process, it lost a significant amount of weight.[26]

In previous studies, a number of different materials have been suggested for the four terms. Particularly for KÙ.AN and *aši'um*, but also occasionally for *amūtum*, scholars have suggested an identification with iron ores, such as haematite and magnetite.[27] However, considering their rarity, and the high prices sometimes quoted for these materials, this solution seems improbable. In the case of *amūtum* and *parzillum*, some authors have suggested an identification with wrought iron, or iron blooms.[28] But this seems very unlikely in the case of *amūtum*, considering that it could be obtained in various places in Anatolia, and in the 'City Office' at Assur. This would require that the technology of smelting was widely

[16] For the quantities, see for example Dercksen 2005: 29. For examples for the larger quantities of KÙ.AN, see Donbaz 2001: 84; Papadopoulou 2018: 64.
[17] Prices, expressed in relationship to silver: KÙ.AN = 1:11.76 (Dercksen 2005: 28); *parzillum* = 1:20 (Erol 2019: 798); *aši'um* = 1:30 (Papadopoulou 2018: 88); *amūtum* = between 1:40 and 1:140 (Erol 2019: 798).
[18] Reiter 1997: 386 ff.; Dercksen 2005: 28; for the pin, see Michel and Kulakoğlu 2019: 5.
[19] Dercksen 2005: 27.
[20] Reiter 1997: 386; Dercksen 2005: 28; Dercksen 2015: 39 f. (12 earrings); Veenhof 2016: 15; Erol 2019: 797 (ring wrapped in gold). A 'large dagger, the handle of which is made of *amūtum* and gold' is also mentioned: Erol 2019: 798.
[21] See, for example: Dercksen 2005: 29; Cordani 2016b: 5.
[22] See for example Reiter 1997: 388; Dercksen 2005: 27 f.; Papadopoulou 2018: 127; 268. — For BIN 4, 50, see Reiter 1997: 114*-116*.
[23] Reiter 1997: 354 (texts dating to the Ur III Dynasty).
[24] See for example Papadopoulou 2018: 92-97.
[25] See Donbaz and Veenhof 1985: 142 ff.; Dercksen 2005: 27.
[26] See Maxwell-Hyslop 1972: 159; Dercksen 2005: 29; Reiter 1997: 389 f.; Papadopoulou 2018: 93.
[27] For example see Maxwell-Hyslop 1972; Dercksen 2005; Cordani 2016b: 5; Papadopoulou 2018: 252 f.
[28] For *amūtum*, see for example Maxwell-Hyslop 1972; Dercksen 2005; Cordani 2016b: 5. — For *parzillum*, see Dercksen 2005.

understood and practised in Assyria and central Anatolia. If so, it is very difficult to imagine that the metal would have remained so rare and expensive. Furthermore, *amūtum* was measured out using tiny weight units: shekels of ca. 8.3 g and grains (*še*) of ca. 0.046 g (1 shekel corresponds to 180 grains).[29] This degree of precision is completely inappropriate for blooms or wrought iron. Finally, particularly in the case of *amūtum* and *parzillum*, authors have argued for an identification with meteoritic iron.[30] However, in the case of *amūtum*, the process of assaying its 'genuineness' by heating, as described above, does not seem readily applicable to meteoritic iron.[31]

It is difficult to draw definite conclusions from the available information. As the texts use four different terms, it is likely that they refer to different metals or minerals, not only iron. In the case of the rarely attested *parzillum* an identification with iron is plausible, because the same term is used for iron in later texts (see Table 3); the ring of *parzillum* mentioned in one of the texts could very well have been made of iron. The identification of KÙ.AN, *amūtum* and *aši'um* with iron is less convincing.[32] Of these, *amūtum* is particularly important, because it is attested most frequently. The main argument in favour of the identification with meteoritic iron is its extremely high value, and the fact that it was often weighed with such precision. Furthermore, the artefacts of *amūtum* described in the texts, ring jewellery, toggle-pins and 'diadems', could all have been made of iron. Indeed, the pin made of *amūtum* recalls a bronze pin decorated with gold and iron found at Kültepe (see below). On the other hand, the information from the Kültepe texts on *amūtum* is somewhat contradictory, and while the identification with meteoritic iron seems plausible, it is by no means certain.

Table 3. Etymological reconstruction of the term for 'iron' in some Semitic languages of the 2nd and 1st millennium BC.

pár-zi-lim, pár-zi-lam	Kültepe/Kanesh
pa-ar-zi-lim, pár-zi-lim, (BAR.ZIL?)	Mari
AN.BAR$^{\text{-zi-lu-u}_2}$	Hattušili I
brḏl	Ugarit
przl	Aramaic
brzl	Phoenician
barzäl	Biblical Hebrew

Turning to Mesopotamia, the archives from the royal palace of Mari, dating to the first half of the 18th century BC, are of crucial importance, because around 50 texts apparently refer to 'iron'. In two or three cases, syllabic *pa-ar-zi-lim* and *pár-zi-lim* are attested, but, normally, the word for 'iron' is written in the form of the pseudo-Sumerogram BAR.ZIL.[33] The logogram is composed of two signs with phonetic values, BAR and ZIL, and is understood to constitute an abbreviated form of *parzillum*.[34] These terms are clearly related to the common term for iron in contemporary and later Mesopotamian texts. Scholars of oriental philology have developed a convincing reconstruction of the etymological history of the main Semitic terms for iron (Akkadian *parzillum* etc.), which reaches back to the early 2nd millennium BC (Table 3).

At Mari, BAR.ZIL was a very valuable material, much rarer than gold or silver, and it only appears in the context of the exchange of royal gifts. Apparently, it was not available locally; instead, it was obtained from distant exchange-partners – most often in north-west Syria, but also occasionally from Babylon. However, the Mari texts also mention two 'ironsmiths' or 'iron specialists' (2 LÚ ša BAR.ZIL), possibly indicating ironworking of some kind.[35] At Mari, BAR.ZIL is hardly ever mentioned as a raw material; it

[29] For example the following quantities of *amūtum* are itemised in the texts from Kültepe: 2½ shekels and 15 grains; 2 shekels and 75 grains; 15 shekels and 84 grains. See Dercksen 2005: 28.
[30] See the discussion in Reiter 1997: 381 f. See for example the translation of *amūtum* as meteoritic iron in Veenhof 2016: 21 ff.; for *parzillum*, see Papadopoulou 2018: 251; 272 f.
[31] Reiter 1997: 390; Dercksen 2005: 28.
[32] See for example the conclusions of Karin Reiter (1997: 470) and Georgia Papadopoulou (2018: 273).
[33] The Mari texts list two arm-rings (*har*) and a neck-ring (*hullu*) made of *parzillum*. See Reiter 1997: 367 f.; Arkhipov 2012: 12 ff.
[34] Depending on the context, the sign BAR can either have the phonetic value 'bar' or the phonetic value 'par'. BAR.ZIL is very closely related to some versions of the term *parzillum*, for example syllabic *par-zil-lu*, *pár-zil-li* (see Roth 2005: 212 ff.). — For assistance with this question, I am grateful to Ilya Arkhipov (Moscow) and Doris Prechel (Mainz).
[35] Roth 2005: 216; Arkhipov 2012: 13.

is listed in the archives in the form of finished artefacts, mainly jewellery, ornaments and ceremonial weapons:[36]

- Jewellery: dozens of bracelets and anklets; 7+ neck-rings; 3 finger rings; 1 earring; 16+ pins, some combined with gold.
- Ornaments: 2+ sun-discs; 1 medallion (encrusted with iron); 7+ half-moons; iron stars (as decoration on a cap and on a sun-disc).
- Weapons: 1 dagger; 2-3 spearheads; 2-4 maces (*kakkum*, *hurpalûm*); 1 axe (*emûqum*), coated with iron; 1 bow, encrusted with iron.
- Vessels: 9-10 vases.
- Miscellaneous: 6+ table knives, some with a golden handle; 4 mountings for seals; 1 mirror.

Karin Reiter and Ilya Arkhipov both believe that at Mari, BAR.ZIL was not treated like a normal metal, but instead as a precious stone.[37] They note that in contrast to metals, but like stone, BAR.ZIL was normally not weighed. And in an interesting text, a list of stone vases includes examples of BAR.ZIL. The vases are ranked in a hierarchy of value: lapis lazuli is most valuable, followed by alabaster, then BAR.ZIL and then the other varieties of stone used for making vessels. Michaël Guichard and Ilya Arkhipov suggest that the treatment of BAR.ZIL like a stone would make sense if it was meteoritic rather than wrought iron. Guichard notes that meteoritic iron was worked like stone in other societies which were not able to produce smelted iron, for example in the case of the Aztecs at the time of the first contact with Spain in the early 16th century.[38] However, it is difficult to imagine that the artefacts made of BAR.ZIL, including ring jewellery, cutting weapons and knives, could have been made of stone. Conversely, it is unlikely that the 9-10 vases mentioned in the archives could have been made of metallic iron. This apparent contradiction would be solved if the vases were made of stone with adornments of BAR.ZIL. If this solution is accepted, then BAR.ZIL could indeed be metallic iron.

On the face of it, the interpretation of the precious material *parzillum* as meteoritic iron seems convincing.[39] However, the sheer quantity of objects of BAR.ZIL listed in the Mari archives is quite inappropriate for meteoritic iron; they could have been made of smelted iron, although this is by no means certain. At present, a definitive interpretation of the logogram BAR.ZIL appears to be impossible.

Further south, in Babylonia and Elam, objects made of AN.BAR/*parzillum* are only mentioned infrequently in Old Babylonian texts: in the epic of Lugalbanda, the king has a dagger of AN.BAR;[40] an iron (AN.BAR) finger ring bound with gold is mentioned in a text from Sippar;[41] and a ring or rings of iron (*parzillum*) are mentioned among a hoard of silver and gold finger rings from Susa.[42] It is clear from bilingual lexical tablets (early dictionaries) that the Sumerian logogram AN.BAR and Akkadian *parzillum* refer to the same metal.[43] As in Mari, this material was rare and valuable, and used for object of high status. In these cases,

[36] The list is derived, with some amendments, from Arkhipov 2012: 13.

[37] Arkhipov 2012: 13 f. — Reiter 1997: 372: "Die Schmiede in Mari betrachteten Eisen an Schmuck wie (Halb)Edelsteine, der zur Identifikation in der Palastverwaltung nur nach Form und Farbe beschrieben werden, auch wenn etwaige Metallapplikationen vorhanden sind. Dadurch wird das Eisen nicht in den Metallsummierungen am Ende der Urkunde genannt." — In his study of the vessels mentioned in the Mari archives, Michaël Guichard also notes that BAR.ZIL was treated as a precious kind of stone. See Guichard 2005: 128 "une sorte de pierre de très grande valeur".

[38] Guichard 2005: 128 note 19. — For a similar technological situation, compare the Andaman Islanders, who collected iron from European shipwrecks. See Radcliffe-Brown 1933: 449 f.

[39] According to Cécile Michel "In the Old Babylonian period, the ratio iron:silver is 1:8 in Southern Mesopotamia; 1:12 in Mari; and 1:40 in Aššur." Reported in Middeke-Conlin and Proust 2014: 10.

[40] Reiter 1997: 357-359; Vanstiphout 2003: 111 line 113; Kühne 2017: 319. — Note also the epic of 'Sargon, the Conquering Hero', which mentions warriors "of *parzillum*" (with iron weapons/clad in iron?); see Westenholz 1997: 59 ff.; 67 line 50; Haul 2009: 212-214.

[41] Wilcke 1984: 177 line 5; Reiter 1997: 360.

[42] Reiter 1997: 366.

[43] AN.BAR translated as *parzillum* in the HAR-ra=*hubullu* lexical tablets from the second half of the 2nd and the 1st millennium BC. For details, see the Digital Corpus of Cuneiform Lexical Texts (DCCLT) and the Cuneiform Digital Library Initiative (CDLI) on the internet. — For example from Assur: AN.BAR = *par$_2$-zil-lum* (CDLI P381752, Middle Assyrian).

there is no reason to doubt the translation of AN.BAR/*parzillum* as iron, but we can only speculate on whether the metal was smelted or of meteoritic origin.

The inventory texts of the 'Temple of Nin-Egal' at Qatna in north-west Syria, which date to the 15th or the first half of the 14th century BC, mention jewellery and 'charms' made of AN.BAR: three sun-discs set in gold, one bead and two animal figures(?) set in gold.[44] Jean Bottéro and Karin Reiter note that AN.BAR was treated like a rare and precious stone at Qatna, recalling the situation in Mari.[45] Bottéro mentions an interesting detail. The French excavations at Qatna uncovered four versions of an inventory list (Inventory I); a sun-disc of AN.BAR is listed in version B, while in version C the same sun-disc is described as made of good-quality blue stone (lazulite or lapis lazuli).[46] Clearly, the scribe made a mistake when copying the list, but this carelessness might partly be explained by the similar appearance of the two materials.[47] It is even possible that the inhabitants of Qatna did not make a clear distinction between metallic (meteoritic?) iron and gemstones which had a similar shiny, metallic appearance.

In the 'Inventory of Gifts from Tušratta', found at El-Amarna, the king of Mitanni lists the contents of the dowry of his daughter Tadu-Hepa, who was married to pharaoh Amenhotep III in the mid-14th century BC. Among the gifts were objects made of AN.BAR and *habalkinnu*. While the logogram AN.BAR is generally accepted to refer to 'iron', the term *habalkinnu* occurs less frequently, and its translation as 'iron' is less clear-cut. The artefacts of AN.BAR and *habalkinnu* are described as follows:[48]

- 1 bracelet, of 'iron' (AN.BAR), overlaid with gold; inlay of lapis lazuli; 6 shekels of gold have been used on it;
- 1 bracelet, of 'iron' (AN.BAR), overlaid with gold; inlay of lapis lazuli; 5 shekels of gold have been used on it;
- 2 finger rings, of 'iron' (AN.BAR);
- 1 mace, of 'iron' (AN.BAR), overlaid with gold; 15 shekels of gold have been used on it;
- 1 dagger, the blade of which is of 'iron' (AN.BAR); the haft has an inlay of stone, overlaid with gold; its pommel is of stone; ... overlaid with gold; 14 shekels of gold have been used on it;
- 1 dagger, the blade of which is of *habalkinnu*; its hilt, of gold; an inlay of lapis lazuli; its pommel is of stone; 5 shekels of gold have been used on it;
- 1 dagger, the blade of which is of *habalkinnu*; its guard, of gold; its haft, of ebony ... overlaid with gold; its pommel is of stone ... overlaid with gold; 6 shekels of gold have been used on it;
- 10 spears/arrows, with tips of *hab*[*alkinnu*].

It is generally accepted that the Hurro-Akkadian term *habalkinnu* is related to the term *hapalki* which, in Hittite texts, in turn seems to be synonymous with the logogram AN.BAR. Following this logic, *habalkinnu* would likewise be equivalent to AN.BAR. On the other hand, the occurrence of both terms (*habalkinnu* and AN.BAR) in the 'Inventory of Gifts' might be explained by the fact that they were used deliberately, in order to distinguish between two different materials. Although the equation *habalkinnu* = AN.BAR = 'iron' seems plausible, there remains the distinct possibility that *habalkinnu* refers to some other metal or mineral.[49]

Because the objects of AN.BAR and *habalkinnu* were listed in such detail in correspondence at the highest political level, and they are often decorated with large amounts of gold, it is clear that they were extremely valuable. Indeed, the daggers described in the list must surely be compared with the exquisite dagger with a blade of meteoritic iron from the tomb of Tutankhamun, which might itself have been imported

[44] Bottéro 1949; Limet 1984; Kühne 2017: 319. — For the texts and translations, see Bottéro 1949: 154 line 165; 156 line 176; 162 line 245; 166 line 310.
[45] Bottéro 1949: 18; Reiter 1997: 360.
[46] Bottéro 1949: 18 note 1; Reiter 1997: 360 note 75.
[47] Jean Bottéro wonders if the sun-disc was actually made of a bluish mineral of iron: Bottéro 1949: 18 note 1.
[48] Moran 1992: 51 ff.; 72 ff.; Rainey 2015: 160 ff.; 242 ff. (EA 22 and 25).
[49] For a discussion of these terms, see Cordani 2016c: 3-5; Karin Reiter (1997: 394; 397 f.) believes that the two terms indicate two different materials, with *habalkinnu* perhaps meaning magnetite.

from the kingdom of Mitanni.[50] For this reason it is not unlikely that at least some of the daggers in the dowry of Tadu-Hepa were likewise made of meteoritic iron, although it is uncertain whether these were referred to as AN.BAR or *habalkinnu*. On the other hand, in the case of the 10 projectile points (arrow- or spearheads) listed in the inventory, it would be rather surprising if they were made of this extremely scarce and valuable metal.[51] Indeed, in view of the large number of artefacts, it is conceivable that either AN.BAR or *habalkinnu* referred to smelted iron, with the other term referring to meteoritic iron.

As we have seen, the various terms possibly referring to 'iron' (*amūtum*, *parzillum*, BAR.ZIL, AN.BAR) designated materials which remained rare and valuable during the period of ca. 500 years from the mid-20th to the mid-14th century BC, and were made into status symbols used at the highest levels of society. As explained above, in the case of small quantities of precious material, it is perfectly possible that the texts were referring to meteoritic iron. Indeed, the finger ring from Sidon, the axe from Ugarit and the objects from the tomb of Tutankhamun prove that meteoritic iron was available during the 2nd millennium BC (see below). On the other hand, the sheer number and sometimes the large size of the objects listed, particularly in the Mari archives, make it doubtful that all the objects described above could have been made of this very rare material. Bearing these considerations in mind, an alternative explanation, suggested by Enrico Lehnhardt, deserves to be considered. As Lehnhardt explains, in Ancient Egypt the term '*bjȝ*' not only referred to meteoritic iron, but also to other substances believed to be of celestial origin, such as haematite and magnetite.[52] For this reason, in Egyptian written sources of the 2nd millennium BC it is difficult, or impossible, to distinguish between different 'heavenly' materials. Furthermore, he notes that haematite – particularly specular haematite – can have a 'submetallic' lustrous appearance very similar to metallic iron. Lehnhardt argues that meteoritic iron and certain types of haematite and magnetite "were used and shaped very similarly and were cold-worked by filing, grinding and polishing. ... This raises the question whether people at that time who did not work on such objects were even able to perceive what material they were actually looking at, hard iron oxide rock or the very rare meteoric iron." Lehnhardt suggests that a similar usage could have been customary in other parts of the Near East, whereby the term 'AN.BAR' could be a rather imprecise term referring to various substances supposedly of celestial origin, including meteoritic iron and 'gem quality' haematite.

Enrico Lehnhardt's theory that the logogram AN.BAR referred to iron oxide rock (haematite and magnetite) will be discussed in more detail below, in the context of the Hittite texts. In my opinion, Lehnhardt's arguments have fundamental weaknesses, and his rejection of the equation of AN.BAR/*parzillum* with iron is not justified. Nevertheless, his more general point that the terms for 'iron' might have had rather fuzzy, imprecise meanings, deserves to be taken seriously. In the Qatna texts from the Temple of Nin-Egal, for example, the material AN.BAR was treated similarly to precious stones, and it is conceivable that the difference between (meteoritic) iron and similar-looking shiny stone was not as clear-cut as it is today. In summary, we can only conclude that our understanding of the textual evidence pertaining to iron, presented above, is imperfect: while many of the objects described in the texts were probably made of meteoritic or smelted iron, others were possibly made of some other material.

Unfortunately, there are no informative texts referring to iron from Mesopotamia and Syria dating to the second half of the 14th and the first half of the 13th century BC. However, the texts from the second half

[50] See the excellent illustrations in Broschat et al. 2018.

[51] The term *iakatu* is sometimes translated as 'spear', sometimes as 'arrow'. See for example Reiter 1997: 397 f. ('arrows').

[52] Lehnhardt 2021: 32. — Harris 1961: 167-8: "In short, it seems that the meaning of *bjȝ* cannot satisfactorily be established, but there is some evidence to suggest that it was originally a word of fairly general meaning, referring to substances which the Egyptians thought were of meteoric origin. It thus included iron, and meteoric agglomerate, which was, however, rare, and perhaps also other minerals which were falsely identified with them. Among these would be magnetite and the haematite of metallic appearance, and perhaps also other iron ores ...". — Graefe 1971: 32-34. — From the 19th Dynasty onwards, 'iron' was referred to as *bjȝ n pt*, meaning 'from the sky'. — Because of their celestial symbolism, in Egypt the materials subsumed under the term '*bjȝ*' were typically used in royal contexts for very specific objects, for example for headrests and for implements used in the Mouth Opening Ceremony. The tomb of Tutankhamun is the most impressive example, with a headrest, 16 small chisels, a horus-eye pendant and the famous dagger all made of meteoritic iron (see below). — For meteoritic iron and haematite in the Mouth Opening Ceremony and used for headrests, see Roth 1993: 69 ff.; Hellinckx 2001: 84. — For the cosmological symbolism of the term *bjȝ*, see Almansa-Villatoro 2019.

of the 13th century are interesting and suggest important changes in the production and consumption of iron.

A Middle Assyrian administrative text from Assur, dated to the year 1238 BC, uses the same terms for 'iron' which we have encountered in the 'Inventory of Gifts from Tušratta': AN.BAR and *habalginnu*. Once again, it is possible that AN.BAR and *habalginnu* refer to different materials.[53] Among other things, the following weapons are listed:[54]

- 4 daggers of ZABAR (bronze);
- 1 dagger of AN.BAR;
- 1 axe of *habalginnu*;
- all of which ... he has returned to the 'bronze house/store-room'.

The context in which these artefacts are listed seems to be significantly different from the lists of luxury, high-status objects which we have previously encountered, for example from Mari, Qatna and the El-Amarna inventory. Apart from the weapons listed above, the administrative tablet also includes objects of day-to-day use, such as various textiles, garments (e.g. loin-cloths) and a pair of boots. This suggests that in the second half of the 13th century BC, the status of iron had changed, with AN.BAR and *habalginnu* no longer restricted to the realm of high-status luxuries and regal gifts.

About ten years later, a letter from the Assyrian governor's residence at Tell Sheikh Hamad (Dūr-Katlimmu) explains the problems encountered by a metalworker named Shulmu in his attempts to produce objects for his lord, Ashur-iddin.[55] The term used for 'iron' in the text is AN.BAR:

"To Ashur-iddin, my lord, tablet of Shulmu, your servant. I bow to [my lord]; I am at the disposal of my lord. The iron that you gave me for the production of arrowheads, 20 arrowheads I have produced from it. The 'tongue' [billet?] of iron that my lord gave to me for the production of a rod is inappropriate. Today Shamash-shezibanni has demanded from me: 'I want a mixture for arrows made from it'. Without approval from my lord, I am afraid to give it to him; I will do what my lord will write to me. The small piece of iron that my lord gave to me is inappropriate for the manufacture of a whip handle. [...] on the fifth day [one has open]ed(?) but there was no iron. [As much (iron) as there is in your area] of responsibility [let them] bring up [to me]."[56]

Shulmu had been given a quantity of iron by Ashur-iddin, an Assyrian official, to make certain objects. Although he was able successfully to produce 20 iron arrowheads, either the quality was not suitable, or the quantity was not sufficient, to make an iron rod and an iron whip handle. Apparently, good quality iron was still in short supply in Assyria at this time.[57] From the description of Shulmu's problems, it seems most likely that he was provided with billets of wrought iron, some of which he was unable to work in his forge.

The third important cuneiform tablet comes from the palace of Ugarit in western Syria. A letter in the archive of Yabninu, dated to the mid- or third quarter of the 13th century BC, mentions two talents of iron.[58] In the alphabetic letter, written in the north-west Semitic language of Ugarit, the word *brḏl* is used for 'iron', which is related both to Akkadian *parzillum*, and to the words for iron in various Semitic languages, for example Phoenician *brzl* (see Table 3).[59] While two talents (ca. 56.4 kg) certainly represent

[53] Karin Reiter (1997: 399) suggested that *habalginnu* might be translated here as magnetite.
[54] Postgate 1973: 13 ff.; Reiter 1997: 399; Kühne 2017: 324; De Ridder and Sassmannshausen 2021: 59 note 9; 61.
[55] Cancik-Kirschbaum 1996: 170 ff. no. 16; Kühne 2017: 322 f.; De Ridder and Sassmannshausen 2021: 59. — Hartmut Kühne (2017: 323) states that the tablet was written around 1233-1223 BC.
[56] For the translation, see Cancik-Kirschbaum 1996: 171-175; Kühne 2017: 322 note 3.
[57] Indeed, AN.BAR is only mentioned rarely in Assyrian texts of the 13th century BC, for example in a foundation deposit of Shalmaneser I. — See Grayson 1987: 185; De Ridder and Sassmannshausen 2021: 59.
[58] Courtois 1990: 121; 124 f.
[59] Artzi 1969 (*b(a)rz(e)l*).

an exceptionally large quantity of iron in the 2nd millennium BC context, it is worth noting that the same tablet mentions 20 talents of tin. The numerical ratio of 2:20 indicates that iron was still in circulation in smaller quantities than other base metals. Nevertheless, this quantity of 'raw' iron is clear proof that wrought, as opposed to meteoritic, iron was produced and traded by the third quarter of the 13th century BC. Although significant quantities of iron were apparently now in circulation, it nevertheless seems that iron remained a fairly valuable material. This is suggested by a text from the end of the 13th century BC mentioning an iron (AN.BAR) dagger sent to the governor (*šaknu*) of Ugarit by Zulannu, prince of Hittite Carchemish: for these powerful men, a single iron dagger was still worthy of mention.[60]

From the 12th century BC onwards, evidence for iron gradually increases in Assyria. A blacksmith is mentioned around the year 1133 BC, in the reign of Ninurta-Tukulti-Assur, and Tiglath-pileser I (1114-1076 BC) is said to have used iron arrowheads on a hunting expedition.[61] Texts become less frequent in the period between the mid-11th and early 9th century BC, Assyria's 'Dark Age'.[62] By the reign of Tukulti-Ninurta II (890-884 BC), things had changed radically and iron tools and weapons were used widely, particularly by the Assyrian army.[63]

There is less information on iron from Babylonia.[64] In the second half of the 13th century BC, in the Chronicle of Kassite Kings, king Kaštiliaš IV is said to have "thrown off the iron chains [of Assyrian rule]".[65] In a mythological text written in the mid-12th century BC, the Elamite king Kudur-Nahhunte "cut(?) his heart with an iron dagger of his belt".[66] A text from Nippur dated to 1033 BC is more important, as it refers to a real land transaction, in which an iron dagger was equivalent in value to two shekels of silver or two fully grown rams.[67] Iron was evidently less valuable than silver at this time. According to John Brinkman, references in texts to bronze daggers eventually decrease, while iron daggers become more frequent around 1000 BC.[68]

In summary, we can confirm that wrought, smelted iron was available in Assyria and at Urartu during the second half of the 13th century BC. The evidence from Ugarit shows that iron was now in circulation in much larger quantities than before. And the Assyrian texts indicate that iron was no longer used exclusively for luxurious status symbols and regal insignia. This marks a fundamental change compared with earlier centuries. Unfortunately, the lack of texts from the second half of the 14th and the first half of the 13th century makes it impossible to trace this change in the production and consumption of iron more precisely. The increase in the availability of iron evident in the latest texts, from the second half of the 13th century BC, can only be explained by production of wrought iron in the smelting furnace. We turn next to the kingdom of the Hittites, where the available evidence offers interesting points of comparison.

Hittite Anatolia has a very important role in the early history of iron, owing to at least 200 cuneiform tablets mentioning iron, mainly discovered in the palace and temples of Boğazköy/Hattuša.[69] Considering that the latest texts from the Old Assyrian colonial period in central Anatolia were written in the later 18th century, and the oldest Hittite texts (Old Hittite) date to the 17th century BC, it is possible that there was an unbroken tradition of iron use in this area, with iron continuing to be highly valued in the Hittite

[60] Lackenbacher 2002: 196-198.
[61] For these texts, see Montero Fenollós 2004: 15; De Ridder and Sassmannshausen 2021: 59.
[62] Roaf 2001.
[63] Moorey 1994: 289.
[64] In the following texts the term for iron is 'AN.BAR'.
[65] De Ridder and Sassmannshausen 2021: 60.
[66] Roaf 2017: 184.
[67] Moorey 1994: 289; De Ridder and Sassmannshausen 2021: 60.
[68] Brinkman 1988: 141 ff.; 156 ff. notes 52 and 63.
[69] See Siegelová 1984; 2005; Siegelová and Tsumoto 2011; Košak 1986; Cordani 2016a. — For the total number of tablets mentioning iron, see Cordani 2016a: 165. — The author wishes to thank Dr Charles Steitler (Mainz) and Dr James Burgin (Würzburg) for their generous help and advice on the Hittite sources.

kingdom. Owing to the nature of the texts, whereas at Kültepe iron is normally documented as a raw material, in the Hittite sources the metal is mainly recorded in the form of finished products.[70]

The most common term used for iron in Hittite cuneiform is the logogram AN.BAR. On the basis of a bilingual tablet, today there is a general consensus in the philological literature that AN.BAR corresponds to syllabic *hapalki* in Hittite texts.[71] The term *hapalki* is encountered in Middle and New Hittite tablets, but much less frequently than AN.BAR.[72] As mentioned above, *hapalki* is related to Hurro-Akkadian *habalkinnu/habalginnu*.[73] All these terms seem to refer to iron, and there is no conclusive evidence that different kinds of iron (i.e. meteoritic or smelted iron) were distinguished by using *hapalki* as opposed to AN.BAR.

The problems involved in understanding the development of Hittite ironworking have recently been explained by Violetta Cordani.[74] Firstly, there are relatively few early (Old and Middle Hittite) texts referring to iron. 80% of the references are in New Hittite texts, which date to the later 14th and 13th centuries BC, although even at that time iron remained a rare metal, used much less than copper, silver or gold.[75] Secondly, and even more crucially, there is a wider range of texts in New Hittite. While Old and Middle Hittite texts are mainly confined to descriptions of festivals and rituals, New Hittite texts also include temple and palace inventories, tax lists and descriptions of cult images ('Bildbeschreibungen'). This discrepancy between the earlier and later texts makes it very difficult to analyse developments in production and consumption during the Hittite period. The administrative texts include a wide range of 'iron' artefacts, sometimes with bewildering descriptions culminating in a 'tub' or 'spring' weighing 90 minas (ca. 45 kg). The question whether similar objects were produced earlier is difficult to answer, because comparable Old and Middle Hittite administrative texts have yet to be discovered.

In the last decades there has been an informative debate on the cuneiform sources for iron, with important contributions by Jana Siegelová, Silvin Košak and Violetta Cordani, which I will briefly summarise.[76]

Jana Siegelová noted a number of features of iron usage in New Hittite texts which she viewed as evidence for gradual progress in iron production, as compared with the previous usage of iron documented in Old and Middle Hittite texts: i) iron objects now occur in larger numbers, and include weapons and tools such as knives, daggers, spearheads, hammers and axes; ii) heavier objects, weighed in minas, are more common; iii) cult objects are frequently mentioned, and – already since the Middle Hittite period – these were used not only by the king, but also by religious functionaries; iv) provincial communities could now pay their taxes in iron (in one case, 56 iron knife/dagger blades and 16 mace-heads were delivered to the royal court); v) smelting was carried out in different parts of the Empire, with iron production being controlled by the state.[77]

Silvin Košak and Annelies Kammenhuber expressed doubts about this supposed increase in iron production. They noted that in New Hittite texts, iron objects as a rule still had an ornamental, ceremonial or prestige function, and until the end of the 13th century BC, iron was used almost exclusively by the king, or for ritual purposes. Violetta Cordani admitted that there is some slight evidence for a change in the value of iron during the 13th century BC.[78] Nevertheless, she concluded "Many elements of the evidence are in conflict with the assumption of a progressively increasing iron production and rather point to a continuity in the use of this metal".[79] In support of this conclusion, she noted that: i) the types

[70] Bebermeier et al. 2016: 165 ff.
[71] Weeden 2011: 152 ff.; Cordani 2016c: 2. — Syllabic *parzillum* does not seem to have been used by the Hittites. See: Michel 2014: 147 note 634; Cordani 2016a: 163 note 10.
[72] For the number of attestations of *hapalki*, see Reiter 1997: 393. — For *hapalki* in Middle Hittite texts, see Vanséveren 2012: 204.
[73] The variant *hapalkini* is represented once in a New Hittite text: Cordani 2016c: 1-5.
[74] Cordani 2016a: 165 ff.
[75] Cordani 2016a: 165. — The transition between the Middle and New Hittite linguistic stages took place during the reign of Šuppiluliuma I (1350/1344-1322 BC).
[76] Siegelová 1984; 2005; Siegelová and Tsumoto 2011; Košak 1986; Cordani 2016a. — See also Kammenhuber 1996.
[77] See also Müller-Karpe 1994a: 76 ff.
[78] Iron was sometimes listed alongside the base metals copper, tin and lead in Late New Hittite texts.
[79] Cordani 2016a: 174.

of objects remained more or less the same; ii) use of iron was restricted to the élite until the end of the Hittite kingdom; iii) there are only minimal differences in the weights given for objects in the earlier and later Hittite texts; and iv) "the vocabulary related to iron quality and technology does not seem to have changed over the centuries".[80]

As already explained, because of the specialized character of Old and Middle Hittite texts, mainly concerned with festivals and rituals, we only have a very restricted view of iron use in the Hittite kingdom before the later 14th century BC. This applies not only to the royal court and its aristocratic entourage, but above all to the rest of the empire, for which we have hardly any information. Nevertheless, in view of the important role often ascribed to the Hittites in spearheading the introduction of iron, it is necessary to summarize the available evidence from Old and Middle Hittite texts, as collected in the fundamental articles published by Jana Siegelová and Silvin Košak.[81]

1. The king possessed a number of iron objects ('insignia'): two kinds of iron spear(head); an iron hammer/adze; iron tongues; an iron 'sky' (a disc or bowl of uncertain size?); an iron vessel; possibly an iron staff/*lituus*.[82]
2. Rituals were performed, in which iron was used in small quantities.[83]
3. In the foundation rituals for palaces and temples, deposits include iron pegs/nails, and in one case a model iron hammer/adze, each of them weighing 1 shekel.[84]
4. There is copious evidence for iron used in metaphorical, symbolic and mythological contexts. In all these cases, the context is fictional, and the texts cannot be taken as evidence that the iron objects ever actually existed. There are many examples, including:
   a. A 'throne and sceptre of iron'.[85]
   b. 'Words of iron'; iron was used metaphorically to express qualities like 'hardness' and 'permanence', particularly in Land Grant documents.[86]
   c. The image of the king with 'iron head, eyes of an eagle and teeth of a lion'.[87]
   d. 'Cauldrons of bronze/lead/iron'.[88]
   e. 'Iron pegs' and 'iron nails', used in a variety of metaphorical and mythological contexts.[89]

[80] Cordani 2016a: 174.
[81] Siegelová 1984; Košak 1986.
[82] Siegelová 1984: 103 f. (tongues, sky); 106 f. (vessel); 131 ff. (spears); 133; 145 (hammer/adze); 142 ff. (staff/*lituus*).
[83] See, for example: KUB 41.8 (Siegelová 1984: 93 f.): "He laid down the ritual implements in front of the [gods of the underworld]. Silver, gold, iron, tin, stones, oil (and) honey, items of clay, braided items, clay of the house, clay of the gatehouse, he mixed together. Then he made from these the God of Blood ... Check the ritual implements. Silver, gold, iron, tin, lapis lazuli, carnelian — check them with the weighing scales." — KUB 27.67, ritual of the woman Ambazzi, in case of illness (Siegelová 1984: 94): "... afterwards they heaped up silver, gold, lapis lazuli, carnelian, [various other stones], iron, tin, copper, bronze for the god, a small quantity of each." KUB 43.60, ritual during the journey of the human soul in the realm of the dead (Archi 2007: 170 f.): "One (woman's) head-dress ... is placed on the table; below, one 'bread for the troop' is placed, on (it there are) silver, gold, tin, iron, copper, lead (and) *lulluri*-stone. He/she holds it with the left hand before his/her lips. They clash the cymbals." — Note that Siegelová and Košak propose different dates for some of these texts (see also Cordani 2016a: 171).
[84] The Hittite shekel weighed ca. 11.75 g. — See, for example: KBo 17.78, foundation ritual (Siegelová 1984: 102): "1 white dress, 12 iron nails of 1 shekel each, 1 shekel of tin, 12 copper nails of 1 shekel each." — KUB 2.2, foundation of a palace (Siegelová 1984: 101 f.): "30 iron nails of 1 shekel each, 30 copper nails of 1 shekel each, 1 hammer/adze of 1 shekel, 1 copper knife of 5 shekels." — For the date of the texts, see also Cordani 2016a: 169.
[85] The throne and crook (sceptre) of iron given or surrendered by the prince of Purušhanda to Anitta, king of Kanesh, are well-known examples of such symbols of regal power. See Siegelová 1984: 76 ff.; 143; Dercksen 2010. — See also Klinger 1996: 320 f. (CTH 591): "Let the good news find them, our mighty Sun (the King) and the Tawananna (the Queen) on a throne of iron! Let it happen that there is only joy."
[86] A Hittite land grant from İnandıktepe, for example, states: "The word of Tabarna, the Great King, is made of iron [AN.BAR]; it is not to be disregarded or broken. The head of whoever alters it shall be cut off!" — See Rüster and Wilhelm 2012: 35-37; for other examples, see Siegelová 1984: 80 ff.
[87] KUB 29.1. This text also uses iron in other metaphorical contexts. — See Siegelová 1984: 86 ff.
[88] See for example the Telipinu myth (KUB 17.10); whatever is placed in these cauldrons can never escape. — See Siegelová 1984: 89 ff.
[89] See for example the Middle Hittite invocation "Like an iron peg I have struck the words to the gods ..." (Steitler 2015); nails and pegs used in mythological foundation rituals (e.g. KBo 37.1, see Soysal and Süel 2016; Steitler 2019: 127 f.); the Ritual of the Sea (KBo 15.19, see Siegelová 1984: 90 f.); and the ritual of Hutuši (Siegelová 1984: 90; Steitler 2015: 213).

f. Iron as an abstract symbol in lists of substances (called 'Substanzenketten' by Jana Siegelová), a literary device to paraphrase all possible wealth.[90]

Apart from these examples, there is hardly any other evidence for the use of iron in pre-New Hittite texts. The exceptions come from descriptions of the KI.LAM festival, which took place in the presence of the king and queen. In one text, 'iron-men' and 'silver-men' heap up lumps/balls of iron and silver; another text lists the rations assigned to the 'iron-makers'.[91] Judging from the contexts, it is likely that the men were craftsmen who manufactured iron objects. Finally, one further tablet mentions iron jewellery given (by the king and queen?) to *hapiya*-men who participated in the KI.LAM festival.[92]

The importance of 'iron' as a symbol or metaphor for durability, strength and legitimacy is a very conspicuous feature of the Old and Middle Hittite texts. This special meaning attributed to iron is presumably rooted in the belief in the celestial origin of the metal, as indicated by a number of texts.[93] As noted above, the same belief was current in Ancient Egypt (*bjꜣ n pt*: iron 'from the sky'), and in Egypt iron had a similar symbolic or metaphorical meaning. For example, in the Qadesh battle inscription, Ramesses II declares: "Did you not know it, in your hearts, that I [the king] am your rampart of iron!".[94] And similar or related ideas might explain the extremely high value of 'iron' (*amūtum*, *parzillum*, AN.BAR) evident in the earlier archives, for example from Kültepe, Mari and Qatna.

As explained above, the small number of texts and their restricted nature, mainly concerned with rituals and festivals, make the interpretation of the Old and Middle Hittite textual references to iron fraught with difficulties. Whereas the large quantity of iron objects described in New Hittite texts could only have been made by smelting iron ores in bloomery furnaces, the situation before the later 14th century BC is unclear. It is certainly possible that the pre-New Hittite texts provide a false impression of iron usage, and iron could conceivably have been produced and consumed in much larger quantities and for types of artefacts which are not documented in the surviving texts. Alternatively, it is equally possible that the Old and Middle Hittite texts provide a fairly realistic picture, with iron usage restricted to the king and his entourage.

Although iron was probably still a precious commodity, the written sources indicate that smelting was already being carried out before the later 14th century BC. The quantities of iron objects mentioned in Old and Middle Hittite texts seem too large for a purely meteoritic source of iron. This pertains not only to the personal insignia of the king, but particularly to the iron objects used in foundation rituals. As mentioned above, large numbers of miniature iron nails/pegs were apparently sometimes deposited in the foundations of palaces and temples; although they were small, it seems unlikely that they were made of precious meteoritic iron.[95] In the context of the KI.LAM festival, iron jewellery was given to a group of participants (the *hapiya*-men), and 'iron men' and 'iron-makers' are mentioned. The use of the latter terms indicates that the men were involved with iron on a fairly regular basis, which seems inappropriate for meteoritic iron, which would only have been obtained on rare occasions. Finally, the frequency with which iron is mentioned in ritual, metaphorical and mythological contexts suggests that iron played a relatively conspicuous role in Hittite society, which seems unlikely if the metal was extremely rare and only obtained from meteorites. Taken together, these arguments make it most likely that iron extractive

[90] See, for example: KBo 12.42, an epic tale of merchants (Hoffner 1968; Siegelová 1984: 92 f.); KUB 17.27, the story of the magician Allaiturahi (Haas 2007): "The (servant of) the priest brings a loaf of sour dough bread to the house of the smith, and gives it to the smith, and (he receives in return) from him silver, gold, iron, tin, lead, *lulluri*-stone, lapis lazuli, carnelian (and various other stones). And this he acquires with the bread."

[91] See Weeden 2011: 154 f.; Steitler 2019: 130 f.

[92] The text is Middle Hittite. See Siegelová 1984: 128 (CTH 627.5).

[93] See above for the iron 'skies' (presumably iron disc- or bowl-shaped objects) used by the king in rituals. — See also: KBo 4.1 i 39: "they brought black iron of the sky from the sky". — KUB 2.2 i 48: "they brought iron from the sky". — KUB 33.34 obv. 9: "over him is a sky of iron". — KUB 34.77 obv. 9-10: mentions iron pillars(?) supporting the sky. — See: Siegelová 1984: 159; Košak 1986: 125 f.; Kammenhuber 1996: 212; 217 f.; Reiter 1997: 395 f.; Vanséveren 2012: 205; Cordani 2016c: 6.

[94] Lichtheim 1976: 386.

[95] For the nails/pegs, see Siegelová 1984: 100 ff.; Košak 1986: 127 f.

metallurgy was already introduced during the Old or Middle Hittite period, as Jana Siegelová argued four decades ago.

There are some indications that iron production and consumption increased markedly in the course of the 13th century BC. Important evidence comes from the famous letter from Hattušili III to the Assyrian king Adad-nirari I, written around 1265 BC: "In regard to the good iron [AN.BAR.SIG$_5$] about which you wrote to me – good iron is not available in my armoury in the city of Kizzuwatna. I have written that it is a bad time for making iron [AN.BAR]. They will make good iron, but they have not yet finished it. When they finish it, I will send it to you. For the moment I have sent you a knife/dagger blade of iron [AN.BAR]."[96] This tablet has often been discussed, and opinions have differed on the extent with which Hattušili's statements about the availability of iron should be understood literally. Carlo Zaccagnini argued that Hattušili was probably just making an excuse for not sending the contingent of iron blades.[97] In his letter, the Assyrian king had requested iron blades, and sent suits of armour in exchange. Apparently, Hattušili considered that the suits of armour were not sufficiently valuable. Rather than simply refusing the transaction, he invented an excuse which must have been fairly plausible – otherwise it would have been a blatant insult for Adad-nirari. Zaccagnini's analysis of the transaction and its diplomatic context appears convincing. The important point is that single iron objects were still of considerable value at the time of the letter; iron blades were not freely available in Assyria, and were probably still quite rare and valuable among the Hittites. This suggests that iron production was still not being carried out on a large scale, even in the Hittite kingdom. In Assyria, metalworkers were apparently not yet able to smelt iron ores and manufacture iron artefacts.

The cult inventories, comprising numerous detailed descriptions of cult images, especially anthropomorphic and zoomorphic figurines, and other paraphernalia ('Bildbeschreibungen'), provide a further clue about the introduction of iron on a large scale. The inventories date almost exclusively to the reigns of Hattušili III (ca. 1267-1237 BC) and Tudhaliya IV (ca. 1237-1209 BC), and have been interpreted as reflecting a reorganization or restoration of state cults.[98] Iron was used for cult images more frequently than before, with bronze figurines sometimes being replaced by iron examples.[99] The cult inventories also show a hierarchy in the status of metals: gold was used for the symbols of the most important gods; silver also for secondary gods; whereas iron was used for the rank and file of lesser gods.[100] The relatively low status of iron is also implied by the fact that iron figurines were sometimes decorated with gold and silver, and iron was often used for statue bases.[101]

The massive extent of iron production becomes visible in the palace and temple administrative inventories and tax lists, which date to the second half of the 13th century BC.[102] Whereas iron was weighed in shekels in Old and Middle Hittite texts, it was often measured in minas in New Hittite texts.[103] For example, a Late New Hittite ritual text lists: "1 shekel of silver, 1 shekel of gold, 1 mina of copper, 1 mina of tin, 1 mina of iron and 1 mina of lead."[104] At this time, iron was evidently regarded as a base metal, like copper, tin and lead. The New Hittite tablets list a wide range of artefacts, including dagger/knife blades, axes, toggle pins, ring jewellery, statue bases, 'wash basins', anthropomorphic and zoomorphic figurines, a boat (model), and various vessels of uncertain size.

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96 KBo 1.14: Siegelová 1984: 155 f.; Beckman 1999: 148 (letter 24B).
97 Zaccagnini 1970.
98 Cammarosano 2012; Cordani 2016a: 165 note 18.
99 Siegelová 1984: 127; 1993: 115; 2005: 37.
100 Siegelová 1984: 121 ff.
101 Siegelová 1984: 117; 126. — One administrative tablet (KUB 42.21 obv. 7) lists no less than 60 iron statue bases.
102 This corresponds to the Late New Hittite stage of the written documents. According to James Burgin (personal communication), the administrative texts probably date between ca. 1240 and 1220 BC. See Burgin (forthcoming).
103 See for example Cordani 2016a: 169 f. — The earliest text, mentioning 1(?) mina of iron, is written in the Early New Script and probably dates to the second half of the 14th century BC: KBo 22.142 rev. 3' "1 talent of copper, 1(?) mina of iron, 1 mina of *lulluri*-stone" (Siegelová 1984: 157 note 11). — For advice on this text the author is grateful to Susanne Görke (Marburg) and Doris Prechel (Mainz).
104 KUB 24.5 + KUB 9.13 obv. 4' and 24': Siegelová 1984: 95 note 11; Cordani 2016a: 170.

The New Hittite texts mention a relatively large number of objects of 'black iron' (AN.BAR GE_6). The earliest tablet with this iron variant has been tentatively assigned by Silvin Košak to the reign of Šuppiluliuma I (ca. 1350/1344-1322 BC).[105] This is a list of offerings, including an axe or axes of gold, lapis lazuli, precious stone and 'black iron', and other axes decorated with 'black iron'.[106] Various interpretations have been put forward for the translation of AN.BAR GE_6. Among other authors, Karin Reiter suggested it might be magnetite or some other iron oxide rock.[107] Jana Siegelová originally identified AN.BAR GE_6 with meteoritic iron, but later corrected herself, noting that the large amounts of 'black iron' listed in the texts make the meteoritic hypothesis impossible.[108] Silvin Košak's comments on the two variants of iron are more convincing, and are worth quoting in full: "Since the unmarked, generic term for the metal is AN.BAR, it is likely that AN.BAR originally meant 'meteoric iron' and that the term was later transferred to smelted iron, unless we assume that the Hittites were familiar with iron technology before they used iron in its native form. Also, while AN.BAR is attested from [Old Script] on, AN.BAR GE_6 occurs much later, probably only in [New Hittite]."[109]

As mentioned at the start of this chapter, in a recent article Enrico Lehnhardt has argued that the written sources on iron have been vastly overinterpreted, because of incorrect translation of words which putatively refer to iron. Lehnhardt contends that the distinction between 'iron' (AN.BAR) and 'black iron' (AN.BAR GE_6) makes no sense, because "iron is iron and a distinction in colour makes no sense".[110] Instead, he believes that both terms refer to iron oxide rock, specifically haematite and magnetite.[111] According to him, the meaning of AN.BAR would be similar or identical to the term ^{NA4}KA.GI.NA/*šadanu* ('haematite/ magnetite'), known from Mesopotamian cuneiform sources.[112] Furthermore, referring mainly to Hittite sources, he argued that with the technology available at the time, it would have been impossible to manufacture many of the 'iron' artefacts described in the texts out of metallic iron – for example the small figurines of oxen, each weighing 1 shekel.[113]

However, his arguments are not convincing, for the following reasons: i) AN.BAR/*parzillum* was still used in (Neo-Assyrian, Neo-Babylonian) cuneiform texts of the 1st millennium BC, when the translation as iron is definitely correct; ii) As we have seen, with ^{NA4}KA.GI.NA/*šadanu* ('stone from the mountains') there already exists a term for iron oxide rock; iii) A list of offerings in a New Hittite tablet includes objects of both AN.BAR and ^{NA4}KA.GI.NA, which must therefore have referred to different materials;[114] iv) Because they are normally found in the form of small, hard pebbles, the materials haematite and magnetite are only suited for making small artefacts. In the database of 3182 objects made of iron oxide rock from the 3rd and 2nd millennia BC assembled by Martine Melein, there is only a very restricted range of small artefacts: seals, weights, beads and amulets.[115] Iron oxide rock is clearly not suitable for the manufacture of many of the objects of 'iron' and 'black iron' described in the Hittite texts, such as spears, knife/dagger blades, ring jewellery, toggle pins etc.

The translation of AN.BAR GE_6 plays a significant role in the interpretation of the development of Hittite iron production. As mentioned above, the identification of AN.BAR GE_6 with 'magnetite' was fundamental for Enrico Lehnhardt's rejection of the translation of AN.BAR as 'iron'. AN.BAR GE_6 was also translated as black iron ore or 'magnetite' by Miguel Valério and Ilya Yakubovich; they suggested that AN.BAR GE_6

105 Košak 1986: 133 f.
106 KBo 21.87: Siegelová 1984: 148; 160; Košak 1986: 133.
107 Reiter 1997: 394.
108 Siegelová 1984: 159; Siegelová and Tsumoto 2011: 296 f.
109 Košak 1986: 125 f.
110 Lehnhardt 2021: 26.
111 Furthermore, Lehnhardt suggests that AN.BAR SIG_5 ('good iron') might refer to specular haematite. See Lehnhardt 2021: 31 f.
112 Lehnhardt 2021: 30. — As it is difficult (or impossible) to distinguish macroscopically between haematite, goethite and magnetite, it is best to translate the term ^{NA4}KA.GI.NA/*šadanu* as 'black, heavy, shiny stone' or 'iron oxide rock' (Melein 2018: 108; 111). — For the cuneiform sources, see Melein 2018: 76-85.
113 Lehnhardt 2021: 26. — For the oxen figurines, see Siegelová 1984: 115.
114 Siegelová 1984: 101 (CTH 415).
115 Melein 2018. — For haematite mace-heads, see also Muhle 2008. — For two small Egyptian haematite cosmetic jars from Megiddo and Tell el-'Ajjul, see Sparks 2007: 317 no. 462; 319 no. 492 (less than 5 cm high).

is equivalent to Luwian **parza-*, which supposedly served as the (Anatolian) root of Akkadian *parzillum* ('iron').[116] According to this theory, the term *parzillum* must originally have been used to designate iron smelted from black iron ore (magnetite). Consequently, the arguments presented above against the 'magnetite hypothesis' are significant for the question of the origin of iron smelting.

According to the objects listed in the inventory texts, the artefacts made of AN.BAR and AN.BAR GE_6 were rather similar, suggesting that both were metallic iron.[117] For example, in both cases, the most frequently attested artefacts are knives/daggers (GÍR) and blades (EME).[118] However, the meaning of 'black iron' is still not clear. On the one hand, it is possible that the iron was intentionally patinated with a black corrosion layer consisting of Fe_3O_4 (magnetite) rather than the normal reddish hydrated Fe_2O_3 (haematite). When treated with oil, the black oxide layer would have offered protection against corrosion, and the Hittites may have found the black colour attractive.[119] Alternatively, the term 'black iron' might be a reference to the black corrosion and waste products which are an unavoidable by-product of the forging process using a charcoal hearth. For this reason wrought iron is referred to as a 'black metal' in many languages, including English (blacksmith), German (Schwarzmetall, as opposed to Buntmetall and Weißmetall), Russian (chernaya metallurgiya = ferrous metallurgy), Sanskrit (*krsna ayas*), and Chinese.[120] If this is also true for the neologism AN.BAR GE_6, it might reflect the practice of iron metallurgy (smelting and smithing) in the Hittite context.

It must be emphasized that the cuneiform texts provide hardly any reliable information on the process of iron production or technological change. A possible exception is the inventory text KUB 42.21 obv. 6, listing "66 AN.BAR SIG_5 22 AN.BAR *ša* GUNNI". This has been interpreted by Jana Siegelová as distinguishing 'good iron' from 'iron (taken directly) from the smelting furnace'.[121] However, the translation as 'furnace' is questionable, with alternatives including 'brazier', 'oven', or 'hearth'.[122] While the translation of AN.BAR *ša* GUNNI as 'iron bloom' is therefore uncertain, this text surely does indicate the production of relatively large quantities of iron – which could only be achieved by the bloomery furnace. Another inventory (KUB 42.76) mentions "3 PAD AN.BAR KI[.LÁ.BI …", translated as "3 billets/bars of iron, weighing …", which again indicates the production of wrought iron in the 13th century BC.[123]

In conclusion, we have found that the weight of the evidence indicates the presence of wrought (smelted) iron already in Old and Middle Hittite texts. It is highly likely that iron use prior to the later 14th century BC was restricted to the royal court, for example for regal insignia or in rituals and religious festivals. However, owing to the nature of the texts, it is impossible to make a reliable estimate of the amount of iron in circulation prior to the later 14th century BC. Nevertheless, there are indications that the use of iron increased massively during the reigns of Hattušili III and Tudhaliya IV, and there is abundant evidence for the production of relatively large quantities of the metal in the 13th century BC, especially in Late New Hittite texts.

Unfortunately, the texts do not provide further details on the introduction of extractive iron metallurgy in the Hittite kingdom. In particular, it is not sufficiently clear when the production of smelted iron began; although a date in the 15th or 14th century BC seems fairly appropriate, an earlier inception of bloomery production cannot be excluded.

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116 Valério and Yakubovich 2010.

117 See Siegelová 1984: 162; 2005: 39. — I am very grateful to James M. Burgin (Würzburg) who shared with me the results of his research on the Hittite Palace and Temple Administrative texts (see Burgin, forthcoming).

118 Information kindly provided by James Burgin; the Hittite texts do not differentiate between daggers and knives, both being designated by the term 'GÍR'.

119 Apparently, iron was often intentionally patinated in Antiquity (see Gilmour and Giumlia-Miar 2009; Giumlia-Mair 2020: 21 ff.). — On the oxidization of iron to form magnetite, as an explanation for AN.BAR GE_6, see Maxwell-Hyslop 1980: 87 f.

120 See Wagner 2008: 50; 85 f.; for *krsna ayas* (black metal), see Rex 1964: 3a-4a (*krsnāyas*); Bryant 2001: 246 ff.

121 Siegelová 1984: 157 f.; Součková-Siegelová 2001: 192.

122 Košak 1986: 126; Cordani 2016a: 171 f.

123 Siegelová 1984: 157; Košak 1986: 126; Cordani 2016a: 172.

2.2 Earlier archaeological evidence (ca. 20th – 13th century BC)

In stark contrast to the 'diffusionist' and 'gradualist' models of the introduction of iron in the Near East, which envisage a long period of development of iron metallurgy during the Bronze Age, Enrico Lehnhardt believes that the production of iron only started during the 13th or 12th century BC. His programmatic statement deserves to be quoted fully as it encapsulates very well the questions to be addressed in the following pages:

[Before the 13th/12th century BC, in the] "vast area of West Asia, Egypt, Cyprus, Crete and the Aegean region, no furnaces, no smelting slags, no blacksmith workshops, no smithing slags and hammerscale and, even worse, not even reliably dated wrought iron artefacts have been found so far ... What are (partly subjectively) declared to be metallic iron objects are merely ferrous waste products (various slags) and intermediate products (matte) of copper smelting, especially with chalcopyrite ($CuFeS_2$); pieces of speiss from smelting arsenopyrite (FeAsS); iron ore lumps, such as hematite (Fe_2O_3) and magnetite (Fe_3O_4), and iron-bearing minerals, such as pyrite (FeS_2), which were used for various purposes; pieces of corroded copper and bronze objects with a higher iron content, which can cause an iron patina; incrustations of iron oxides originating from soil or water; and objects that only look like iron but have never been proven to be made of metallic (wrought) iron at all. In addition, there are wrongly dated iron objects and objects that have never been published in detail or whose find context is not comprehensible at all."[124]

As we shall see, I am in broad agreement with Lehnhardt's conclusions: a careful study of the published sources shows that there is hardly any archaeological evidence for smelted iron before the 13th century BC. On the other hand, as explained above, Lehnhardt and I come to different conclusions in regard to the cuneiform texts. The available evidence will be discussed in the following pages, starting with Anatolia, which is often considered to be the region where iron metallurgy originated.[125]

The evidence from the Early Bronze Age and the Old Assyrian Colony period is sparse and often difficult to interpret. The iron objects from the 'royal' tombs at Alaca Höyük, dating to the mid-3rd millennium BC, are the most significant and well-known, comprising two dagger blades, two pins with golden heads, four pendants and a semi-lunate disc.[126] Otherwise, the available evidence is less clear-cut. In the case of the important settlement of Kaman-Kalehöyük, where a Japanese team uncovered occupation layers dating from the 21st to the 18th centuries BC, Lehnhardt has suggested that the published small 'iron' fragments and slags could in reality be iron-containing debris from copper production, and do not definitely demonstrate iron smelting.[127] According to the original publication, the splendid ivory pyxis from Acemhöyük (probably the Purušhanda known from the Kültepe texts; ca. 1800 BC) is decorated with iron nails, but Lehnhardt notes that they have never been analysed, and they could in fact be made of bronze or some other material, such as an iron-rich mineral.[128] Finally, there are two pins made of bronze, gold, lapis lazuli and iron from a Level Ib tomb at Kültepe.[129] Although scientific analyses of these pins have not been published, according to the photographs it seems highly likely that the pins were decorated with iron. Further scientific analyses are required to clarify the role of iron in the early 2nd millennium BC; however, it is apparent that reliable evidence for iron is extremely rare.

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124 Lehnhardt 2021: 41.

125 This subject has been covered quite frequently, particularly by James Muhly et al., Ünsal Yalçin, Eric Jean and Julie Patrier. — See: Muhly et al. 1985; Yalçin 1999; 2005; Jean 2001; Patrier 2014. — See also the comments in Erb-Satullo 2019 and Lehnhardt 2021.

126 Yalçin and Gönül Yalçin 2018.

127 Lehnhardt 2021: 38; see also Erb-Satullo 2019: 564; 575. — For the Kaman Kalehöyük finds, see Akanuma 2008 with earlier references.

128 For the pyxis, see Özgüç 1976: pl. 1-2. — According to Lehnhardt (2021: 38) some of the 'iron' nails show traces of green copper oxide corrosion products.

129 The Kültepe Ib phase dates from the later 19th to the later 18th century BC. — Kulakoğlu and Kangal 2010: 310 cat no. 349-350; Michel and Kulakoğlu 2019: 10 note 25.

In his review of the archaeological evidence for Hittite iron, Eric Jean listed almost 40 iron objects from Turkey supposedly dating between the 17th and 13th centuries BC. However, most of them come from early excavations, and in the 20 years since publication of his article, very little new evidence has been discovered. This led Lehnhardt, in his important critical study, to question the validity of all the supposed evidence for Hittite iron – from both archaeological and textual sources.[130] For this reason, it is necessary to discuss briefly the main sites involved.

At Tell Atchana (Alalakh), in the Amuq plain, Aslıhan Yener has reported an 'iron' bead from a Plaster Tomb dating to the 15th century BC; however, as the bead has not been analysed, it is uncertain whether it is made of metallic iron or some other material, perhaps a mineral such as pyrite or magnetite.[131] Further iron finds, two arrowheads and a spatula, apparently came from Tell Atchana Levels II and I, but in view of the early date of the excavations, conducted by Leonard Woolley between 1937 and 1949, there is a distinct possibility that these are later, perhaps Iron Age, intrusions.[132]

The iron finds from Hittite Alaca Höyük, in central Anatolia, were (with one exception) found during the excavation campaigns between 1939 and 1942.[133] Unfortunately, although they are assigned by the excavators to the Hittite period (Levels 4-2), in the publications there is no information on their stratigraphical contexts.[134] In fact, it seems that even the excavators themselves were not wholly convinced by the Hittite iron finds, as they state explicitly that the only iron find from the 1940-1948 excavations was a stamp-seal.[135] According to the published photographs, it even seems doubtful that the stamp-seal was made of metallic iron; until it is analysed, the material composition of the seal must be considered uncertain.[136] In conclusion, most, if not all, the evidence for Hittite iron at Alaca Höyük is insecure.

Iron finds have also been reported from Korucutepe and Tepecik, which lie on the upper Euphrates at the border between the Hittite and Assyrian Empires.[137] At Korucutepe an iron bar or chisel(?) was found in Level CXXVIII ('Orthostat Stage'), but since the excavator mentions that Medieval sherds were also discovered there, the stratigraphical context must be regarded as questionable.[138] In the case of the miniature iron axe and the piece of iron scale armour, it is not clear from the available publications whether they should be assigned to Level CXXX ('Early Pits') or Level CXXXI ('Later Pits').[139] This is important, considering that the 'Later Pits' phase definitely dates to the Iron Age.[140] As for Tepecik, analyses have shown that the supposed "heavily corroded iron artefacts" have a surprisingly low iron content with levels of copper between 3.27% and 11.06%, strongly suggesting that these fragments should instead be interpreted as by-products of copper smelting.[141]

Owing to the extensive excavations, Boğazköy/Hattuša is by far the most important site for the question of Hittite iron metallurgy. In her recent monograph on the Upper City of Hattuša, Suzanne Herbordt drew the following conclusions: "Im Gegensatz zur landläufigen Meinung, dass die Hethiter das Eisen im

[130] Lehnhardt 2021.
[131] Yener 2013: 268. — The same author mentioned an iron finger ring from Tell Atchana, Layer VII, dating to the 17th century BC (Yener 2006: 382 note 11). However, Aslihan Yener (New York) kindly informs me that the ring was found some years after the end of the excavations on the surface of the Layer VII palace; the ring is therefore a stray find and does not have a reliable archaeological context.
[132] Woolley 1955: 86 note 3; 279; 282 (Ar. 3 and Ar. 7); 283 (Spat. 2).
[133] See Koşay 1951; Koşay and Akok 1966. — The finds from the 1939-1942 excavations have the inventory numbers Al.d-Al.g. The following iron objects were discovered during those excavation seasons: Al.d.225; Al.d.226; Al.e.5; Al.e.35; Al.f.82; Al.g.78; Al.g.301.
[134] For a discussion of the problems associated with the Alaca Höyük stratigraphy, a list of the iron objects, and further literature, see Jean 2001: 171 ff. — See also the comments in Muhly et al. 1985: 71. — Note that the iron spearhead (inv. no. Al.m.71) is probably Phrygian; see Lehnhardt 2021: 38.
[135] Koşay and Akok 1966: 142 ("Der einzige Gegenstand aus Eisen ist das Siegel Al.f.82").
[136] For the stamp-seal (Al.f.82), see Koşay and Akok 1966: 27; 51; 141 f.; 168; 227 f.; pl. 32.
[137] Jean 2001: 177 f.
[138] Van Loon 1978: 37; 1980: 147-148.
[139] Van Loon 1978: 40 ("from a post-CXXX pit"); 1980: 147 f. (inv. no. 68-106 and 68-273); pl. 45: F.G.H; 49: F.G.
[140] Van Loon 1978: 38 f.; Jean 2001: 177 note 86.
[141] For Tepecik, see Jean 2001: 178 with further literature. — For the analyses, see Çukur and Kunç 1989.

Vorderen Orient eingeführt haben, steht der Befund der Oberstadt von Hattusa. Die wenigen möglichen hethitischen Eisenobjekte entstammen der obersten Bauschicht oder unsicherem Kontext."[142] During the excavations conducted between 1978 and 1992, a total of 2801 artefacts of bronze, 18 of lead, 9 of silver, 3 of gold, and only 2-3 of iron were found. Iron only accounted for 0.1% of the metal artefacts, and Herbordt considers it possible that even these could be intrusive from Phrygian or later periods of occupation.[143] Since then, in the excavations of the last three decades, iron objects have never been found in reliable Hittite contexts. As all the other iron objects which were supposedly discovered in Hittite contexts at Boğazköy come from earlier excavations, when excavation methodology was less precise, it seems justified to suspect that some or all of these might be intrusive finds from later, post-Hittite activity at the site.[144]

It is clear from these comments that iron was extremely rare at Hattuša before the Iron Age, and there is not a single iron artefact with a reliable stratigraphical context in the Hittite period. According to the figures published by Suzanne Herbordt, the quantity of iron used would, at most, be comparable to the precious metals silver and gold.

While it is difficult to avoid these conclusions, it should be noted that for at least some of the iron artefacts from the earlier excavations, a date in the Hittite period remains fairly plausible. In particular, this applies to the fragmentary trunnion axe assigned to Level 1b of the Lower City which has close parallels among bronze trunnion axes of the Hittite period (Figure 2).[145] It is obviously different to the iron trunnion axes known from Phrygian contexts and it is presumably earlier.[146] The axe is important because it is made from smelted (not meteoritic) iron.[147] Rainer Boehmer considered that an iron tanged chisel/spatula comes from a reliable Hittite context (Büyükkaya Layer III).[148] Furthermore, the finds supposedly from the earliest contexts at Boğazköy (Lower City, Levels 2 and 3), a fine chisel and a finger ring, are comparable with similar finds from other early contexts in the Near East, such as Kamid el-Loz, which will be discussed below.[149] And the three iron finger rings from Level 1 in the Lower City would not be out of place in a 13th-century BC context, as the discussion of the 'ring horizon' in the next section will show.[150] Indeed, excavations at

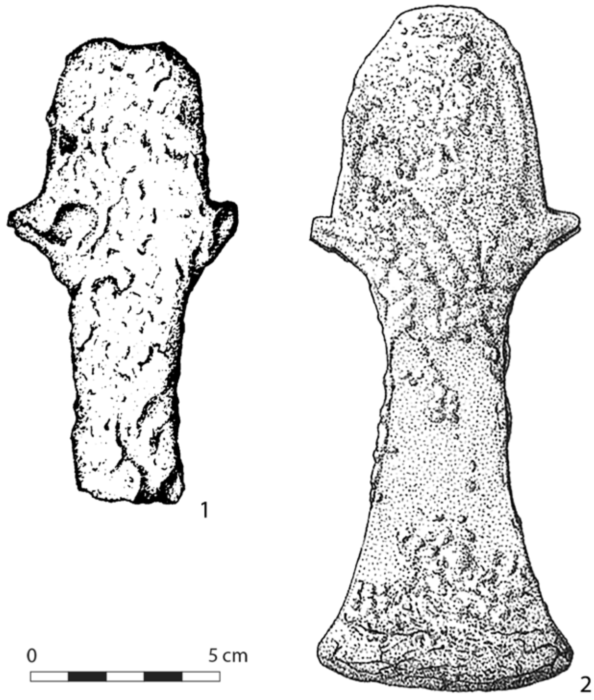

Figure 2. Trunnion axes: 1 from Boğazköy (iron), 2 from Tell Afis (bronze). — 1 after Muhly et al. 1985: pl. 9: b3. — 2 after Archi and Venturi 2012: 20 fig. 9: 1. — Scale 1:2.

[142] Herbordt 2021: 25.
[143] Herbordt 2021: 24 table 4.2-3; iron objects: Herbordt 2021: 91 cat. no. Bo 86/319; pl. 37: 5 (iron chisel); 496 cat no. E86/140 (iron 'point'); 521 cat. no. E87/57 (iron chisel). — See also the comments in Lehnhardt 2021.
[144] Around 10 iron artefacts come from excavations between 1931 and 1969, and one artefact from the excavations between 1970 and 1978. See Boehmer 1972; 1979; the finds are listed in Jean 2001: 175-177. — For helpful advice on the excavations at Boğazköy the author is grateful to Dirk Mielke (Münster) and Andreas Schachner (Istanbul).
[145] For the trunnion axe, see Bittel 1957: 17; 19 fig. 12; Boehmer 1972: 138 no. 1255; pl. 44: 1255 (imprecise drawing); Muhly et al. 1985: 78; pl. 9: b3. — For bronze parallels, see for example Wesse 1990: 76 (especially type IIA); Erkanal 1977: pl. 2: 25 ('Anatolia'); Herbordt 2021: pl. 29: 1 (Boğazköy); Yıldırım 2001: 141 fig. 6 ('Bolu' hoard); Archi and Venturi 2012: 20 fig. 9: 1 (Tell Afis); Ingholt 1940: 114; pl. 38: 1 (Hama, stratigraphical context uncertain).
[146] Compare, for example: Boğazköy (Büyükkale IIa): Boehmer 1972: 139 no. 1258; pl. 44: 1258. — Alişar (uncertain stratigraphy): Wesse 1990: 205 no. 202; pl. 27: 202. — Göltepe: Yener 2021: 141; fig. 80: M1.M2.
[147] See Muhly et al. 1985: 78; Yalçin 1999: 182.
[148] Bittel 1936: 23; 24 fig. 18: e; Boehmer 1972: 138 no. 1256; pl. 44: 1256.
[149] Chisel: Boehmer 1972: 145 no. 1295; pl. 46: 1295. — Finger ring: Boehmer 1979: 35 no. 3466; pl. 21: 3466.
[150] Boehmer 1972: 155 f. no. 1628-1630; pl. 55; Boehmer 1979: 35.

Kuşaklı, in the Hittite 'Upper Land', discovered a fragmentary iron finger ring in Temple 1, demonstrating the use of iron for jewellery rather than for utilitarian implements.[151] This is one of the very few recent excavations in which iron has been found at a Hittite site.

To conclude our review of the Anatolian evidence, it is clear that iron was extremely rare in the centuries before the Iron Age. According to the archaeological evidence, the great majority of the population had no access to it during the Hittite period. Although – with the exception of the finger ring from Kuşaklı – none of the artefacts discussed above from Hittite sites have a rock-solid, well-dated context, in the case of some of the objects from Boğazköy a Hittite date seems fairly likely, although it is impossible to rule out the possibility that most of them are later (Phrygian?) intrusions. A detailed study of the unpublished excavation documentation from Boğazköy might in the future allow a more reliable judgement concerning the use of iron in the Hittite capital.

In other areas of the Near East, iron objects from archaeological sites are also extremely uncommon. The most famous Levantine object is the splendid axe with a copper shaft-hole with gold inlay from the 'Hurrian' temple at Ugarit, dating to ca. 1450/1350 BC; the iron blade emerges from the jaws of two lions. Here, iron was used to produce a prestigious object, and the combination with the lions indicates that the axe had a symbolic meaning reflecting the power of the bearer; a similar composition is found on the dagger of the god Nergal depicted on a relief sculpture from the Yazılıkaya sanctuary near Boğazköy/Hattuša.[152] Otherwise, the state of research on the metal objects excavated at Ugarit is rather poor. Only two iron artefacts have been mentioned in publications of Claude Schaeffer's excavations: a large chisel and a knife, both discovered in the 'South City' (Ville Sud).[153] The excavators believed that the chisel came from a metallurgical workshop (associated with bronze tools, tuyères and slag), but this interpretation has been criticised by Olivier Callot.[154] While a date in the 13th century BC has been suggested for the chisel, the chronology of the knife has not been specified. Finally, at Ugarit's harbour town of Minet el-Beida, a bimetallic silver and iron finger ring was found in a robbed tomb of the 14th or 13th century BC.[155]

A gold finger ring with an inlaid iron band has been found in a burial of the 17th century BC at Sidon, with iron clearly being used as a precious metal.[156] The iron finger ring and pin or chisel fragment discovered at Kamid el-Loz were mentioned above. They came from the workshops of the last phase of Palace P4, dated by the excavators to the reign of Akhenaten (Amenhotep IV, 1351-1334 BC). It is important to note that the finger ring was analysed: as it contained slag inclusions, and nickel was not recorded, it is clear that the ring was made from smelted iron.[157]

In Mesopotamia, there is even less evidence for iron than in the Levant. Putative 'iron' inlays have been reported on two artefacts: the handle of a bronze dagger from Nuzi, and a copper mace-head from Aqar Quf/Dur Kurigalzu, both dating to the 14th century BC.[158] In both cases, it seems equally likely that the inlays were made of non-metallic, iron-rich minerals, such as pyrite or magnetite. In the absence of scientific analyses, the true nature of the inlays remains uncertain. A toggle pin with iron shaft was apparently found in a context of the 13th century BC from Tell Zubeidi, in the Hamrin Basin in eastern

[151] Müller-Karpe 2017: 66 f.; 58 fig. 51: k.

[152] Schaeffer 1939: 107-125; for a good illustration of the axe, see Yon 2006: 167 no. 60. — For stylistic parallels with the Yazılıkaya relief sculpture near Boğazköy/Hattuša, see: Schaeffer 1939: 120 ff.; Courtois 1974: 111.

[153] Iron chisel (House E, Block XIII, Locus 47): Courtois 1979: 109 ("un très long et gros ciseau en fer"); Courtois 1990: 125 note 121; Amiet 1992: 94 f. (13th century BC); Callot 1994: 80; 224; Yon 2006: 96. — Iron knife (House A, Block X, Locus 25): Callot 1994: 51 ff.; 222 (according to Callot, the knife probably fell from House B, the "maison aux tablettes", into House A).

[154] This area of the site is referred to as the "quartier des orfèvres". See Callot 1994: 80; 186 ff.

[155] Minet el-Beida, Tomb III: Schaeffer 1929: 292; Schaeffer 1939: 112 note 1. — In a recent publication, the finger ring is described as silver with two iron wires. See Sauvage and Lorre 2023: 268 ff.; 273 no. AO 11673.

[156] Sidon, College Site, Grave 102 (Middle Bronze Age IIB): Griffiths and Merkel 2012; Jambon and Doumet-Serhal 2018.

[157] Frisch et al. 1985: 95 f.; 111; 146 ff.; pl. 28: 2; 29: 2; 34: 5.6; 79 table 25 (metal analysis). For the chronology, see Heinz 2016: 148-150.

[158] Nuzi, bronze dagger from temple A: Starr 1937: pl. 125: KK; 1939: 475; Moorey 1994: 288. — Aqar Quf/Dur Kurigalzu: copper mace-head: Baqir 1945: 13.

Iraq.[159] Finally, there is an interesting find from Tell Brak. A small iron rod and a lump of corroded 'iron' were excavated in a Middle Assyrian workshop of the 13th century BC. The iron rod, 4.5 cm in length, has tapered ends, suggesting that it might have been used as a chisel or awl; in the case of the corroded lump, however, areas of high copper concentration were observed in the iron oxide, showing that it cannot be regarded as the remains of a metallic iron artefact.[160]

One of the most intriguing aspects of the earliest iron artefacts, both in the Near East and in the Aegean, is the occurrence of iron containing relatively high levels of nickel, ranging between 2% and 13% Ni. In later periods, after the 13th century BC, nickel-rich iron seems no longer to have been used: later irons hardly ever have more than 1% Ni. The question of nickel has often been discussed, because a high content of it (in excess of ca. 5%) is a characteristic feature of meteoritic iron.[161]

Unfortunately, the identification of meteoritic iron by its nickel content alone is not as easy as it might seem, simply because most early iron artefacts are severely corroded. As analyses are often performed on corroded material, it is very difficult – if not impossible – to make a precise estimate of the original nickel content of the metallic iron. For example, PGAA measurements on the beads from El-Gerzeh in Egypt recorded between 2.8% and 4.1% Ni, but the metallic iron probably originally contained 6-9% Ni.[162] And in the case of the famous axe from Ugarit, discussed above, portable XRF measurements on the surface of the blade yielded values ranging between 1.7% and 7.6% Ni (average 4.33% Ni), the wide range presumably being caused by the varying degrees of corrosion in different parts of the blade.[163] According to this argument, the nickel content of the axe was originally at least 7.6%, indicating a meteoritic source. The implement (dagger blade?) with a flat blade and a tang from Royal Tomb 58 at Ur has an even higher nickel content of 10.9%.[164] And the 19 exceptionally well-preserved iron artefacts from the tomb of Tutankhamun have nickel values consistently between 8% and 13%.[165]

Albert Jambon has developed an elegant method for distinguishing meteoritic and terrestrial iron, using simple analytical equipment.[166] As explained above, iron meteorites are composed of an iron-nickel alloy, but they also contain trace elements, especially cobalt. Jambon recognised that in the case of meteoritic iron, the Ni/Fe and Ni/Co ratios of the analysed samples exhibit a clear linear correlation even when the iron is corroded.[167] By contrast, terrestrial irons do not have this typical correlation of Ni:Co:Fe. The method entails analysing multiple samples from different parts of an artefact, with different degrees of weathering, to test whether the Ni/Fe and Ni/Co ratios show the characteristic linear trend. An important advantage of Jambon's method is that portable, handheld equipment (pXRF) can be used, making organisation of the analytical work less complicated. Furthermore, it is easier to gain permission to analyse artefacts, as XRF is a non-invasive technique. Applying the new method, Jambon argued for the meteoritic origin of the iron in the case of the axe from Ugarit and the finger ring from Sidon.[168]

While the above artefacts all probably originally contained over 5% Ni, and can be regarded as of meteoritic origin, it is more difficult to form a definitive judgement about the terrestrial or meteoritic origins of other poorly preserved iron objects. This is the case for the artefacts from Alaca Höyük, mentioned

[159] The iron shaft was apparently covered with ribbed bronze sheet; a glass paste (frit) bead was attached to the upper end of the pin. — See Moorey 1994: 288; Boehmer and Dämmer 1985: 64 f.; pl. 151: 674.
[160] Shell 1997: 120 f.; 123 (samples HH 149 and HH 172B). — As Enrico Lehnhardt has argued, the theory that the iron from Tell Brak was obtained as a by-product during the smelting of polymetallic copper ores is not tenable. See Lehnhardt 2021: 21.
[161] Traditionally, meteoritic iron has been given an important role in the early stages of iron use. See for example Wainwright 1936: 5 ("Inquiry immediately makes it clear that man must first have come to know iron through meteorites."). — For recent discussions of the question and further literature, see Rehren et al. 2013; Jambon 2017.
[162] El-Gerzeh, nine beads from two tombs of the Naqada culture (phases IIC-IIIA, ca. 3400-3100 BC): Rehren et al. 2013.
[163] Ugarit: Jambon 2017. — For discussion of the earlier analytical results, see Muhly et al. 1985: 81; Photos 1989.
[164] Ur, Royal Tomb 58 (Early Dynastic IIIA, 26th century BC): Woolley 1934: 49; 293; 542 no. 9139; Desch 1929: 440.
[165] Tomb of Tutankhamun (1341-1323 BC): dagger blade, horus-eye pendant, headrest and 16 small chisels: Broschat et al. 2018.
[166] Jambon 2017.
[167] See for example Jambon 2017: 48 fig. 2; 49 fig. 3.
[168] For Ugarit, see Jambon 2017. — For Sidon, College Site, Tomb 102 (Middle Bronze Age IIB, 17th century BC), see Jambon and Doumet-Serhal 2018.

above; in the case of the bead from Umm el-Marra, it is not even clear if it was originally made of metallic iron.[169] Despite the uncertainty caused by the poor state of preservation of the objects from Alaca Höyük, at present it seems most likely that the iron is of meteoritic origin, at least until a more convincing alternative explanation for the relatively high levels of nickel is put forward.

In this review of the archaeological evidence, I have mentioned all the iron artefacts known to me from early contexts in the Near East. It is abundantly clear that iron was a very uncommon metal before the 13th century BC. As we have seen, the available evidence is often difficult to interpret, and comes from very few sites scattered over most of the Near East. Despite this unpromising state of affairs, it does seem possible to draw an interesting comparison with the results obtained from the cuneiform sources.

In the case of the earlier objects, iron was obviously treated as a precious metal; very often the iron artefacts come from high-status or 'royal' tombs. This is the case for the earliest contexts, from El-Gerzeh, Ur and Alaca Höyük, but also for the tombs of the Old Assyrian colony period from Acemhöyük and Kültepe.[170] The finger ring from Sidon, the axe from Ugarit, and the finds from the tomb of Tutankhamun also demonstrate this élite usage of iron. As we have seen, most of these objects were probably made of meteoritic iron. The splendid axe from Ugarit and the magnificent dagger from the tomb of Tutankhamun show that status symbols of iron were used as 'regal' attributes by the most powerful leaders of the Late Bronze Age. Meteoritic iron was imbued with cosmological symbolism, as it was understood to have a heavenly origin.

Unfortunately, for the reasons explained above there is hardly any reliable archaeological information available from Hittite sites. But from other areas of the Near East, it is sufficiently clear that the situation changes after the second half of the 14th century BC. Now we have evidence for very different uses of iron, typically found in non-élite contexts.[171] This change in the status of iron corresponds with the treatment of iron as a base metal in the literary sources of the second half of the 13th century BC.

At present, in the absence of more reliable information from Kaman Kalehöyük and Hittite Anatolia, the archaeological sources provide no clear information on the location of the invention and primary innovation of smelting and wrought iron metallurgy. While the texts suggest that iron was produced on a large scale in the last stage of the Hittite kingdom, this is not reflected by the archaeological finds.

2.3 Later archaeological evidence (ca. 13th – 10th century BC)

The discussion of the later archaeological evidence will examine the following regions: central and eastern Anatolia; Mesopotamia; western and north-western Iran; the northern Levant; and the southern Levant.

Central and eastern Anatolia

After the end of the Hittite Empire, the erstwhile core area of the Hittite kingdom sank for centuries into insignificance. The number of archaeological sites and finds for the period between the destruction of the Hittite palaces and the emergence of the Phrygian kingdom (Early Iron Age, ca. 1200-900 BC) is greatly reduced.[172] According to Hermann Genz, during the Early Iron Age central Anatolia was characterized by

[169] Alaca Höyük, Tombs K, M.A, M.C and T.M: Gold-hilted dagger: 3.08-7.59% Ni (Nakai et al. 2008), or 2.43-5.99% Ni (Jambon 2017). — Second dagger: 0.6-2.0% Ni (Yalçin 2011: 60; 64). — Semi-lunate disc: 2.4% Ni (Yalçin 1999: 178). — Gold-headed pin: 2.7% Ni (Yalçin 1999: 178). — Umm el-Marra, Acropolis Centre, Tomb 1 (ca. 2300 BC): spherical bead or pendant: av. 2.12% Ni, but with only 47.8% Fe (Schwartz et al. 2003: 331; Bilal 2014: 85; Jambon 2017). Albert Jambon has recently argued that the bead from Umm el-Marra was made from a piece of iron meteorite (Jambon 2024).

[170] As mentioned above, it is uncertain whether the nails on the ivory pyxis from Acemhöyük are made of metallic iron.

[171] Specifically: the finger ring from Minet el-Beida; the finger ring and the chisel/pin fragment from Kamid el-Loz; the chisel and the knife from Ugarit; the chisel/pin from Tell Brak; and the pin-shaft from Tell Zubeidi. — In the next section, more evidence for iron dating to the 13th century BC will be presented (jewellery of the 'ring horizon').

[172] According to Andreas Schachner, after the collapse of the Hittite Empire, "no traces of its culture or its language survived in Central Anatolia" (Schachner 2020: 394 note 83). — For further literature on palaeo-climate research and survey data from

isolated village communities.[173] Hardly any metal objects dating between the 12th and 10th centuries BC are known from these settlements, and it is unlikely that this area had any supra-regional importance for the development of metallurgy.[174] The only (potentially) important evidence is a workshop for bronze and iron production in operation towards the end of the Early Iron Age (10th century BC?) excavated on the hill of Büyükkaya at Boğazköy.[175] A probable blacksmith's forge was also discovered at Göltepe, in the central Taurus mountains; in this case, the chronology is less precise, it was active sometime between the 10th and 8th centuries BC.[176] Against this background, the reconstruction of the development of iron production after the Hittite collapse – during the 12th and 11th centuries BC – is impossible at present.

In the Armenian Highlands of eastern Turkey, the archaeology of the Early Iron Age is also poorly understood.[177] The earliest evidence for iron production has been discovered in the settlement of Büyükardıç, located between Erzincan and Erzerum, where remains of bronze and ironworking date to around 900 BC.[178] However, some authors have identified the region around Lake Van, the core of the later kingdom of Urartu, as a possible centre of early iron production. The discussion centres on the cemeteries, including Dilkaya, Ernis-Evditepe, Hakkari, Karagündüz and Yoncatepe, containing many iron objects, which have been dated to the Early Iron Age by Veli Sevin and Jens Nieling.[179] Sevin and Nieling draw attention to the fact that some of the graves from Karagündüz and Hakkari, considered to be the earliest ('Early Iron Age I'), have a particular selection of iron objects, mainly comprising bracelets and finger rings, but also iron toggle pins, simple daggers and small knives. Karagündüz grave 6, for example, from which a calibrated radiocarbon date of 1314-1042 BC was obtained, contained 11 finger rings and bracelets, two small knives and one pin made of iron.[180] And Grave 2 from the Hakkari cemetery contained 14 iron bracelet fragments and one iron dagger. Sevin noted that similar iron bracelets are found in a number of cemeteries between Lakes Sevan, Van and Urmia, and Nieling spoke of an early iron horizon mainly characterised by iron finger rings and bracelets.[181] However, despite Nieling's arguments, the early date of these grave finds has not been widely accepted. Because of the collective burial rite customary in the Lake Van area at this time, with subterranean stone chambers each containing up to 80 buried individuals, it is in fact quite impossible to date the iron grave goods with any precision. At present, there is no conclusive evidence that they date earlier than the similar iron grave furnishings found in north-west Iran during Iron II (ca. 1050-800 BC).[182]

Mesopotamia

In the northernmost part of Mesopotamia, on the upper Tigris in south-east Turkey, two graves have been discussed recently by Jens Nieling, Aline Tenu and Hartmut Kühne.[183] The seven iron bracelets from an

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Central Anatolia, and the dry phase between 1200 and 900 BC, see Allcock 2017.

173 Genz 2011.

174 See the comments in Genz (2011), particularly p. 352: "hardly any metal artefacts dating to the Early Iron Age are known so far from Central Anatolia". — In her thesis on the iron finds from Gordion, Joanna McClellan (1975: 706-744; 762 ff.) found no evidence for continuity between Hittite and Phrygian ironworking.

175 Büyükkaya Layers 7-5 (ca. 11th-9th century BC) have produced a small number of iron finds, including chisels and remains of other small implements. The metal workshop had remains of copper production (crucible and slag), and – according to the preliminary report – possibly iron hammerscale. A piece from the middle of a smith's forge was found in a levelling layer above Layer 5. — See Seeher 1997: 327 f.; 328 fig. 11; 2010: 222 f.; 2018: 93-99; Lehner 2017: 150.

176 The hearth/oven is dated to period 1 (10th-8th century BC); a radiocarbon date from the context yielded a date in the 10th/9th century BC. Associated with the hearth were an iron trunnion axe and an iron spearhead; another iron trunnion axe was found out of context. See Yener 2021: 24 f.; 72 f.; 141; fig. 80: M1.M2.M4.

177 See for example Khatchadourian 2011.

178 Şenyurt 2006.

179 Sevin 2003: 191 ff.; Nieling 2009: 155 ff.; 246; 297 ff.; Özfirat 2018. — See also Yalçin 1999: 182; Jean 2001: 181; McConchie 2004: 93; 122 f. — For Ernis-Evditepe, see Belli and Konyar 2003.

180 This is a 2σ calibration, the date was obtained from charcoal. For the uncalibrated radiocarbon date, see Khatchadourian 2011: 471.

181 Sevin 2003: 192 ff.; Nieling 2009: 87; 273 („Stufe des Ringeisens").

182 Muscarella 2006: 171 (Sevin's 'Early Iron Age II' belongs to the Urartian period); Köroglu and Konyar 2008. — See also Khatchadourian 2011: 476 "There is thus a lacuna in the archaeological record of the Lake Van region during the centuries preceding the Urartian Empire."

183 Nieling 2009: 52; 171 ff.; 297; Tenu 2009: 94; Kühne 2017: 327 f. — For evidence for small-scale bronze and ironworking at Kenan

urn grave at Giricano recall the iron ring jewellery from around Lake Van discussed by Sevin and Nieling. In this case, the assemblage is reliably dated between the second half of the 11th and the 10th century BC. The second grave, an inhumation, was excavated at Grê Dimsê. The grave goods comprise an iron sword, an iron finger ring and six iron arrowheads, along with a pottery vase with painted geometric decoration and a bowl of grooved ware.[184] A date similar to Giricano has been proposed, between the second half of the 11th and the first half of the 10th century BC. With a length of almost 70 cm, this sword is important evidence for the early production of large iron weapons.

Further south in Mesopotamia, there is earlier evidence for a very significant increase in the number of iron artefacts in the archaeological record. The most important evidence comes from the following Middle Assyrian sites:

1. In the burials from Assur, iron is still a rare metal, with iron grave goods comprising only 2.1% of all the metal grave furnishings. The earliest iron object is a finger ring from grave 112, dated to the 13th century BC. The other early iron objects, nine finger rings and bracelets from graves 155, 162 and 173, date to the 12th and 11th centuries BC.[185]
2. At Mari, 24 of the 384 graves from the Middle Assyrian cemeteries contain in total 80 iron objects. Of these 24 graves, 21 graves only contained iron finger rings, bracelets and anklets, the remaining three graves apparently had iron arrowheads.[186] Marylou Jean-Marie and Juan-Luis Montero-Fenollós suggest that the cemetery should be dated between ca. 1350 and 1200 BC. However, as some of the graves contain objects that are certainly later, it seems that the cemetery continued in use long after 1200 BC.[187] Despite the uncertain chronology of the tombs, it is clear that ring jewellery is very predominant among the earliest iron artefacts in the Mari cemeteries.
3. The third site is Tell Sabi Abyad, a Middle Assyrian fortress (*dunnu*) situated north of Raqqa in Syria.[188] Iron objects are absent in Level 7, which dates between 1350 and 1250 BC. Three iron finger rings were discovered in Level 6 (ca. 1233-1197 BC), and a further five or six finger rings and bracelets, along with various other fragments (some of which apparently from pins and rings), came from Levels 5-3 (ca. 1196-1150 BC). It is important to note that apart from five objects from burials (finger rings and bracelets) all the other objects came from settlement contexts.[189] This observation is relevant because the iron finds from burial and settlement contexts are similar, mainly comprising ring jewellery, with a complete absence of tools or weapons.
4. In the Middle Assyrian provincial capital at Tell Sheikh Hamad, excavations not only uncovered the cuneiform texts of the later 13th century BC mentioning iron (see above), but also a small number of iron objects. Iron was absent in layer 28 (13th and first half of the 12th century BC), but appeared in two contexts which can very probably be assigned to layer 27c (12th-11th century BC): an iron finger ring from grave 78/3 and an arrowhead from a settlement context.[190]

Tepe, dating to the 11th or 10th century BC, see Parker 2003: 533 f.; 548.

[184] Karg 2004: 676-80; 664 fig. 3b; 670 fig. 9.

[185] Pedde 2015: 31; 52; 104; pl. 86: 13 (grave 112); pl. 124: 6; pl. 125: 7-8 (grave 173).

[186] Jean-Marie 1999; Montero Fenollós 2004; Kühne 2017: 326. — In the excavation report (Jean-Marie 1999), it is clear that the stratigraphical position of the arrowheads is uncertain in some cases; see Jean-Marie 1999: 45; 120 f. (Tomb 134); 85; 138 (Tomb 368); 52; 149 (Tomb 506). See also Lehnhardt 2021: 30.

[187] I am grateful to Alexander Pruß (Mainz) for advice on this question. — See for example the fibulae from graves 287 and 307: Jean-Marie 1999: 59; pl. 42; 49.

[188] Nieling 2009: 173 ff.; Kühne 2017: 326; for the chronology, see Düring et al. 2015.

[189] For information on the stratigraphical position of the iron objects from Tell Sabi Abyad I am very grateful to Merel Brüning (Leiden University). — Most of the iron finds from Levels 6-3 are published in catalogue form by Jens Nieling (2009: 314 ff.): finger rings (cat. no. 126, 130, 132, 134, 143, 147), bracelets/anklets (cat. no. 133, 135, 146), twisted wire (bracelet? cat. no. 124), pins/nails (cat. no. 131, 139, 140), small fragments (cat. no. 127, 128, 129, 138). — Four rings (all finger rings) come from non-burial contexts: Level 6A/B (inv. no. M91-27, M03-6), Level 4D (inv. no. M98-70), Unstratified (inv. no. M93-3). — Note that the chronological position of the large iron knife (Nieling 2009: 318 cat. no. 137) from Level 2 is uncertain: the 'layer' has mixed finds from the Middle Assyrian, Hellenistic and Islamic periods. — Note that the new monograph by Keshia Akkermans (2023) with details of four iron finger rings, two iron anklets, and one gold and iron pendant from burials of the first half of the 12th century BC from Tell Sabi Abyad has subsequently been published.

[190] Kühne 2017: 325.

5. Two further inhumation burials in mud-brick cists have recently been excavated at Tell Halaf in north-east Syria. Grave 8 contained the burial of a young child with two iron bracelets. Rich furnishings accompanied grave 16, housing a young woman of 15-16 years, including a massive iron bracelet weighing 97 g, and a fragmentary iron pin or needle. According to the stratigraphy, the two graves are contemporary, dating sometime between the 13th and 11th centuries BC.[191]
6. An iron bracelet was found in a burial of the 13th/12th century BC from Tell Mohammed Diyab, a Middle Assyrian site in north-east Syria.[192]

As our list shows, iron became relatively abundant in the Middle Assyrian kingdom around the 13th/12th century BC. Iron ring jewellery, particularly bracelets and finger rings, are very prominent in the archaeological record, whereas utilitarian objects are almost completely lacking (for examples, see Figure 3: 1.3.6.11.14.15).[193] The archaeological evidence contradicts the impression given by the Assyrian texts, in which iron still appears to be "a metal for kings" in the 12th century BC.[194]

In his 1994 monograph, Roger Moorey stated that iron was less abundant in Babylonia than in Assyria in the later 2nd millennium BC.[195] Sadly, relevant modern research is lacking for most of the region. The exception is Babylon itself, where the archaeological evidence from the 2nd millennium BC has recently been systematically studied by Katja Sternitzke. According to Sternitzke, iron objects are completely absent at Babylon in the 2nd millennium BC – with the exception of three graves of the late Kassite and Isin II period. Grave 15a, a rich burial, contained three iron anklets; according to its stratigraphic position and associated pottery, the grave most likely dates to the 13th century BC, although the first half of the 12th century is also possible. The two other graves are slightly later: grave 45 (a double pithos burial) with two bracelets from the second half of the 12th century, and grave 248 with a single iron bracelet having a less precise chronological position in the 12th century BC.[196] Otherwise, iron objects remain extremely rare in late 2nd millennium Babylonia. Dominique Beyer has discussed some iron finger rings or bracelets, other iron artefacts from dateable contexts are unknown to me.[197]

Ring jewellery (finger rings, bracelets and anklets) is very predominant among these early iron artefacts of the 13th, 12th and 11th centuries BC. While most of them come from funerary contexts, it is important to note that the four early iron objects from settlement contexts at Tell Sabi Abyad were finger rings. It is most unfortunate that for most of these contexts, without further, more detailed research, the chronology remains so imprecise. There are some indications that iron, in the form of ring jewellery, only became more frequent in the second half of the 13th century BC. Tell Sabi Abyad is most important: iron is absent at the site before the later 13th century, and the earliest iron artefacts are three finger rings. The earliest iron at Assur is, once again, a finger ring. Ring jewellery is also the only form of iron in the earliest contexts at Babylon. For the history of the introduction of iron metallurgy, these observations are of the greatest importance, because the 'ring horizon' represents the first more regular use of iron detectable in the archaeological record. In view of the large number of iron rings found at this time, there can be no doubt that they were made of wrought, smelted iron.

191 Heitmann 2012. — Whereas a radiocarbon date obtained from charcoal would suggest a date in the 14th or 13th century BC, the pottery vessels from grave 16 point to a later date, possibly in the 11th century BC; see Sievertsen 2012: 141.
192 Tomb 1497. See Sauvage 1997: 162; 2005: 49. — The author is grateful to Martin Sauvage (Paris) for information on this find.
193 A potentially important discovery of utilitarian iron from Tell Amuda has recently been discussed by Hartmut Kühne. Here, a burial containing six iron spearheads supposedly dates to the 13th century BC; see Kühne 2017: 325 f.; Faivre 1992: 138. However, as the excavations from Tell Amuda have not yet been published in detail, it seems wise to treat this possible exception with caution. Enrico Lehnhardt (2021: 30) suggests a date in the 11th century BC.
194 Maxwell-Hyslop 1974: 140; Pleiner and Bjorkman 1974: 286 f.; 307.
195 Moorey 1994: 289.
196 The author is grateful to Katja Sternitzke (Berlin) for her generous advice on these graves. See Sternitzke 2017: 391.
197 Beyer 1982.

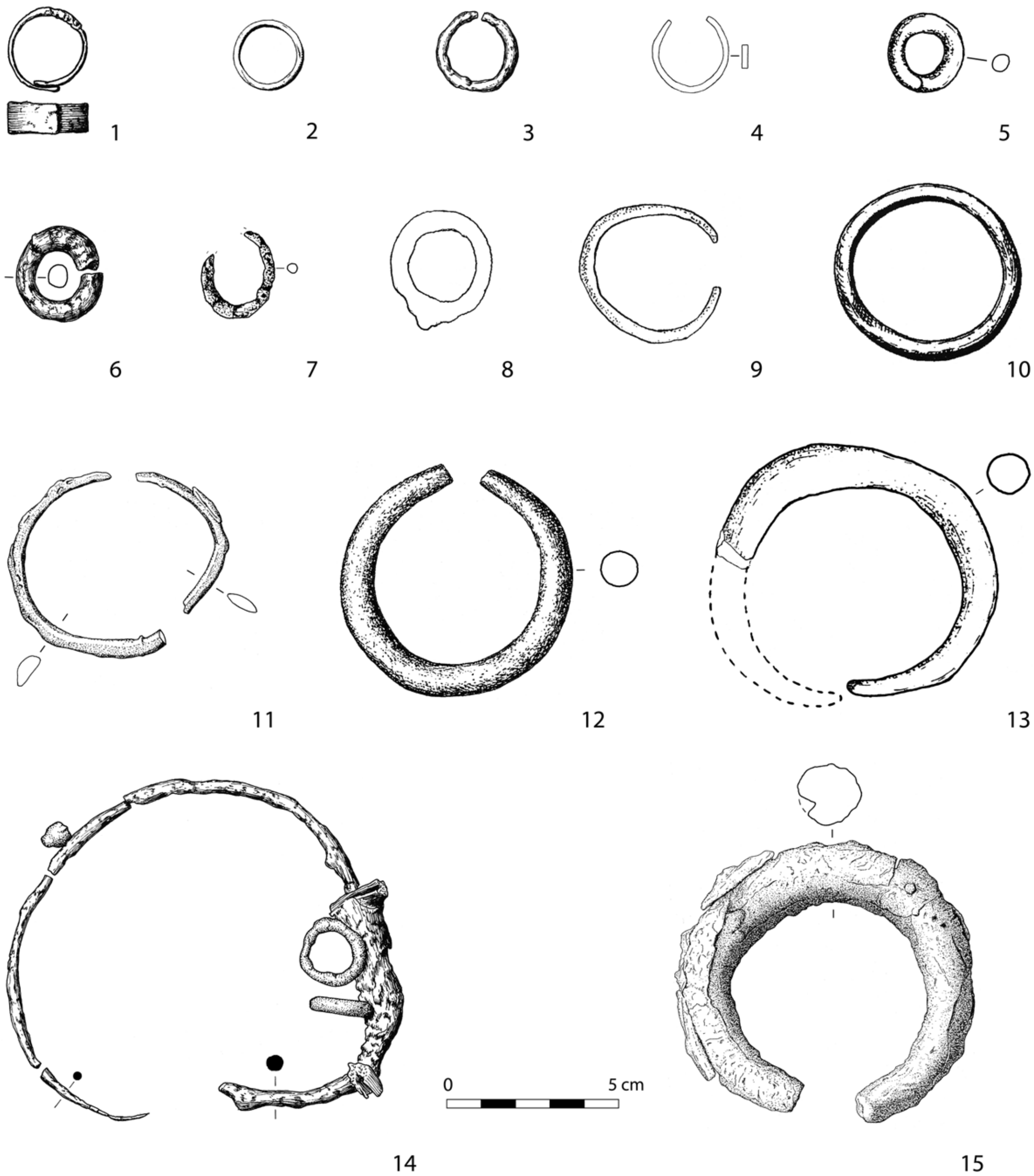

Figure 3. Early iron ornaments from Mesopotamia, Syria and the Levant belonging to the 'ring horizon'. — 1, 3, 6, 14 Tell Sabi Abyad (after Nieling 2009: cat. no. 132, 133, 134, 147). — 2, 10 Megiddo, Graves 221B and 912B (after Guy 1938: 172 fig. 176: 7; 178 fig. 179: 6). — 4 Baq'ah Valley, Cave A4 (after McGovern 1986: 267 fig. 86: 24). — 5, 13 Tell 'Eitun (after Edelstein and Aurant 1992: 30 fig. 13: 18.21). — 7 Timna (after Rothenberg 1988: 277 fig. 54: 6). — 8 Hama, Period F2 (after Riis and Buhl 1990: 111 fig. 52: 282). — 9 Beth Shean, Grave 219 (after Oren 1973: 242 fig. 49: 2). — 11, 15 Tell Halaf (after Heitmann 2012: 64 fig. 54: 2; 71 fig. 59: 1). — 12 Tel Qasile (after Mazar 1985: 6 fig. 2: 2). — Scale 1:2.

Western and north-western Iran

Against the background of the evidence from Mesopotamia, it is worth discussing briefly the introduction of iron in Iran. General reviews of its adoption in the region have been published by Vincent Pigott and, most recently, by Aurélie Cuénod.[198] It is clear that iron was extremely rare in Iran during Iron Age I.

In the north-west of the country, in the Lake Urmia Basin, the most important excavated site is Hasanlu. In Iron I, a single iron ring was excavated on the High Mound (Hasanlu phase IVc, ca. 1250-1050 BC).[199] The ring has an external diameter of 2.8 cm, and can be interpreted as a small finger ring.[200] As very little artefactual material dating to phase IVc has been excavated at Hasanlu, it would be inappropriate to draw far-reaching conclusions from the fact that this is the only iron artefact known from this period at the site. Iron only became common in Iron Age II (Hasanlu IVb, ca. 1050-800 BC). The rich warrior graves of Hasanlu IVb, often containing bimetallic weaponry, are clear evidence that iron was used for weapons and implements such as knives. Unfortunately, Hasanlu IVb is a rather long phase, and it is still impossible to determine more precisely when, during the phase's 250-year time-span, production of utilitarian artefacts began. However, one of the weapon graves (SK 107), with one bronze and one iron socketed spearhead, an iron dagger and an iron bracelet, has been assigned by Michael Danti to the late 11th or 10th century BC.[201] At the end of phase IVb, almost 2,000 iron artefacts discovered in Hasanlu's destruction layer illustrate the massive scale of iron production by the late 9th century BC.[202] Among the weapons, the bimetallic daggers and spearheads are a characteristic feature of Iron II (Hasanlu IVb).[203] In her recent publications, Megan Cifarelli has emphasized the close connections between Hasanlu and the southern Caucasus (Georgia and Armenia) during Iron II, as shown, for example, by the furnishings in the warrior graves.[204]

The results from Hasanlu concerning the inception of iron use are supported by research at other sites around Lake Urmia. Iron first appears at Dinkha Tepe in Iron II (Dinkha II), for example in a male grave with an iron bracelet and two iron finger rings, and a female grave with two iron finger rings and two iron pins. Similarly, iron is first found at Kordlar Tepe in Iron II contexts (Kordlar IIa). Grave 7, for example, contained five iron finger rings and an iron bracelet.[205]

The important and richly furnished cemetery of Marlik lies to the south-west of the Caspian Sea in the province of Gilan. Christian Piller has studied the cemetery in detail, and suggested a chronological sequence for the tombs.[206] In Stage IIa (ca. 12th century BC), one tomb contained a small iron awl; in Stage IIb (ca. 11th century BC), four or five tombs contained iron spearheads and daggers, including one bimetallic example; and two further iron weapons were found in tombs of Stage III (ca. 1000 BC).[207] Some authors have argued that the Marlik cemetery was re-used for secondary burials during Iron II-III, and this is obviously true in the case of Tomb 36, as the elbow fibula shows.[208] As human bones were not preserved in any of the eight tombs with iron artefacts, the possible existence of secondary burials is difficult to prove or disprove conclusively. However, Piller argues persuasively that – with very few exceptions – the tomb furnishings form a homogeneous assemblage belonging to the 'Marlik culture' (corresponding to his Marlik Stages I-III). The fibula from Tomb 36 is one exception, and the two iron socketed spearheads from Tomb 41 also seem to be anachronous in the north-west Iranian context in the 11th century BC.

198 Pigott 1977; 1980; 1999; 2004; Cuénod 2013.
199 Danti 2013a: 46. — Other iron objects which are sometimes mentioned in the literature as belonging to Hasanlu IVc burials are not reliably associated. For the iron fragment from grave SK24 and the iron finger ring from grave SK29, see Danti 2013a: 292 f.; 305 f.; 405; Cifarelli 2019: 25 f.
200 The author is grateful for the information generously provided by Megan Cifarelli (New York).
201 Danti and Cifarelli 2015: 104 ff.
202 Pigott 2004; Danti 2013a: 46.
203 See Thornton and Pigott 2011.
204 See for example the discussion of the sheet bronze belts possibly introduced from Transcaucasia at this time. See Cifarelli et al. 2018: 546 ff.
205 For a general overview, see Nieling 2009: 163-71; Danti 2013a: 8; 281; 2013b: 332. — Dinkha Tepe, B9a, burial 9 and B10b, Grave 11: Muscarella 1974: 60 ff. fig. 26. — Kordlar Tepe, Grave 7: Lippert 1979: 132 f.; 134 fig. 15.
206 See particularly Piller 2008; 2018. — Iron was discovered in eight of the tombs at Marlik (Piller 2008: 147).
207 Piller notes that the iron dagger blade from Tomb 42 was not securely associated, as it was discovered above the tomb. — Tomb 7 was plundered and contained few remaining artefacts; for this reason, its chronological position is unclear. — In the case of the awl in Tomb 52 (from Stage IIa), Piller notes that it was not mentioned in the final report of the excavations, and it therefore seems somewhat uncertain whether it belonged to the burial furnishings; see Piller 2008: 147 note 334.
208 See for example Löw 1998: 57-61; Piller 2008: 44 ff.

Most of the iron artefacts from the Marlik cemetery cannot be assigned to specific typological variants. The iron tanged spearhead from Tomb 18 is an exception, as it corresponds to Piller's type IIA of the bronze spearheads, which strongly suggests that this kind of weapon was made locally of iron during the 11th century BC. Furthermore, the bimetallic dagger from Grave 7 could be related to Piller's dagger type VB, which is known from several examples in Marlik Stage III. The Marlik tombs, despite the problems concerning the quality and documentation of the excavations, indicate that the manufacture of iron weapons, including spearheads and bimetallic daggers, began in the Gilan region at some point during the 11th century BC. Nevertheless, bronze remained predominant for weapons and tools until the end of the use of the cemetery.[209]

The other region in western Iran which has been studied intensively lies further south, in the western Luristan region, close to the border with Iraq.[210] According to Bruno Overlaet, there is no definite evidence for iron in Pusht-i Kuh Iron Age IA, but iron bracelets, anklets and finger rings and bimetallic pins are encountered in Iron IB, dating between 1150 and 1000 BC.[211] At Tepe Guran, for example, a well-furnished grave with a bronze dagger and two bronze vessels contained numerous iron finger rings and fragments of an iron bracelet.[212] Iron ring jewellery is more common in Iron II, but fell out of fashion after the 9th century BC. Iron was first used to make weapons at some time between 1000 and 900 BC, including bimetallic daggers, halberds and adzes, and the so-called 'decorated Luristan ironwork'.[213] An iron sword from Grave 9 at Tepe Kalwali is particularly interesting, because it is very closely related to the similar bronze daggers and swords of Overlaet's group B2, which date to Iron Age I.[214]

As we have seen, the chronological resolution around the Bronze/Iron transition in western and north-western Iran is insufficient for a detailed reconstruction of the introduction of the new metal. However, as we have observed both in Mesopotamia and in the region around Lake Van, ring jewellery is conspicuous among the earliest iron finds, for example from Hasanlu, Dinkha Tepe, Kordlar Tepe and Tepe Guran. Iron weapons were apparently introduced at Marlik at some point during the 11th century BC, although bronze remained the main metal for the great majority of artefacts. Utilitarian iron artefacts were manufactured at Hasanlu during the 10th century BC; it is possible that production already started during the second half of the 11th century BC, but this is uncertain. Likewise, in Luristan the production of iron weapons began during the 10th century BC. In all three areas in western and north-western Iran bimetallic weapons are a typical feature of early iron weaponry.

The northern Levant

To my knowledge, there is no recent synoptic study on early iron finds from the northern Levant. However, Christian Schulz's monograph on the metallic weapons dating between the 14th and 11th centuries BC from the area between the Amuq plain in the north and Israel in the south yields interesting results.[215] Iron weapons are very uncommon – even after the destruction of urban sites such as Ugarit, Tell Kazel and Emar in the 'Crisis Years' around 1200 BC. The bimetallic axe using meteoritic iron from Ugarit was mentioned above; otherwise, well-dated iron weapons are unknown during the Bronze Age in

[209] The author is very grateful for helpful advice from Christian Piller (Munich). — For some alternative suggestions on the question of secondary burials at Marlik, see Vahdati and Piller 2018.
[210] Most excavations have taken place in the Pusht-i Kuh region in the western Zagros mountains. For discussions of the iron finds, see Pigott 1999: 92 f.; Overlaet 2003: 150 f.; 2004; 2005; 2013. — In earlier literature, the iron tanged dagger from Grave 23 from Tepe Giyan, in Luristan, was often claimed to be one of the earliest iron artefacts in Iran. See Contenau and Ghirshman 1935: 22; pl. 12; Pigott 1977: 225. However, Theodore Cuyler Young demonstrated that the stratigraphy of Graves 20-28 from Giyan is unreliable, and a date in the 9th/8th century BC can today be considered as certain. See Young 1965: 66; Overlaet 2003: 52; 55 fig. 38.
[211] Overlaet 2003: 195; 198; 203; 210.
[212] Grave 4: Thrane 2001: 93-101; pl. 65 (T. 4): 3.5.6-8.11-15; Overlaet 2003: 26; 151; for the chronology, see also Piller 2008: 48 note 135.
[213] Moorey 1991; Overlaet 2013: 388 f.
[214] Overlaet 2003: 160 f.; 164.
[215] Schulz 2014.

Syria.[216] Even in the 12th and 11th centuries BC, with the exception of a few arrowheads, iron weapons are unknown.[217]

The cemetery of Hama, situated on the Orontes, has the most important complex of early iron artefacts in Syria.[218] In the earliest part of the cemetery (Period I), 20 graves contain iron objects (3.3% of the total 610 graves in Period I), comprising 20 finger rings, seven bracelets/anklets, one iron knife and one pin. In the contemporary settlement (Period F2), the excavators found a single iron object, an iron finger ring (Figure 3: 8).[219] These finds (settlement Period F2/cemetery Period I) were dated by Poul Riis and Marie-Louise Buhl to 1175/50-1075/50 BC, whereas Stefania Mazzoni prefers a somewhat later date, mainly in the 11th century BC.[220] In addition to these 20 graves in Period I, there is one further grave (IV/315) with an iron sword, three iron arrowheads and a fragmentary iron bracelet/anklet.[221] Whereas Jens Nieling suggests that the iron finds from Grave IV/315 might partly derive from later burials, Poul Riis assigned the grave to a very late stage or near the end of Period I.[222] Although the integrity of this grave inventory is not beyond doubt, it is not unlikely that iron swords began to be used at Hama at the end of Period I, perhaps around the middle or second half of the 11th century BC. In Hama Period II, the proportion of graves with iron increases slightly (7.6%, i.e., 37 of the total 490 graves of Period II). There is a wider range of iron grave goods, not only including bracelets/anklets and finger rings, but also five swords, four arrowheads, three knives, a spearhead and a dagger.[223]

As we have seen, the vast majority of iron grave goods in Hama Period I/F2 were iron rings; Hama is therefore a further site in which the earliest iron finds belong to the 'ring horizon'. Otherwise, iron rings do not seem to play a major role among the earliest iron artefacts in Syria. The example from Minet el-Beida, from a tomb of the 14th or 13th century BC, has been mentioned above, and another small iron ring was found at Tell Sukas, which may date around the Late Bronze/Early Iron Age transition.[224] Apart from these rings, the earliest iron artefacts are mostly knives.

The only iron knife found in Period I at Hama has two rivet holes and one preserved bronze rivet; it is related to the iron knives with bronze rivets found so frequently in Cyprus and the southern Levant (see below).[225] Furthermore, there are two 'bone' (or ivory?) objects from Hama Period I, which resemble the well-known ivory knife handles with ring-shaped pommels from Israel and Cyprus. The handles from Hama have ring-shaped pommels 2.4-2.8 cm in diameter, similar in size to examples from Beth Shean, Tel Qasile and Tel Miqne, which measure between 2.3 cm and 3.1 cm in diameter.[226] Taken together, the knife with bronze rivets and the handles with ring-shaped pommels suggest that iron knives reached Hama from the Mediterranean coast, and most likely from Cyprus.

A fragmentary iron knife, dating to the 11th century BC, was uncovered at Kinet Höyük in Cilicia (Phase 12c). At that time, after the destruction of the Hittite town, there was only a small rural settlement at the site.[227] Three further knives were recently discovered in the Canaanite/Phoenician temple of Sidon,

[216] For two iron arrowheads from Leonard Woolley's excavations at Tell Atchana (Alalakh), possibly from Late Bronze Age contexts, see above.
[217] Schulz 2014: 230-234; a sword-grave from Hama (Grave IV/315) is an important exception, and will be discussed below. — The cemeteries of Tell Shiukh Fawqani (near Carchemish) and Tell al-Nasriyah (near Hama) have been discussed briefly in preliminary reports. Some of the graves containing iron artefacts (mainly arrowheads) have been dated by radiocarbon. An assessment of the iron artefacts from these two sites must await systematic publication. See Faivre 2013; Tenu 2009; 2013; 2015.
[218] Nieling 2009: 178 ff.; 321.
[219] Riis and Buhl 1990: 324; 110 no. 282; 111 fig. 52, 282.
[220] Riis and Buhl 1990: 18; Mazzoni 2000a: 34 f. with note 15; 2000b: 123 f.; see also Lehmann 2013: 312 table 3.
[221] For Hama, Grave IV/315, see Riis 1948: 217 f.
[222] Nieling 2009: 180 f.; Riis 1948: 141; 193.
[223] Nieling 2009: 178 ff.; 321 ff.
[224] Buhl 1983: 42 no. 187; 116 ("Period H").
[225] Grave VIII/483: Riis 1948: 237 no. 483; Waldbaum 1982: 331 fig. 2: 1. — Iron knives with bronze rivets are called 'bimetallic' by Jane Waldbaum (1982).
[226] Hama, Graves IV/76 and VIII/635; see Riis 1948: 178 fig. 226. — For Beth Shean, Tel Qasile and Tel Miqne, see below and List 2.2.
[227] Gates 2013: 106; Güder et al. 2017: 54 fig. 2; 56 table 1. — Analysis of the knife tang indicated that the iron had areas with both medium and high carburization; the iron showed signs of annealing, but not of quenching.

dating to the second half of the 11th century BC, and another iron knife of the same date has been reported from Tyre.[228] A further iron blade fragment, probably from a knife, comes from Tell Tayinat, the successor of Alalakh as principal centre in the Amuq plain, once again assigned to the 11th century BC. Tell Tayinat, however, is particularly important because excavations in 2006 also uncovered a metal workshop in which both bronze and iron artefacts were manufactured during the 11th century BC. Blacksmithing (hammer-scale), copper smelting and alloying with tin were all carried out, suggesting that iron was being worked by non-specialized smiths.[229]

These knives from Kinet Höyük, Tell Tayinat, Hama, Sidon and Tyre constitute a rather clear horizon of early iron finds in the 11th century BC; comparable iron knives are found further south, in Israel, where the earliest examples already appear in the late 12th century BC. Together with violin-bow fibulae, Aegean-style loom weights, clay figurines and 'Aegeanizing' pottery, the Levantine iron knives are often regarded as evidence for contact or trade with Cyprus and the Aegean.[230] Indeed, in his recent monograph on the Aegean-style pottery from Tell Tayinat, Brian Janeway argues that Cilicia and the Amuq plain were settled by migrating 'westerners' from the Aegean and Cyprus around the LH IIIC Middle/Late transition, in the late 12th century BC. He links this historical event to profound changes in Cyprus in LC IIIB, marking the immigration of Greek-speakers from the Aegean, and to the beginning of the Philistine bichrome phase in the southern Levant.[231] Although the details of Janeway's arguments cannot be discussed further, his conclusions are obviously important for the interpretation of the iron knives: alongside trade, we must consider migration as a possible mechanism for the introduction of iron knives and other aspects of iron metallurgy along the Levantine coast.

The southern Levant

The state of research on iron finds from settlements in Israel is much more advanced than in other parts of the Near East. In two new articles by Yulia Gottlieb, Naama Yahalom-Mack and Adi Eliyahu-Behar, the authors compile and evaluate all known metal artefacts from reliable stratified settlement contexts.[232] Alongside the numerical ratio of iron compared to bronze objects, the use of iron for utilitarian artefacts (weapons, agricultural tools, implements such as knives) was analysed in detail. According to Yahalom-Mack and Eliyahu-Behar utilitarian artefacts are completely absent in settlements in Iron IA.[233] Iron continues to be surprisingly uncommon until the second half of the 10th century BC (early Iron IIA). During the entire span of Iron IB, only 13% of all metal artefacts were made of iron; the number of iron tools and weapons only surpassed bronze in the 9th century BC (late Iron IIA).[234] So according to the data assembled from settlement excavations, large-scale use of iron only started in the second half of the 10th century BC.

While iron tools and weapons are not reliably documented before Iron IB in the southern Levant (beginning ca. 1140/30 BC), iron ring ornaments were already worn in LB II and Iron IA. Yahalom-Mack and Eliyahu-Behar write the following: "a routine production of prestige iron objects of specific and singular types preceded the production of iron for utilitarian purposes".[235] So initially, in LB II and Iron

[228] Jambon and Doumet-Serhal 2018; the knives contained low levels of nickel, indicating that they were made of smelted rather than meteoritic iron. — For the iron knife from Tyre, Level XIII-2 (second half of the 11th century BC), see Sherratt 1994a: 90. — Note also the iron knife with bronze rivets from Sarepta (see List 2.2); owing to the present state of publication, the context of the knife cannot be dated precisely, although Susan Sherratt suggests a date in the 12th century BC (Sherratt 2003: 50 note 27).
[229] Roames 2011; Welton et al. 2019: 313; 319 ff.; 323 fig. 28; see also Harrison 2013: 74; 2014: 400. — Note that an iron arrowhead was also found at Tell Tayinat, from a slightly later context (late 11th/early 10th century BC). — For critical comments on other supposed early workshops with evidence for iron production in the Near East, see Veldhuijzen and Rehren 2007: 189 ff.
[230] See for example Lehmann 2013: 318 fig. 13; 326 fig. 15.
[231] Janeway 2017: 115-123.
[232] Gottlieb 2010; Yahalom-Mack and Eliyahu-Behar 2015.
[233] Yahalom-Mack and Eliyahu-Behar 2015: 288. — Yahalom-Mack and Eliyahu-Behar refer to the period of domination of southern Canaan by 20th Dynasty Egypt as 'LB III'. In this article, following Amihai Mazar, I refer to this period as 'Iron IA'. For an introduction to the chronology of Iron I and IIA in Israel, see for example Herzog and Singer-Avitz 2004; 2006.
[234] Yahalom-Mack and Eliyahu-Behar 2015: 287 fig. 1; Yahalom-Mack et al. 2017: 66 fig. 11. — According to the figures published by Gottlieb (2010: 105 ff.), the proportion of iron objects during Iron I was even smaller. — See also Pare 2017: 21 table 1.
[235] Yahalom-Mack and Eliyahu-Behar 2015: 289.

IA, production appears to have been restricted to iron ring jewellery (bracelets, anklets, finger rings), while iron knives were only introduced later, in Iron IB. In fact, rings and knives are crucial in the introduction of iron in the southern Levant, with other types of artefacts only playing a relatively minor role.

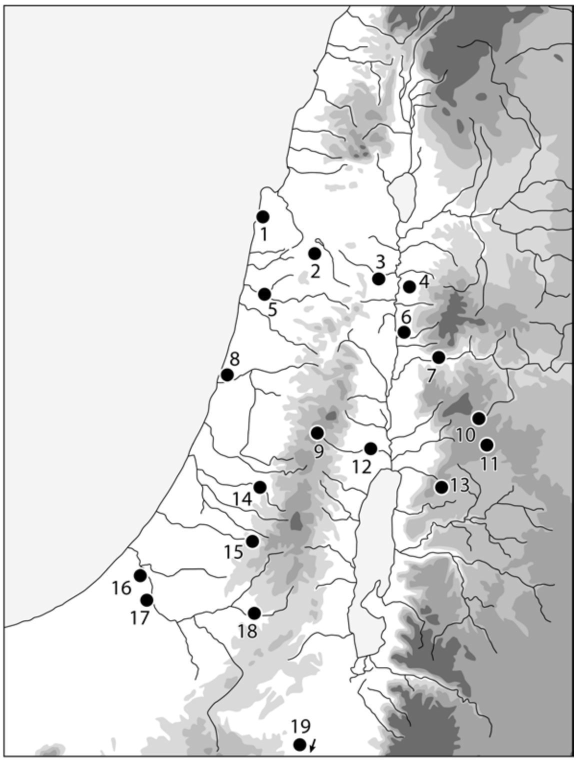

Figure 4. Distribution map of iron ring jewellery in Israel and Jordan in Late Bronze II and Iron I. — For the numbers, see List 2.1.

Considering our discussion of other areas of the Near East, the prominent role of ring jewellery in early iron production hardly comes as a surprise (for examples, see Figure 3). In Canaan, the iron bracelets, anklets and finger rings of LB II and Iron I are widely distributed in the area between Transjordan and the coastal plain (see Figure 4 and List 2.1). Single iron finger rings and bracelets already occurred occasionally in graves of the 13th century BC, at Tel Nami, Megiddo (Tomb 912B) and the Baq'ah Valley (Cave B3). But they became much more common in the 12th and 11th centuries BC, particularly in Transjordan, for example in burials from Jabal al-Nuzha, Madaba, Pella, Sahab and the Baq'ah Valley, but similar ornaments also come from burial caves west of the Jordan, for example at Khirbet Nisya and Tell 'Eitun. The largest numbers of iron rings came to light in the multiple burial caves from Pella (more than 20 iron bracelets/anklets in Tomb 89), Baq'ah, Cave A4 (eight complete bracelets/anklets, three finger rings and 40 further fragments of iron rings) and Khirbet Nisya, Tomb 65 (nine or 10 iron bracelets/anklets).

The extensive cemetery of Tell es-Sa'idiyeh provides more detail on the early stages in the introduction of iron. During Period 1, when the Tell still functioned as an Egyptian administrative centre, only two of the 74 burials contained iron artefacts: an iron bracelet/anklet from Tomb 209 and a bimetallic bronze/iron finger ring from Tomb 355. After the Egyptian withdrawal around 1140/30 BC, in Period 2 of the cemetery (11th-10th century BC) iron occurs in 17% of the 135 graves, in the form of iron ornaments (mainly bracelets and finger rings), iron knives, and one iron dirk.[236] A considerable quantity of iron rings is also known from Megiddo: a small iron ring was discovered by the Oriental Institute excavations in an Iron IA context (Stratum VIIA); Tomb 39 contained a bimetallic iron/gold finger ring, and iron bracelets were found in several other Iron I tombs; and a further eight examples were contained in two late Iron I hoards. Further to the south, iron bracelets were discovered at Khirbet Qeiyafa (Iron IB/IIA transition) and Tel Qasile (Level X/late Iron IB), in the latter case in a ritual setting.[237]

The excavations at Timna, in the southern Negev, are particularly interesting, because early iron occurs there exclusively in the form of ring ornaments: two bracelets from Site 2 and more than 10 finger rings from the Hathor Temple (Site 200).[238] Unfortunately, these objects do not come from reliable stratified contexts; the use of the sites at Timna can be broadly dated by radiocarbon to the 15th-11th century BC (Site 2) and the 13th-10th century BC (Site 200), greater chronological precision is impossible.[239]

[236] For the cemetery of Tell es-Sa'idiyeh, see Green 2006; 2007; 2009; 2013. — The date of the iron knife from grave 113 is uncertain (Period 1 or 2, see Green 2006: 391 note 13; 398). — The iron dirk (Figure 6) will be discussed below.
[237] For references to these iron rings from Megiddo, Khirbet Qeiyafa and Tel Qasile, see List 2.1.
[238] One of the finger rings has traces of gilding. See Gale et al. 1990: 182-191; 184 fig. 162; 186 fig. 163.
[239] Personal communication from Uzu Avner (Eilat). See Avner 2014; for archaeomagnetic dating of slag heaps from Timna to the Early Iron Age, see now Peters et al. 2018. — The idea that iron could be produced 'adventitiously' in the course of copper smelting, originally proposed for the Timna rings, has been refuted. Instead, the copper in the iron rings was shown to be the

In contrast to the wide distribution of ring jewellery, most of the iron knives known from Iron IB contexts come from sites on or near the coastal plain; this repeats the pattern further north, where most of the iron knives from the 11th century BC are located near the coast (Kinet Höyük, Tell Tayinat, Sidon, Tyre; see Figure 7). The earliest knives with reliable contexts are found in Philistia and date to the late 12th century BC (Tel Miqne, Level VI; Tel Qasile, Level XII). This coastal orientation fits well with the hypothesis that the earliest iron knives, particularly those with bronze rivets, represent Cypriot influence, as a number of authors have argued.[240] Alongside the iron knives, other artefacts, such as incised bovine scapulae and characteristic pottery, link the coast of the southern Levant with Cyprus at this time. The influence from Cyprus began in earnest in the Philistine Bichrome phase, and may even have involved movements of Cypriots to the Levantine coast around the LC IIIA/B transition. Other authors, notably Susan Sherratt, prefer mercantile/socio-economic interpretative models to explain the widespread distribution of these early iron knives; Sherratt believes that the knives were exported by Cypriot entrepreneurs to the Levantine market.[241] The coastal orientation of the early knives is particularly clear in the case of the knives with ivory or bone handles with ring-shaped pommels and bronze rivets (see Figure 5 and List 2.2).[242] As iron knives were already manufactured in considerable quantity in Cyprus during LC IIIA, there can be little doubt that this artefact type was introduced to the Levantine coast from the island.[243] Whereas the earlier knives were either imports, or imitated Cypriot products, later iron knives were probably manufactured locally in Canaan, as Lead Isotope analyses of bronze rivets on knives from Megiddo and Khirbet Qeiyafa suggest.[244]

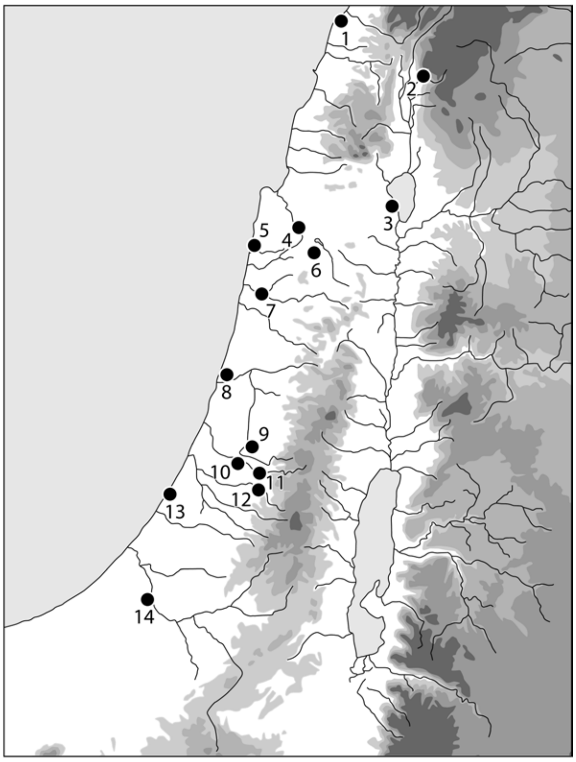

Figure 5. Distribution map of iron knives in Iron I with ivory handles, ring-shaped pommels and/or bronze rivets in the southern Levant. — For the numbers, see List 2.2.

Apart from the ring jewellery and knives, which together make up the lion's share of early iron products, the new metal is otherwise only found rarely during Iron I in the southern Levant. Weapons were still made of bronze, and only a very few iron daggers/dirks and arrowheads can be dated before Iron IIA. Iron daggers, measuring ca. 30-34 cm in length, have been found at Megiddo, Tel Dor and Tell el-Far'ah (S).[245] The Megiddo example has an ivory hilt, while the example from Tell el-Far'ah (S) is bimetallic, with

result of contamination from neighbouring copper alloy objects. For the original theory, see Gale et al. 1990; for the refutation, see Merkel and Barrett 2000.

240 See for example Sherratt 1994a; Dothan 2002.

241 Gilboa 2007: 213; Yasur-Landau 2010: 300 f.; Sherratt 1994a.

242 In addition to the knives on the coastal plain, there are some outliers in Galilee.

243 The design of the knife with riveted flanged hilt and ring-shaped pommel probably derived originally from Italy or Central Europe. — Bronze examples with ring-shaped pommels of the 12th century BC are known from Ialysos (Rhodes) and Enkomi (Cyprus), and from Roca Vecchia (Prov. Lecce) from a context dating to the transition from *Bronzo Recente* to *Bronzo Finale*. — See: Benzi 2009; Courtois 1984: 26 fig. 8: 13; Pagliara et al. 2008: 247; 258; 267; 264 fig. 15: B.V.2.

244 Yahalom-Mack and Eliyahu-Behar 2015: 300; Rabinovich et al. 2019: 103 f.

245 Megiddo, Hoard from Area Q (late Iron I, late 11th/early 10th century BC): Hall 2016; 2021. — Tel Dor, Area G: Ben Basat 2018: 255; 265 fig. 26.4: 9. — Tell el-Far'ah (S), Tomb 542: Petrie 1930: 7 f.; pl. 21: 90; 25: 542; Dothan 1982: pl. 2: 1.2; Shalev 2004: 53 no. 164; pl. 18: 164; Laemmel 2012: 178 f. — The iron 'dagger' from Megiddo, Tomb 1101B/Upper, dating to Iron I, should probably be interpreted as a two-edged knife rather than as a weapon; the implement is 30 cm long, but the blade is only 2.5 cm wide. See Guy 1938: 164 f. fig. 171: 14; pl. 87: 5; Harrison 2004: 88; fig. 127: a; pl. 35: 8. — Iron daggers are reported from Tel Zeror, Graves V and VIII; however, as they have not been published in detail, and the nomenclature of daggers and knives in the Zeror publications is unclear, these examples must be regarded as uncertain: Ohata 1967: 40 f.; 1970: 73; Waldbaum 1982: 342 (the 'daggers' from Graves VI and VII are actually knives). — A further possible 'dagger' or two-edge knife was uncovered in Beth Shean, Level VI:

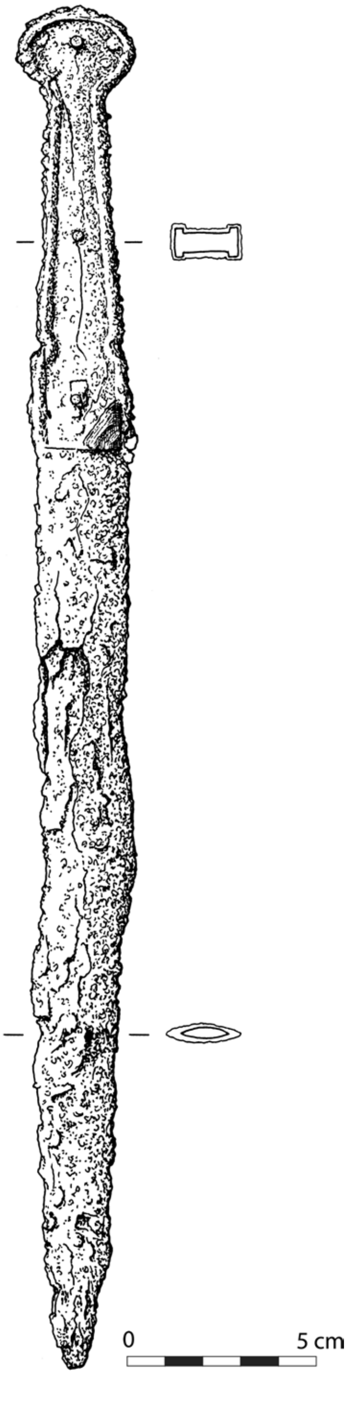

Figure 6. Iron dirk from Tell es-Sa'idiyeh, Tomb 274/282. — Illustration kindly provided by Jack Green (Miami) and Jonathan Tubb (London). — Scale 1:2.

a cast-on bronze hilt; in both cases the special treatment of the hilt suggests that the daggers were highly valued. By contrast, the handle of the example from Tel Dor is of bone. The dagger from Tell el-Far'ah was found, along with three iron bracelets and an iron finger ring, in a tomb used between the second half of the 12th and the first half of the 11th century BC; a similar date is likely for the example from Tel Dor.[246] An iron dirk was discovered in a rich family cist grave from Tell es-Sa'idiyeh (Figure 6).[247] Along with the swords mentioned above from Hama, Tomb IV/315 (Syria), and from Grê Dimsê (south-east Turkey), the Tell es-Sa'idiyeh dirk belongs among the earliest iron swords and dirks in the Near East, dating to the 11th or 10th century BC. Concerning the start of the use of iron for weaponry, it is perhaps significant that the Tell es-Sa'idiyeh example has typological parallels among bronze swords and dirks not only in Syria, but also in eastern Iraq and western Iran.[248] As mentioned above, iron arrowheads are occasionally documented in Iron I contexts in Syria, for example from Hama and Tell Shiukh Fawqani. In her detailed discussion of the subject, Yulia Gottlieb could only identify two iron arrowheads from probable Iron I contexts in the southern Levant, from Ashdod, Level XI and Kinneret, Level VI.[249]

In recent publications, Israeli authors have been much more critical about evidence from earlier settlement excavations, and many supposedly early iron objects are now treated sceptically.[250] Today it appears that large tools were not produced regularly in iron before Iron II. The most important exceptions are the strange sickle- or scythe-like implements from modern excavations at Tell Yoqne'am and Khirbet Qeiyafa.[251] Unfortunately, the function of the 'scythe' blades is uncertain; in the case of the examples from Khirbet Qeiyafa, they have been interpreted either as weapons or as agricultural tools.[252] Because of their long and slender blades, it is doubtful whether the 'scythes' could ever have been used for harvesting, and a use as 'swords' is equally unconvincing.

James 1966: 322; fig. 104 (not illustrated).

[246] Although the dagger from Tel Dor came from a layer dating to LB II (Layer 11), the layer also contained finds belonging to Dor Iron 1a (ca. 1125-1075 BC, corresponding to Megiddo VIB). As a date in LB II seems very unlikely, it is assumed that the dagger belongs with the later finds from Layer 11. See also the comments on the dagger/knife from Tel Dor in Chapter 12.1.

[247] Tomb 274/282 (Period 2); the dirk is about 36 cm long. — The author is very grateful to Jack Green (Miami) and Jonathan Tubb (British Museum) for permission to illustrate an unpublished drawing of the dirk.

[248] Compare Hama, Tomb IV/301: Ingholt 1940: 82; pl. 25: 6; Riis 1948: 120 fig. 135: A; Schulz 2014: 92; pl. 22: Sw 28 ("Luristanschwert"). — Deve Hüyük, near Carchemish: Moorey 1980: 53 ff.; fig. 9: 148. — Tepe Kalwali: Overlaet 2003: 161 fig. 127; 165 fig. (Overlaet discusses similar weapons from Iran and Iraq).

[249] Gottlieb 2016: 1193. — However, note that the arrowhead is the only iron artefact from Kinneret, Stratum VI; otherwise, iron artefacts first appear in Kinneret, Stratum IV, around the mid-10th century BC. See Muhly et al. 1990; Eliyahu-Behar and Yahalom-Mack 2018: 460 (corrected stratigraphical position of an iron knife). This makes the stratigraphical context of the arrowhead rather doubtful.

[250] See for example Yulia Gottlieb's comments on Megiddo, Tel Qiri and Ashdod: Gottlieb 2010: 91 note 4; 101 note 18; 98. — The iron objects which supposedly come from Iron I contexts discovered by the University of Pennsylvania excavations at Beth Shean, and from the 1949-56 excavations at Tel Qasile (Area A) should also be treated with caution.

[251] Ben-Tor et al. 2005: 77 fig. 1.28: 19 (Yoqne'am, Level XVII, Late Iron I). — Garfinkel et al. 2014: 307 fig. 8.115; 2016: 82 fig. 48 (Khirbet Qeiyafa, referred to as 'swords'). — Note that the 'sickle' from Yoqne'am is much smaller than the 'scythes' from Khirbet Qeiyafa, the longest of which survives with a length of 56.3 cm.

[252] Rabinovich et al. 2019: 94.

The excavations at Khirbet Qeiyafa are particularly interesting because the settlement was short-lived. It is dated around the Iron IB/IIA transition, and offers an insight into the use of iron around 975/950 BC. Apart from the three 'scythes', the excavated iron finds comprise only two categories of objects: 12 knives and six bracelets, along with some smaller fragments of uncertain function. By contrast, the spectrum of bronze artefacts is much more varied, including a spearhead, a trunnion axe, two or three chisels, two dagger/spearhead tips, two earrings, five small open rings (earrings or finger rings), a bracelet, a fibula, three needles, a hemispherical bowl, and fragments of sheet bronze.[253] It seems that iron was used at Khirbet Qeiyafa only for the manufacture of a very restricted selection of artefacts; once again, knives and ring jewellery are predominant. Indeed, this seems to be a characteristic feature of Iron I in the southern Levant, as a comparison with Megiddo suggests. At Megiddo, there are very few iron finds from settlement contexts in Stratum VIB (early Iron IB). In Stratum VIA (later Iron IB) iron is more prevalent, with at least 13 knives, 10 items of ring jewellery, a needle, some smaller fragments of uncertain function, and the dagger mentioned above.[254] Clearly, during Iron I, most tools and weapons were still made of bronze. In Iron IIA a radical change took place, and iron replaced bronze as the metal of choice for utilitarian purposes.

In an interesting discussion, Naama Yahalom-Mack and Adi Eliyahu-Behar have argued for a structural change in the organisation of iron production in the southern Levant in Iron IIA.[255] Their argument is based on three developments at the transition from Iron I to Iron IIA: i) the massive increase in the number and variety of iron artefacts, particularly tools and weapons; ii) the contemporary increase in evidence for iron production (both blacksmithing and smelting) in urban contexts; and iii) the location of ironworking activities in public spaces in association with administrative and religious buildings. According to Yahalom-Mack and Eliyahu-Behar, whereas in Iron I iron was probably manufactured in the workshops of bronze craftsmen in a de-centralised, 'household' mode of production, during Iron IIA production of iron was carried out under the control of urban administrations by specialised 'industrial' workshops.

Yahalom-Mack and Eliyahu-Behar also carried out a project of metallographic analyses, which showed that the early iron implements were, technologically, no improvement compared with bronze examples.[256] They found no evidence indicating advances in smelting or blacksmithing technology between the 11th and the 8th century BC (Iron I-IIB). During the whole of this period, the iron artefacts were made from material with a heterogeneous distribution of carbon, as a non-deliberate result of the smelting process. Apparently, the iron artefacts were not intentionally carburized in the blacksmith's forge (secondary carburization). Furthermore, the authors conclude that the smiths did not harden their products using thermal treatment (quenching and tempering). "As far as we can conclude from the analyses of the objects, no major breakthrough in forging techniques was achieved in the course of the Iron Age, which could have accounted for the full adoption of iron technology".[257] The transition to the full Iron Age took place, according to this model, without the new metal necessarily being better than the traditional bronze for the manufacture of utilitarian implements. These conclusions concerning the level of bloomery and smithing technology are in broad agreement with the observations on iron artefacts of the 11th-8th century BC from Kinet Höyuk in Cilicia, published by Ümit Güder, Marie-Henriette Gates and Ünsal Yalçın.[258] Their metallographic analyses again indicated that the iron was characterised by "heterogeneous structures of

[253] Rabinovich et al. 2019.
[254] Iron finds from settlement (not burial!) contexts: Locus 1795: 2 rings (Harrison 2004: 77; 164). — Locus K7, 1729, 1769, 1740, 1746: 5 knives (Harrison 2004: 88; 158). — Locus 1732: 1 needle (Harrison 2004: 91; 162). — Locus 1798: 1 staple (Harrison 2004: 85; 169). — Hoard 6206: 6 bracelets (Zarzecki-Peleg 2016: 305 ff.; 310 fig. 98; Hall 2021: 31). — Hoard 12/Q/76: 1 dagger with ivory hilt, 8 knives, 2 bracelets (Hall 2016; Hall 2021: 28 ff.). — 'Hoard' from burnt layer ("Brandschicht"): 4 knives (Schumacher 1908: 87; Watzinger 1929: 31 fig. 22; Hall 2021: 37).
[255] Yahalom-Mack and Eliyahu-Behar 2015: 299 ff. — See also: Yahalom-Mack et al. 2017; Eliyahu-Behar and Yahalom-Mack 2018; Rabinovich et al. 2019; Workman et al. 2020.
[256] Yahalom-Mack and Eliyahu-Behar 2015: 295-300; Eliyahu-Behar and Yahalom-Mack 2018. — In all, 59 iron artefacts dating from Iron I to Iron IIB were analysed, from Megiddo, Hazor, Tel Rehov, Khirbet Qeiyafa, and Tell es-Safi/Gath.
[257] Yahalom-Mack and Eliyahu-Behar 2015: 300.
[258] Güder et al. 2017. — See also the similar conclusions on the technological level of early ironwork by Matasha McConchie (2004: 33).

incidentally carburized zones ... [the smiths] did not have enough knowledge to apply thermal treatment processes like quenching and tempering".[259] In fact, the thermal processes used during the manufacture of the iron artefacts – annealing and normalizing – are no different from the techniques traditionally used in the manufacture of bronzes.[260] In Turkey, evidence for deliberate carburization has been demonstrated earliest at Phrygian and Urartian sites, dating to the 9th or 8th century BC.[261]

This new research has important implications. The new results render untenable the view that the massive increase in the use of iron for utilitarian purposes can be explained by the 'discovery' of steel.[262] The intentional carburization of iron in the blacksmith's forge, and the regular production of harder and sharper steel artefacts by using new thermal treatments (quenching and tempering), appear to be relatively late developments, which occurred with a significant delay after the widespread introduction of iron for tools and weapons.[263]

In view of these results, Naama Yahalom-Mack and Adi Eliyahu-Behar have offered an alternative explanation for the structural changes in the organisation of iron production observed at the transition from Iron IB to IIA in the southern Levant. In place of the 'technological advance' model, they argue that the increased iron production was driven by political and economic circumstances and demands; it was "an official initiative that came with statehood". To explain this administrative policy, the authors point to the potential advantage of iron compared with bronze: the ability to maintain local control of all the stages of the *chaîne opératoire*. The authors relate the situation in the southern Levant to analogous developments in other regions of the Near East, seeing a "connection between the full adoption of iron, the rise of states and great empires such as Assyria, and the consolidation of their armies during the early 1st millennium".[264] As bronze continued in use alongside iron, the adoption of the new metal led to a significant increase in the quantity of metal objects, resulting in a considerable advantage not only for the economy (particularly agriculture), but also for military purposes. Therefore, the crucial advantages of iron for the emerging Iron Age territorial kingdoms were not the metal's superiority (hardness, sharpness), but instead the possibility of complete local control of the means of production, and the increased metal supply.[265]

2.4 Discussion and conclusions

In this chapter we have seen how iron underwent a profound transformation: initially being a precious, and later becoming a base metal. This development is apparently related to the use of meteoritic iron for the earliest artefacts, and the subsequent innovation of extractive metallurgy. The process of the discovery or 'invention' of the technologies of smelting and smithing will probably always remain obscure. In this regard, the cuneiform texts are rather unhelpful, as they normally do not seem to use different terms for meteoritic and smelted iron. For this reason, the most important indication of the introduction of wrought, smelted iron is the sheer quantity of metal which was produced towards the end of the Bronze Age.

As explained above, there is a convincing reconstruction of the origin and transmission of the common Semitic terms for iron, which reaches back to the early 2nd millennium BC (Table 3). Akkadian *parzillum* supposedly represents a Luwian loanword, which could have been adopted by Assyrians at the beginning

[259] Güder et al. 2017: 53.
[260] Güder et al. 2017: 61.
[261] Güder et al. 2017: 52 f.
[262] For the supposed early evidence for intentional carburization and quenching, and the importance of the discovery of steel for the start of the Iron Age, see Chapter 3.4, and Snodgrass 1980: 345; Stech-Wheeler et al. 1981; Åström et al. 1986; Muhly et al. 1990; Pickles and Peltenburg 1998: 84 ff.; Muhly 2006.
[263] For a good discussion of the question of intentionality in carburization and heat treatment, see Erb-Satullo 2019: 577 ff.
[264] The quotations are taken from Yahalom-Mack and Eliyahu-Behar 2015: 301. — See also the discussion in Bunimovitz and Lederman 2012.
[265] In Iron II, bronze products had a mean tin content of 5-6%; apparently there were no major problems in maintaining the tin supply.

of the 2nd millennium BC in their Anatolian trading colonies (Old Assyrian *pár-zi-lim/pár-zi-lam*). The term then spread to other parts of Mesopotamia, including Mari (*pa-ar-zi-lim/pár-zi-lim*), and later entered a number of north-west Semitic languages, such as Aramaic (*przl*), Ugaritic (*brḏl*), Phoenician (*brzl*), and Biblical Hebrew (*barzäl*).[266] Furthermore, it is clear from bilingual lexical tablets that Akkadian *parzillum* can be equated with the logogram AN.BAR. Both therefore seem to refer to the same metal: iron.

The objects of *parzillum*/AN.BAR mentioned in the earlier texts, for example from Kültepe, Mari, Sippar, Susa and Qatna, are rare and precious items of jewellery and other small ornaments and 'charms'. This treatment of iron as a precious metal, often combined with gold, is also encountered in the earliest known iron artefacts, such as the daggers and ornaments from Alaca Höyük, the dagger blade from Ur, the pins from Kültepe, the finger ring from Sidon, and the axe from Ugarit. As there is no archaeological evidence for smelted iron before the second half of the 14th century BC, and scientific analysis has demonstrated that some at least of these artefacts were certainly, or very probably, made of meteoritic iron, it is more than likely that the rare objects of *parzillum*/AN.BAR mentioned in the earlier texts were of meteoritic origin. The same might be true for the small quantities of the metal *amūtum* recorded at Kültepe.

Egyptian and Hittite sources demonstrate that the concept of the celestial origin of iron was definitely understood ('iron from the sky', 'sky of iron'). As it was considered to have a heavenly origin, it is understandable that (meteoritic) iron was imbued with cosmological symbolism. Indeed, in both cultures iron had a similar symbolic or metaphorical meaning, associated with strength, permanence and legitimacy. Similar beliefs may well have been current in other parts of the Near East.

While it seems sufficiently clear that the earliest iron in the Near East was of meteoritic origin, the sheer quantity of iron listed in the 'Inventory of Gifts from Tušratta' (two bracelets, two finger rings, three daggers, one mace-head and 10 spears or arrows) makes it unlikely that all these objects could have been of meteoritic origin, although it is conceivable that huge iron meteorites might occasionally have been discovered. The fact that the Inventory uses two terms for the metal (AN.BAR, *habalkinnu*) supports the possibility that two kinds of iron were used: terrestrial (smelted) and meteoritic. This suggests that the technology of extractive iron metallurgy was already being practised at the time of the wedding of Tadu-Hepa (mid-14th century BC), possibly in the kingdom of Mitanni. The Hittite texts indicate that this scenario is by no means unlikely.

While the texts clearly show that the Hittites treated iron as a rare and precious metal, the quantities of iron mentioned in the Old and Middle Hittite texts, and the existence of craftsmen who worked iron ('iron men', 'iron-makers') makes it more than likely that the technology of smelting iron ores in the bloomery furnace had already been introduced at an early date, perhaps around the mid-2nd millennium BC, as Jana Siegelová concluded many years ago. While the earliest iron known to the Hittites was probably meteoritic, at some stage – perhaps in the 15th or 14th century BC – iron extractive metallurgy was introduced. Note that the idea that the Hittites were at the forefront in the development of iron production is founded exclusively on the written sources.

The earliest reliable archaeological evidence for the smelting of iron ores dates to the mid- or second half of the 14th century BC, in the form of a finger ring and a chisel from a workshop in the palace of Kamid el-Loz. The oldest iron finds from the Lower City at Boğazköy/Hattuša could be earlier, possibly dating to the 15th century BC. As iron was also used at Boğazköy to make a chisel, rather than a precious weapon or ornament, it is quite plausible that it was made from smelted iron.

The 13th century BC marks a sharp change in the use of iron. The volume of iron production increased substantially, it lost its previous status and now ranked among the base metals.

266 See, for example: Artzi 1969; Valério and Yakubovich 2010; Noonan 2019: 78 f.; Kogan and Krebernik 2020: 324.

The Hittite records show that iron artefacts were manufactured on a large scale during the reigns of Hattušili III and Tudhaliya IV. The texts, mainly dating from the second half of the 13th century BC, record a wide range of iron objects demanding a high level of craftsmanship, including: spears, daggers/knives, axes, hammers/hoes, anthropomorphic statuettes, zoomorphic figurines, vases/beakers, a (model) boat, and the mysterious tub/spring weighing 90 minas; the texts also mention an iron tablet which recorded a contract between Tudhaliya IV and Ulmi-Tesup of Tarhuntašša. Clearly, such large quantities of iron could only have been obtained by the smelting of iron ores.

The situation was different in Assyria. The famous letter from Hattušili III to Adad-nirari I, written ca. 1265 BC, and the tablet from Tell Sheikh Hamad describing Shulmu's inability to manufacture anything but the simplest iron implements, suggest that in Assyria iron was still difficult to obtain and process during the 13th century BC. It is difficult to avoid the conclusion that the technology of iron production was further advanced in the Hittite kingdom. Against this background, it is not unlikely that the two talents of iron listed in the archive of Yabninu were imported to Ugarit from Hittite Anatolia.

The Hattušili letter and the other evidence discussed above has led to the idea that the Hittites had a monopoly in the production of iron, and jealously protected their technological expertise. However, apart from the iron artefacts which have been excavated at Boğazköy, iron objects appear at a number of sites in different parts of the Near East in the course of the 13th century BC, including a knife and chisel from Ugarit, a 'chisel/awl' from Tell Brak, a pin from Tell Zubeidi, and finger rings, bracelets and anklets from Babylon, Assur, Tell Sabi Abyad, Minet el-Beida, Tel Nami, Megiddo and the Baq'ah Valley. The 'Hittite monopoly' hypothesis would therefore require the following modification: while the monopoly could still have been maintained at the time of the Hattušili letter (ca. 1265 BC), shortly afterwards the monopoly was undermined, leading to the dissemination of iron production to wide areas of the Near East during the second half of the 13th century BC. This 'mid-13th century' hypothesis appears plausible; however, as the chronology of the earliest iron artefacts is often imprecise this remains an attractive, but unprovable scenario.

It is very interesting that iron artefacts have hardly ever been found in reliable contexts at Hittite sites, including the capital at Boğazköy. There are specific features of the archaeological record which go some way to explain this apparent absence of iron finds, particularly the lack of burials of the Empire period, and the problems of distinguishing between Hittite artefacts and intrusive material from later, Iron Age settlement activity. Nevertheless, the extreme rarity of iron finds from Hittite sites is obviously highly significant. The only convincing explanation is that iron was not in general use; iron objects can only have been available to a very restricted segment of society, presumably members of the élite and their entourage, and was mainly confined to the palaces and temples. The cosmological symbolism of meteoritic iron and its association with the Hittite ruler probably still adhered to smelted iron until the downfall of the palaces. This could explain why the advanced smelting and blacksmithing technologies necessary to manufacture the large quantities of elaborate artefacts listed in the palace and temple administrative texts were apparently lost after the collapse of the Hittite kingdom. According to this scenario, the iron-producing workshops were dependent on and controlled by the palatial élite. With the end of the palaces, the workshops were abandoned, the craftsmen dispersed, and their technical expertise was forgotten.

As suggested above, the 'Inventory of Gifts from Tušratta' apparently shows that smelted iron was available in the kingdom of Mitanni, if only as a precious metal for royal insignia and gifts. If iron smelting and smithing was practised in Mitanni, then the technology must have been confined to the palaces, as in the case of Hittite Anatolia. Alternatively, smelted iron artefacts or iron billets could have been obtained from the Hittites.

The case of the supposed iron artefacts listed in the Mari texts is much more difficult to understand. As explained above, artefacts made of BAR.ZIL are mentioned in almost 50 tablets dating to the 18th century BC. As the identification of BAR.ZIL with *parzillum* ('iron') is accepted by most philologists, the possibility that large amounts of iron were circulating at Mari must be considered – even though it seems anachronistic.

The artefacts made of BAR.ZIL, including ring jewellery, knives, a dagger, spearheads, and vases, must surely have been made of metal; it is difficult to imagine a precious stone which could have been used to make them; as explained above, haematite and magnetite, for example, would be wholly unsuited. The sheer quantity and size of the objects made of BAR.ZIL makes it almost inconceivable that they were made of meteoritic iron. But the conclusion that BAR.ZIL corresponds to bloomery iron appears counter-intuitive: If the technology of bloomery smelting had been developed, why did iron remain such a precious metal? As the iron was not produced at Mari, but obtained by exchange mainly from partners in northern Syria, why is there no evidence in northern Syria for an established iron 'industry' at this early date? Why was smelted iron only recorded in large quantities in Mari, and not in other parts of the Near East? Why did the large-scale production of smelted iron apparently cease after the period of the Mari archives?

It could be argued that the Mari evidence, if it is accepted, necessitated a kind of organisation of iron production similar to that in the Hittite kingdom. I have suggested that the technologies of smelting and blacksmithing were restricted to workshops dependent on the Hittite palatial élite, and iron seems to have been used for very specific purposes. Furthermore, for a long time the technology of iron production did not 'escape' the palaces. And when the élite disappeared, the craftsmen dispersed and the technology was forgotten. A similar scenario might be suggested for the 18th century BC, although admittedly it is quite unclear where (in northern Syria? Anatolia?) the iron described in the Mari archives would have been smelted. The Hittite model goes some way to explain why iron production might have remained so tightly constrained in the 18th century BC, and why the technology subsequently seems to disappear without trace.

Although on the face of it the identification of BAR.ZIL with *parzillum*, the Semitic word for iron, is convincing, it is possible that the logogram was used to designate some other metal or mineral, although I am unable to suggest a plausible alternative. Unfortunately, the interpretation of the objects made of BAR.ZIL at Mari remains an open question.

The Hittite texts indicate that the iron-producing workshops were tightly controlled by the palatial authorities, which inhibited the free dissemination of the technology of iron production. Iron had a special symbolic value and was used exclusively for the production of high-status objects for the palatial élite; iron was treated as a precious metal. Scholars such as James Burgin and Theo van den Hout have explained these 'inhibitive', constraining practices by applying the concept of the 'wealth-finance' economy, in which the Hittite state controlled the circulation of precious materials. In the words of James Burgin: "The ideal luxury good for the ruler of a wealth-financed state would be a highly desirable object which only he could obtain and give, and once given could never be re-gifted."[267] Clearly, this model would provide a perfect context for the tight constraints imposed in Hittite iron production.

Iron is found much more frequently in archaeological sites from the 13th and the first half of the 12th century onwards, mainly in the form of ring jewellery. Iron rings are known in a vast area reaching from Babylon, to Assyria, the Syrian coast (Tell Sukas), and the southern Levant, as far as Timna in the Negev, where iron has been found exclusively in the form of finger rings and bracelets (see Figure 7).[268] Rings likewise represent the earliest iron finds at sites around Lake Urmia (e.g. Hasanlu), in Luristan (e.g. Tepe Guran), and in the settlement and cemetery at Hama in western Syria. This 'ring horizon' is characteristic for the Near East, and it is very likely that the iron rings dating to the 13th/12th century BC from Ialysos

[267] For the quotation, see Burgin 2016: 94 f. — See also van den Hout 2020: 9-11, and particularly the detailed stipulations in the 'Instruction of the Temple Personnel' (CTH 264).

[268] Assyria: Assur, Mari, Tell Sabi Abyad, and Tell Mohammed Diyab; the examples from Tell Halaf are not closely dated. — Southern Levant: Baq'ah Valley, Jabal al-Nuzha, Madaba, Megiddo, Tell es-Sa'idiyeh, and Tell Nami. — Note also the three iron finger rings from Level 1 in the Lower City at Boğazköy.

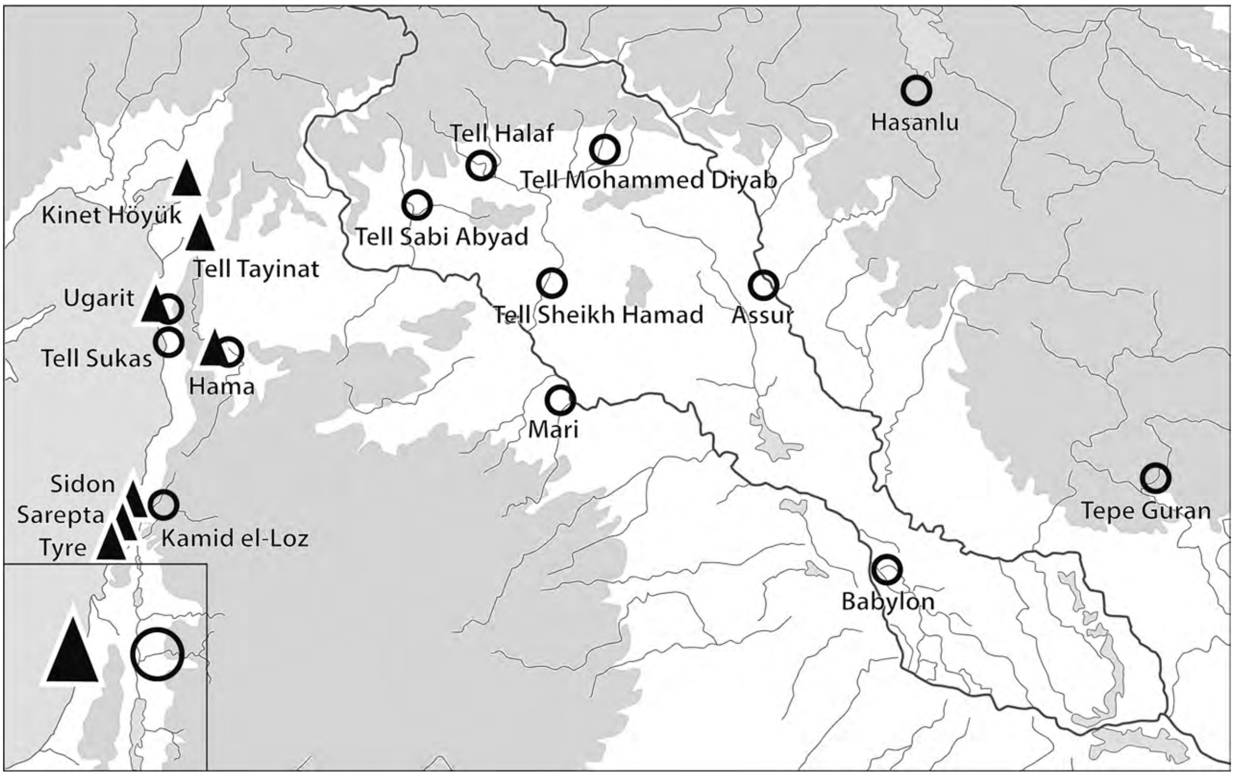

Figure 7. Schematic map of sites of the 'ring horizon' and 'knife horizon' in the Near East. For detailed maps of the southern Levant, see Figures 4 and 5.

(Rhodes) are distant members of the 'ring horizon', which presumably reached their final destination by passing through exchange networks in the East Mediterranean.

It is not immediately clear what exactly these iron rings tell us about the dissemination of iron technology in the 13th and 12th centuries BC. It need hardly be emphasized that the archaeological record does not provide us with a complete picture of iron production and consumption, and different points of view are possible. On the one hand, it could be argued that the large number of iron rings discovered in excavations mainly tells us about burial practices. According to this point of view, iron rings are discovered by archaeologists because they were provided as grave goods, and they tell us little or nothing about the range of other iron objects which may potentially have been manufactured and used in the later 2nd millennium BC. On the other hand, it is possible to argue that the new technology was, indeed, at first used primarily for the production of ring jewellery. In my opinion, there are convincing arguments to support the second point of view. Firstly, iron rings are not only found in burials of the 13th/12th century BC, but also in settlement contexts, and as cult offerings at Timna.[269] Secondly, during the early stages of iron production in the whole area between Mesopotamia and the Levant, there are hardly any other iron artefacts which might provide an indication of a more general use of the new metal. Thirdly, it is very noticeable that the earliest iron artefacts of the 13th and 12th century BC are, technologically speaking, extremely simple. Apparently, most early ironworkers were not capable of manufacturing anything larger or more technologically demanding.

It seems plausible that most of the iron production at this early stage was at a low level – not only in a technological, but also in a sociological sense. For some period of time, most of the early metalworkers were only able to manufacture simple and small types of artefacts.[270] While ring jewellery seems to have

[269] For iron rings from settlements, see for example Tell Sabi Abyad, Hasanlu, Hama, Tell Sukas, and Megiddo.
[270] The bimetallic gold/iron finger ring from Megiddo, Tomb 39, was probably made in a specialist workshop producing precious,

been the main focus of production, it is more than likely that the craftsmen also made other small and simple artefacts, such as arrowheads, awls and pins, which have occasionally been found on excavations.[271]

The 'ring horizon' seems to reflect a low-level manufacture of iron objects in non-specialist workshops. This obviously stands in stark contrast to the situation in the final decades of the Hittite kingdom, where iron production was controlled by the palaces, and the workshops made a wide range of artefacts, apparently only available to the élite. It is evident that iron production of the 'ring horizon' and in the Hittite kingdom was organized completely differently. While the Hittite system was tightly controlled and centred on the palaces, the extremely wide occurrence of ring jewellery points to a decentralized and low-level production.

It is difficult to explain why this low-level production of iron spread throughout the Near East at this time. If the scenario of the 'Hittite monopoly' is accepted, then it is conceivable that the 'secrets' of iron smelting and smithing might at some point have 'escaped' the Hittite palaces. In view of the decline of the Hittite centres of the Central Anatolian Plateau during the 13th century BC, and the evidence of external threats to the kingdom since the middle of the same century, and particularly since the reign of Tudhaliya IV, it is easy to imagine that some craftsmen, including metalworkers, re-located to more peaceful regions in Cilicia, the Levant or Mesopotamia (the 'mid-13th century' hypothesis).[272] And in the 'Crisis Years' around 1200 BC mobility in the whole region, including the East Mediterranean, increased enormously. To explain the fast dissemination of iron extractive metallurgy at this time, it might also be necessary to envisage nomadic/semi-nomadic groups in possession of ironworking expertise or trading in iron billets or rings. Perhaps it is significant that sites with early iron artefacts frequently also had double pithos (double jar, *Doppeltopf*) burials.[273] Owing to the large number of these burials, and their wide distribution, it no longer seems possible to link this rite with "refugees from the disintegrating Hittite empire".[274] Nevertheless, the burial rite is evidence for close contacts between far-flung communities throughout the Near East, which suggest a high degree of mobility at this time.

The 'ring horizon' in the Near East represents a distinct trajectory in the "social and spatial process of adopting inventions", reflecting a characteristic conceptualization of iron.[275] In other areas, to the west (Cyprus) and the north (Transcaucasia, Marlik), the new metal was used to manufacture utilitarian implements and weapons, and iron rings had no significant role.

The vast geographical extent of the 'ring horizon' (Figure 7) suggests that the technology of iron production was transmitted relatively quickly in the 13th/12th century BC. Because the chronology of the earliest rings in the 13th century BC is insufficiently precise, it is impossible to identify the origin of this crucial phenomenon of technological transmission. The idea that the technology 'escaped' the palaces and the 'Hittite monopoly', and the suggestion that the rings were made or traded by nomadic or semi-nomadic craftsmen, remain speculative. And it is also uncertain why rings are so predominant among the iron finds at this time. Perhaps iron still retained some of its traditional symbolic meaning (strength, permanence?); this might have lent a special significance to the iron ring jewellery, which was probably mainly worn by women and girls.

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high-status objects, but it might well have been an antique heirloom manufactured centuries earlier (see above). — The similar gold/iron finger ring from Kition, Tomb 9, dating to the early 12th century BC, was probably imported to Cyprus (see Chapter 3.1).

271 Iron arrow- or spearheads are mentioned in the 'Inventory of Gifts from Tušratta', arrowheads in the Tablet of Shulmu the metalsmith, and among the weapons of Tiglath-Pileser I. — Iron arrowheads are mentioned quite frequently from archaeological sites, but at present none are reliably dated before the second half of the 11th/first half of the 10th century BC. See the following sites: Mari, Tell Sheikh Hamad, Tell Shiukh Fawqani, Tell al-Nasriyah, Grê Dimsê, Tell Atchana, Tell Tayinat, Hama, Ashdod, and Kinneret.

272 For the decline of the Hittite Empire, see for example Bryce 2005; Halayqa 2010. — For evidence of drought and climatic adversity in the Central Anatolian Plateau, see Müller-Karpe 2009; Allcock 2017. — For the end of Hattuša, see Seeher 2010.

273 For the double pithos burial rite, see for example: Negbi 1998: 188 ff.; Sauvage 2005: 52 fig. 1; Ben-Shlomo 2008: 48; Sternitzke 2017: 400 f.

274 Yahalom-Mack and Eliyahu-Behar 2015: 299.

275 For the definition of innovation as "the social and spatial process of accepting inventions", see Kristiansen 2005: 152.

During the 12th and 11th centuries BC, iron utilitarian objects remained uncommon in the Near East. The iron one-edged knives distributed along the Levantine coast represent the most important exception (see Figure 7). An iron knife has been reported from Ugarit, possibly dating to the 13th century BC, but otherwise the 'knife horizon' can first be detected in Philistia in the later 12th century (Tel Miqne, Tel Qasile) and became prominent in the 11th century BC. As explained above, these knives reflect Cypriot influence starting around the LC IIIA/B transition, and could have been obtained by trade; alternatively, the first iron knives could have been brought to the Levant by immigrants from Cyprus or the Aegean, where iron knives are already known in the 12th century BC.

Apart from the knives, daggers are among the earliest utilitarian iron objects in the Near East. The daggers from Tel Dor and Tell el-Far'ah (S) date from approximately the same time as the earliest iron knives.[276] Together with the example from Megiddo, they could be viewed as reflecting Cypriot influence, particularly in view of their distribution close to the Levantine coast and the fact that daggers are found at the same time in Cyprus (LC IIIB). However, precise typological parallels are absent in Cyprus; furthermore, iron daggers are among the most common implements mentioned in cuneiform texts, and the examples made of meteoritic iron show that they had a long tradition of use in the Near East.[277] Finally, a few larger offensive weapons signal a changed perception of the potential value of iron as a utilitarian metal around the second half of the 11th and the first half of the 10th century BC.[278]

The range of iron artefacts known from archaeological sites remained remarkably restricted until the end of the 2nd millennium BC. At sites such as Khirbet Qeiyafa, Tell es-Sa'idiyeh, Megiddo and Hama, ring jewellery and knives still make up the great majority of iron artefacts before the mid-10th century BC.[279] There is little information on iron in Mesopotamia at this time, which might be an indication that iron was not being produced on a significant scale. Further to the east, in Luristan, only iron rings and bimetallic pins are found before the 10th century BC.

Although iron use was already widespread in the Near East during the 12th and 11th centuries BC, the new metal was hardly ever used for the manufacture of tools and weapons. This apparently conservative approach to iron seems to be a characteristic feature of the Near East; the innovation process was markedly different in other areas, such as Cyprus, the Aegean or Transcaucasia, where utilitarian artefacts are predominant among the earliest wrought iron objects. The slow development of iron metallurgy in the Near East during the post-palatial period seems even more exceptional in comparison with the extremely rapid spread of utilitarian ironworking eastwards during the 10th/9th century BC – along the Silk Road via the Ferghana Valley to Xinjiang, the Yellow River and the plains of China.[280]

The role of iron changed fundamentally around the 9th century BC: now iron weapons and tools were produced in large quantities throughout the Near East, including the southern Levant, Phrygia, Urartu, Assyria and western Iran.[281] The transition to this new stage, in which iron overtook bronze as the main utilitarian metal, has been studied most successfully by Naama Yahalom-Mack and Adi Eliyahu-Behar.[282] Their research has shown how iron production in the southern Levant increased gradually during the

[276] But see also the comments on the dagger/knife from Tel Dor in Chapter 12.1.
[277] Iron daggers in cuneiform texts, for example: 'Inventory of Gifts of Tušratta' (14th century BC). — Administrative text from Assur. — Dagger sent to Ugarit by Zulannu, king of Carchemish. — Dagger mentioned in the Hattušili letter (13th century BC). — Dagger of Kudur-Nahhunte, king of Elam (12th century BC). — Dagger mentioned in land transaction at Nippur (11th century BC). — Daggers with blades of meteoritic iron from Alaca Höyük, the tomb of Tutankhamun, and probably Royal Tomb 58 at Ur.
[278] See the swords and dirks from Tell es-Sa'idiyeh (Figure 6), Hama, Grave IV/315, and Grê Dimsê; note that the chronology of the burials from Hama and Tell es-Sa'idiyeh is somewhat uncertain. Although the function of the scythes/swords from Khirbet Qeiyafa is unclear, an interpretation as offensive or sacrificial weapons seems plausible.
[279] See above for the iron objects found in Khirbet Qeiyafa (Iron IB/IIA transition), Megiddo (later Iron IB), Tell es-Sa'idiyeh (Period 2), and Hama (Period I/F2).
[280] For the introduction of iron in China (especially in Xinjiang in the 10th/8th century BC, and at Sanmenxia in Henan Province, ca. 800 BC), see Wagner 2008: 83-114; Guo 2009. — For the introduction of iron in Central Asia and China, see Chapter 12.2.
[281] See for example the comments by Roger Moorey (1994: 289) on iron tools and weapons in the Neo-Assyrian Empire; and the large collection of iron artefacts from Phase IVb at Hasanlu.
[282] Yahalom-Mack and Eliyahu-Behar 2015.

second half of the 10th century BC; and from this time onwards, remains of iron smelting and smithing become more common on archaeological sites. Unfortunately, we know much less about the innovation process during the 11th and 10th centuries BC in other regions in the Near East, for example in the Neo-Hittite states or in Assyria. For this reason, it is inappropriate to draw far-reaching conclusions concerning the introduction of iron for making tools and weapons in these regions, or to assume that the process of innovation in the southern Levant was typical for the whole of the Near East.

In this chapter I have argued against the ‘gradualist’ model for the introduction of iron in the Near East. Instead, the production and consumption of iron during the Bronze Age seems to have been strictly controlled by the palaces. At the end of the Bronze Age, in the course of the 13th century, most likely after the mid-century, the technology of iron production spread rapidly throughout Mesopotamia and the Levant. In essence, my account can therefore be characterised by the succession of two models: ‘palatial/monopolist’ and ‘diffusionist’.

The development of iron metallurgy in the Near East is intimately connected to the rhythm of political/historical events. The diffusion of iron usage was made possible by the downfall of the palatial system, and the onset of intensive production of tools and weapons was associated with the resurgence of powerful states after the second half of the 10th century BC.

The downfall of the Bronze Age palatial system was the necessary precondition for the widespread introduction of iron (for further discussion of the Late Bronze Age collapse in the Near East, see Chapter 12.3). The extreme centralisation of the economy and political power is a feature of the Late Bronze Age palaces which has often been emphasized, for example by Mario Liverani and Susan Sherratt.[283] At some point, the central control exercised by the palaces inhibited economic and technological development, and eventually this may have contributed to their downfall. The idea that the fall of the palaces in the ‘Crisis Years’ allowed the emergence of new forms of society with new forms of economic organisation, setting free the productive forces, seems compelling. However, the case of iron refuses to fit this scenario neatly. Recent research in Israel and on the finds from Kinet Höyük suggest that the iron tools and weapons were no better (harder, sharper) than bronze examples. Indeed, when the productive forces were set free, the Near Eastern blacksmiths concentrated their energy on manufacturing ring jewellery rather than utilitarian implements. The story of iron in the 2nd millennium BC in the Near East is therefore not one of irresistible progress or technological determinism. Nevertheless, the development of extractive metallurgy and ironworking were important technological achievements of the Bronze Age palaces which became more widely available during the post-palatial ‘Dark Age’.

Both Liverani and Sherratt believe that the fall of the Late Bronze Age palatial system was followed by a burst of economic and technological innovation.[284] Some of these supposed innovations were introduced from outside the area of the Bronze Age palaces, for example the domestication of the dromedary (from southern Arabia) and the use of the ridden horse in warfare (from the Eurasian steppe), and so they are not readily comparable with the case of the innovation of iron, rooted as it was in the palatial system. By contrast, the development of the alphabet took place within the palaces. The alphabet and iron therefore represent analogous case studies, and they do in fact display interesting similarities. For this reason there follows a short excursus on the innovation process of the alphabet, drawn mainly from publications by Aaron Koller and André Lemaire.[285]

[283] Liverani 1987: 69: “The particular concentration in the Palace of all the elements of organization, transformation, exchange etc. – a concentration which seems to reach its maximum in the Late Bronze Age – has the effect of transforming the physical collapse of the Palace into a general disaster for the entire kingdom.” Sherratt 1998: 300.

[284] See for example Liverani 2007: 43-51 (innovation horizon, including: utilitarian iron, the alphabet, the use of dromedaries as pack animals, the use of ridden camels and horses in warfare, advances in open-sea navigation and sailing techniques, and technical improvements in agriculture). — Sherratt 1998: 300; 2000: 82 f. (innovative entrepreneurial practices, particularly in the coastal centres of Cyprus; see also Chapter 3.4).

[285] Koller 2018; Lemaire 2015; 2016.

Because it was necessary to learn so few letters, the alphabet made literacy potentially much more accessible or 'democratic' than was possible with other writing systems existing in the Bronze Age. As Koller recently concluded: the alphabet "contained latent revolutionary potential that was easily discerned by those who encountered it".[286] Gordon Childe's conception of iron as a 'democratic' metal which could be produced in decentralised socio-economic systems, is clearly related to the case of the alphabet: "Iron was ... obtainable without the large capital accumulation indispensable for the regular use of copper or bronze. It was in fact obtained by people independent of kings or chieftains concentrating the social surplus, and used in production more freely and widely than bronze had ever been. ... A technology based upon metal so easily available could work under relations of production different from those indispensable when copper or bronze was the basis, such extreme concentration was no longer necessary."[287] According to this model, both the development of utilitarian iron and the widespread use of the alphabet must be understood in the context of the collapse of the palace-based economies.[288]

Although the principle of the alphabet is familiar to us, it is perhaps worth mentioning two major innovations introduced with this kind of writing. Firstly, each sign of the alphabet signifies a single phoneme, the great advantage being that only as few as 22, or at most around 30 signs are necessary to express the sounds used in a given language (depending whether just consonants or also vowels are represented). Secondly, new graphemes were developed: instead of iconographic signs, a process called 'linearization' resulted in simple and abstract letter forms. The best example is the first letter of the alphabet in Semitic languages such as Hebrew (*alef*) and Arabic (*alif*), from which the Greek *alpha* derives. The letter was originally derived from the Egyptian hieroglyph representing the ox (ʿalp), in the form of an ox's head; the modern letter A still preserves the same shape (∀), but now with the two horns pointing downwards.

The first alphabetic inscriptions, termed 'proto-Sinaitic' appeared in Egypt and the Sinai Peninsula around the 19th/18th century BC at sites like Serabit el-Khadim and Wadi el-Hol. By the middle of the 2nd millennium, the new technology had already spread to the southern Levant, in the form of 'proto-Canaanite' inscriptions, including an example on a bronze dagger from Lachish. At this time, Egypt was becoming increasingly dominant in the southern Levant, and it is not difficult to imagine that the alphabet was brought to the area by Egyptian scribes. It is more surprising to find letters belonging to a similar script on the sides of four cuneiform tablets dating to ca. 1500 BC from the Sealand kingdom of southern Mesopotamia, with letters such as *alef* and *lamed*, which are known from proto-Canaanite texts, being clearly recognizable. Owing to the use of the alphabet as labels ('dockets') on these cuneiform tablets, in this case it is absolutely clear that knowledge of the alphabet was transmitted among scribes.

The palaces of Egypt and the Near East continued to use the traditional forms of writing, hieroglyphic/hieratic and logosyllabic (Akkadian) cuneiform. The exception was Ugarit where, around the middle of the 13th century BC, the alphabet was adapted so that it could be written on clay tablets using cuneiform graphemes.[289] But even in Ugarit, the alphabet was only for internal use, and external correspondence was still written in the traditional Akkadian cuneiform system.

After the 'crisis years', there is, unsurprisingly, much less evidence for written correspondence on an élite level. In the absence of palaces there was little need for scribes and monumental stone inscriptions became much less common or ceased completely. Instead, short alphabetical inscriptions are now found in the area of modern-day Lebanon and Israel, mainly on pottery sherds and bronze arrowheads. This marks a fundamental change in literacy in the Ancient World: for the first time, writing was more widely used and not just restricted to the palaces and scribes. Many more inscriptions from this time (ca.

[286] Koller 2018: 7.
[287] Childe 1946: 30 f.
[288] For the case of iron, see Sherratt 2000: 82 f. — See also Sherratt and Sherratt 2001: 18: "... the idea of particular types of technology as being characteristic of certain types of societies."
[289] Boyes 2021: 69 f.; 280 f.

12th/11th century BC) on materials such as papyrus, leather and wood doubtless originally existed, but have not survived.

Around the turn of the millennia, use of the alphabet became increasingly common in Phoenicia, where an improved, standardized alphabet was developed; the most important Phoenician inscriptions come from Byblos, particularly the sarcophagus of Ahiram, which dates to the 10th century BC. But 'proto-Hebrew' inscriptions are also found further south, in Philistia, Judah and Israel, and at around the same time – at the end of the 2nd or the beginning of the 1st millennium BC – the first South Arabian or 'proto-Arabic' inscriptions appear in Yemen. From the second half of the 9th century BC onwards, the use of the alphabet spread rapidly, with the inception of the Aramaic inscriptions and the spread of Phoenician to Cilicia and the central and western Mediterranean.

So, after the early invention of the alphabet in the 19th/18th century BC "there was no explosion in its use, nor any wildfire-like uncontrollable expansion", the alphabet did not displace the existing non-alphabetic Egyptian and Akkadian writing systems.[290] Instead, the alphabet was transmitted by and for scribes and used by them sporadically for non-official purposes. Clearly, as long as the palatial system was functioning, use of the alphabet was obstructed by the customary procedures of the royal administrations. Koller summarizes the argument as follows: "The alphabet did spread, however, in the hands of scribes, proficient also in cuneiform (Mesopotamia and Ugarit) or hieratic (Egypt). The new technology did not, therefore, quickly lead to any democratization of writing, or any overthrow of the scribal élite. On the contrary, based on current knowledge, the alphabet seems to have been kept in the hands of the scribes and benefited no one else."[291]

The two case studies, in the fields of literacy and metallurgy, exhibit significant similarities which suggest a common explanatory model. Initially, use of iron and the alphabet were confined to the palaces, and production was in the hands of dependent specialists. There are indications that the hegemony of the palaces was starting to weaken in the second half of the 13th century BC, already before the 'Crisis Years'.[292] During the 12th and 11th centuries BC, the diffusion of the alphabet and of ironworking took place in sub-élite contexts. Finally, both the alphabet and utilitarian iron experienced a phase of massive expansion during the 10th/9th centuries BC.

Essentially, both the development of the alphabet and of ironworking were accomplishments of the Bronze Age palaces. After the 'Crisis Years' these technologies, along with other achievements of the palaces, were free to spread at an ever-increasing rate throughout the Ancient World.[293]

[290] Quotation taken from Lemaire 2016: 106.
[291] Koller 2018: 7-8.
[292] For the case of iron, this corresponds to the 'mid-13th century' hypothesis, discussed above.
[293] For further discussion of the system collapse in the Near East ca. 1200 BC, see Chapter 12.3.

List 2.1. Iron ring jewellery (bracelets, anklets, finger rings, earrings) in Israel and Jordan in Late Bronze II and Iron I (see Figure 4).

1. Tel Nami, Israel: iron ring from a tomb. Waldbaum 1999: 46.
2. Megiddo, Israel, Level VIIA: iron ring and iron 'hook'. Loud 1948: 153 f. — 'Locus 1795': deposit of two iron rings. Harrison 2004: 77; 164. — Tomb 39: finger ring of iron and gold, iron knife blade. Guy 1938: 173; 166 fig. 172: 6; 172 fig. 176: 10; pl. 166: 2; 167: 6; Harrison 2004: 88; fig. 127: b; pl. 35: 10. — Tomb 221B: iron bracelet. Guy 1938: 178 fig. 179: 6; pl. 170: 1; Harrison 2004: 73 f.; 158; pl. 27: 4. — Tomb 912B: iron finger ring. Guy 1938: 162; 172 fig. 176: 7; pl. 128: 19. — Tomb 1778: iron bracelet. Harrison 2004: 73 f.; 158; 238 fig. 95. — For a Cave Tomb with an iron bracelet and an iron knife, see Schumacher 1908: 166-68; 167 fig. 246: g.h. — Hoard Q: two iron bracelets. Hall 2016: pl. 8; Hall 2021. — Hoard from Building 6206: six iron bracelets. Zarzecki-Peleg 2016: 305 ff.; 310 fig. 98.
3. Beth Shean, Israel, Tomb 90: iron finger ring. Oren 1973: 228 fig. 45: 20. — Tomb 219: iron bracelet. Oren 1973: 242 fig. 49: 2.
4. Pella, Jordan, Tomb 89: more than 20 iron anklets from an intact tomb. McGovern 1988: 52; Bourke 1997: 112 f. fig. 19; Green 2007: 290; pers. comm. Stephen Bourke (University of Sydney).
5. Tel Zeror, Israel, Tomb III: two iron bracelets. — Tomb V: one iron bracelet, two iron 'daggers', one iron knife. — Tomb VI: two iron bracelets, one iron finger ring. — Ohata 1967: 40 f.; 1970: 70; 73.
6. Tell es-Sa'idiyeh, Jordan, Tomb 209: iron bracelet. — Tomb 355: bimetallic bronze/iron finger ring. Green 2006: 270 ff.; 398 ff.; 2013.
7. Baq'ah Valley, Jordan, Cave B3: one fragment of an iron anklet/bracelet. McGovern 1986: 253 fig. 79: 1; 2004: 297. — Cave A4: eight complete iron bracelets, three complete iron finger rings, 40 fragments of iron rings. McGovern 1986: 53-61; 263 fig. 84: 11-13; 265 fig. 85: 14.15; 267 fig. 86: 24.
8. Tel Qasile, Israel, Level X: iron bracelet. Mazar 1985: 8 f.; 6 fig. 2: 2; 8 photo 4.
9. Khirbet Nisya, Israel, Tomb 65: nine or 10 iron bracelets. Livingston 2002: 36.
10. Jabal al-Nuzha, Amman, Jordan: fragmentary iron bracelet. Dajani 1966: 48-52; pl. 10: 4.
11. Sahab, Jordan, Tomb C1: iron bracelets and (finger?) rings. Ibrahim 1972: 32-34.
12. Jericho, Israel, Tomb 11: iron anklets/bracelets. Garstang 1932: 37; 1933: 36; fig. 11: P.37.
13. Madaba, Jordan, Tomb A: two iron bracelets and two iron finger rings. Harding and Isserlin 1953: 27-41; pl. 4: 160.161; 5: 228.229.
14. Khirbet Qeiyafa, Israel: four iron bracelets/anklets and further fragments. Rabinovich et al. 2019.
15. Tell 'Eitun, Israel, Tomb C1: five iron rings (bracelets and finger rings), iron tweezers. Edelstein and Aurant 1992: 30; 39 fig. 13: 18-22; Faust 2015.
16. Tell Jemmeh, Israel: small iron ring in a hoard of jewellery (attribution to Iron I uncertain). Petrie 1928: 10; pl. 21: 5.
17. Tell el-Far'ah (S), Israel, Tomb 542: three iron bracelets, one iron finger ring, one bimetallic dagger. Petrie 1930: pl. 21: 90; Laemmel 2012: 178 f.; 2013: 187 f. — Tomb 552: several iron finger(?) rings. Petrie 1930: pl. 27: 552. — Tomb 615: iron bracelet, iron finger ring and iron knife. Petrie 1930: pl. 30: 111. — Tomb 839: iron bracelet. Petrie 1930: pl. 71; Laemmel 2013: 189.
18. Tel Masos, Israel, Level III: Fritz and Kempinski 1983: pl. 103: 9.
19. Timna, Israel, Site 2 (Hathor temple) and Site 200: two iron bracelets and numerous iron finger rings. Rothenberg 1988: 147 f.; 277; fig. 54; Gale et al. 1990: 184 fig. 162; 186 fig. 163; Avner 2014.

List 2.2. Iron knives in Iron I with ivory handles, ring-shaped pommels and/or bronze rivets in the southern Levant (see Figure 5).

1. Sarepta, Lebanon: Pritchard 1988: 107 no. 5; 281 fig. 27: 5; Koehl 1985: 185; Sherratt 1994a: 87 (with LH IIIC-style pottery).
2. Tel Dan, Israel: Rabinovich 2016: 22.
3. Tel Yin'am, Israel: Waldbaum 1982: 342; pl. 34: 11.
4. Tel Yoqne'am, Israel: Ben-Tor et al. 2005: 372 f.; 77 fig. 1.28: 18.
5. Tel Dor, Israel: Dothan 2002: 20 fig. 20; Stern 2006: 393 f. fig. 6.
6. Megiddo, Israel: Hall 2016; 2021 (hoard from Area Q); Watzinger 1929: 31 fig. 22; Dothan 2002: 18 fig. 19: b.c ('Brandschicht').
7. Tel Zeror, Israel: Ohata 1970: pl. 63: 10; Waldbaum 1982: 342.
8. Tel Qasile, Israel: Mazar 1985: 6 fig. 2: 1.
9. Gezer, Israel: Waldbaum 1982: 342 (Grave 58); Macalister 1912: 268; pl. 198: 16 (ivory handle).
10. Tel Miqne, Israel: Dothan 2002: 15 ff.; fig. 12-16; Ben-Shlomo and Dothan 2006; Dothan et al. 2016: 478 fig. 8.2: 9-10.
11. Tel Beth Shemesh, Israel, Level III: Waldbaum 1982: 342 no. 78A.
12. Khirbet Qeiyafa, Israel: Rabinovich et al. 2019.
13. Ashkelon, Israel, Phase 17: Stager et al. 2008: 272.
14. Tell el-Far'ah (S), Israel, Grave 562: Petrie 1930: pl. 21: 96; Stech-Wheeler et al. 1981: 258.

Chapter 3
Cyprus

Cyprus has a prominent place in the introduction of iron for the manufacture of utilitarian implements. This has been made clear in a number of important studies by authors including Anthony Snodgrass, Jane Waldbaum and Susan Sherratt.[1] Before discussing the available published evidence, it is necessary to review some fundamental questions which have played an important role in previous research on Cyprus.

A question which is obviously central to the question of Cypriot iron production is the availability of suitable iron ores. This has been doubted by a number of authors, and Vassos Karageorghis even suggested that iron ores from Italy, and specifically Sardinia, might have been imported to Cyprus in exchange for copper ox-hide ingots.[2] However, Vasiliki Kassianidou has demonstrated that iron ores, mainly in the form of ochres and umbers, with high concentrations of iron oxide, do indeed exist in sufficient quantities on the island.[3] Furthermore, Kassianidou notes that disused iron mines have been described at various locations in western Cyprus.[4]

The belief in the absence of workable iron deposits explains the popularity of the idea that early Cypriot iron was obtained as a by-product of copper smelting.[5] According to this hypothesis, either iron-rich copper ores were smelted, or iron-rich fluxes were added to the charge in the furnace.[6] Indeed, during experimental copper smelting by the team excavating at Agia Varvara, a site located south of Nicosia, metallic iron was produced in quantities visible to the naked eye from chalcopyrite ores, showing that early copper smelters were quite likely acquainted with iron.[7] However, it has never been proven that malleable iron can be produced by these methods. Owing to the chemistry of the smelting process, iron would normally remain bound as oxide (FeO) in the slags, and if any metallic iron were produced, it would be mixed with copper, making it unsuitable for practical use.[8]

Anthony Snodgrass is to be credited with an influential theory concerning the introduction of iron. Previously, from the days of Christian Jürgensen Thomsen until the late 1960s, it had been assumed that iron replaced bronze because its qualities are simply superior for the manufacture of utilitarian tools and weapons. On the contrary, Snodgrass argued that bronze was just as good as the sorts of iron which were produced by early blacksmiths.[9] For this reason, he believed that the introduction of iron must have been forced by an external constraint: the disruption of the copper and tin supply and the ensuing bronze shortage.[10] Originally, Snodgrass developed his theory for central Greece during the period ca. 1025-950 BC, but the idea of a bronze shortage was then extended by Jane Waldbaum to the 12th and 11th centuries BC and the whole East Mediterranean area.[11] Although initially the 'bronze shortage' theory seemed convincing, it later became apparent that the bronze supply was not interrupted during the

1 See for example Snodgrass 1980; 1982. — Waldbaum 1980; 1982; 1999. — Sherratt 1994a.
2 Karageorghis 1994: 5 f.
3 Kassianidou 1994; Muhly and Kassianidou 2012: 134 f.
4 See for example Pococke 1745: 224 f.; 229.
5 Snodgrass 1982: 293; Snodgrass 1994: 168. — Sherratt 1994a: 66 ("systematic exploitation of what would otherwise remain a waste product of copper smelting"; iron extracted from copper slag); Sherratt 2016: 296; and see below for further discussion of Sherratt's views on the production of iron. — Pickles and Peltenburg 1998: 87. — Palermo 2018: 215 (iron as a by-product from smelting copper sulphide ore using iron-rich fluxes, gossan ores, or from copper matte production); 237 (ironworking relied on the development of a parochial copper smelting by-product rather than the bloomery process).
6 For the suggestion that nickel-rich iron could have been obtained in Mycenaean Greece during copper smelting by the addition of a lateritic flux, see Varoufakis 1982: 317.
7 Fasnacht and Senn 2001.
8 See Merkel and Barrett 2000; Erb-Satullo et al. 2014: 157; 2019: 575 f.; 2020: 44; Lehnhardt 2021: 21.
9 Snodgrass 1971: 215 f.; 238.
10 Snodgrass 1971: 231 (the disruption of the bronze supply "drove the people of the Aegean, willy-nilly, to a more widespread use of iron than they would otherwise have chosen to make").
11 Waldbaum 1978: 72 f.; 1980: 83; 1982: 338; 1989: 111.

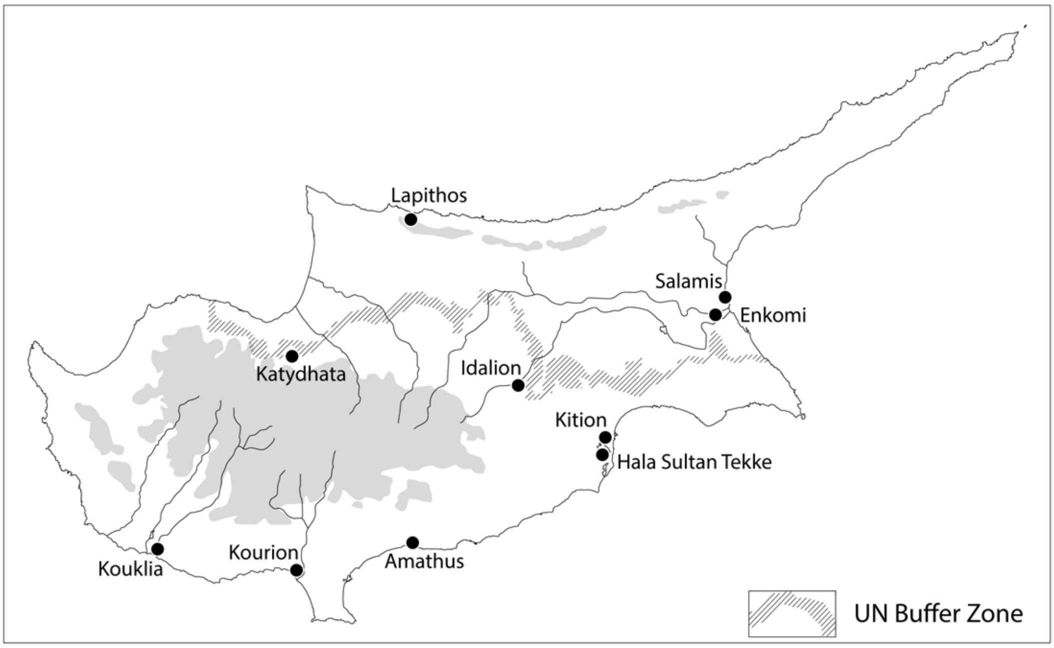

Figure 8. Map of Cyprus with sites mentioned in the text.

12th-10th centuries BC, and bronzes continued to be alloyed with relatively large amounts of tin. Indeed, bronze production continued at a high level in Cyprus, not only during the 12th century BC but also in the following centuries. For this reason, since the late 1980s, the 'bronze shortage' theory has fallen out of favour.[12]

As the following pages will show, Cyprus has the largest quantity of smelted iron artefacts in the East Mediterranean area in the 12th century BC, and there is no conceivable source from which iron could have been imported at this time. For this reason, there can hardly be any doubt that Cypriot ironworking relied on local ores. As Snodgrass's 'bronze shortage' theory has been contradicted by subsequent research, the precocious production of utilitarian iron artefacts on Cyprus must have another explanation.

Before further discussion, a brief note on Late Cypriot and Cypro-Geometric chronology is required. The Cypro-Geometric chronological sequence (CG I-III) is based on the work of Einar Gjerstad, published shortly after the Second World War.[13] Gjerstad's chronological system is still used as a convention, but a thorough review taking account of regional differences between the Cypriot sites is an urgent desideratum.[14] By contrast, the main sites and contexts of LC IIIA (and partly LC IIIB) have recently been studied in a monumental publication by Penelope Mountjoy.[15]

Finally, it is necessary to mention the partition of Cyprus in 1974, with the ensuing hiatus in archaeological activity in the Turkish-occupied territory; this is obviously a very important factor with unfortunate consequences for research (see Figure 8).

[12] See for example Waldbaum 1989: 111 ff.; 1999: 39; Sherratt 1994a: 61; Pickles and Peltenburg 1998: 80; Kayafa 2006.

[13] See for example Gjerstad 1948: 421 ff. — The conventional phases used in most publications are the following: LC IIIA (ca. 1200-1125/1100 BC); LC IIIB (ca. 1125/1100-1050 BC); CG I (ca. 1050-950 BC); CG II (ca. 950-850 BC); CG III (ca. 850-700 BC).

[14] See comments by Anna Georgiadou (2014: 369 ff.; 382 f.). — For the importance of linking the Cypriot and Levantine chronological sequences, see Georgiadou 2018.

[15] Mountjoy 2018.

3.1 Iron in Late Cypriot IIIA

As previous authors have always emphasized, the large number of iron objects which can be dated to LC IIIA is impressive, particularly considering that iron has never been found in archaeological contexts before the 12th century BC.[16]

The following iron objects have been found in tombs of LC IIIA: 10 (one-edged) knives, two two-edged knives, six spatulae, one 'chisel', one pin, the tang of an unidentified object, and an iron wire inlay on a gold finger ring:

- Enkomi, British Tomb 58 (knife, ivory bull's leg handle with iron tang); British Tomb 74 ('chisel').[17]
- Kition, Tomb 9, Upper Burial (gold finger ring with an iron wire wrapped around the middle).[18]
- Kouklia, Asproyi, Tomb IV (two knives, spatula); Tomb V (spatula). — Evreti, Tomb IIIA (two-edged knife); Tomb IV (two-edged knife); Tomb VIII (two knives, two spatulae).[19] — Eliomylia, Tomb 119 (knife). — Teratsoudhia, Tomb 104, Chamber N (knife blade fragment); Tomb 105, Chamber B (spatula).[20]
- Kourion, Bamboula, Tomb 16 (knife); Tomb 19 (pin); Tomb 25 (spatula); Tomb 32 (knife).[21]
- Lapithos, Agia Anastasia, Tomb 501 (knife).[22]

At this point, it is necessary to clarify the terminology used here, which distinguishes between (one-edged) knives, two-edged knives and daggers. Following the usage introduced by Einar Gjerstad, the term 'knife' is used to refer to cutting implements (either one- or two-edged), while the term 'dagger' is reserved for weapons.[23] In Cyprus, bronze two-edged knives with narrow and thin blades, measuring up to 25 cm in length, were the typical cutting implements during the Late Bronze Age. In the literature, these implements are sometimes called 'daggers'; but in my view, this leads to confusion concerning their function.[24] Bronze one-edged knives were first introduced to the island from the Aegean during the 13th century BC, but the customary two-edged variety still remained in use in Cyprus until the start of the Iron Age – sometimes being made of bronze, sometimes of iron (for an iron example, see Figure 9: 1).[25]

Previous research has already shown that knives make up the lion's share of the early iron objects from Cyprus. Typically, they have bronze rivets, a feature discussed in detail by Jane Waldbaum (see, for

16 In her dissertation, Joanna Palermo mentions "a chain ornament of oxidised iron" from a grave at Katydata-Linu, dated to LC II, as among the earliest evidence for iron in Cyprus (Palermo 2018: 213). However, as Max Ohnefalsch-Richter explains in a footnote to his description of the finds, the ornaments were probably made of iron oxide (presumably a naturally occurring mineral), rather than metallic iron, and so these objects cannot be considered as evidence for the early use of iron – be it of meteoritic or smelted origin. — For a description of the tomb contents, see Ohnefalsch-Richter 1893: 465 ('Grave 16'); pl. 172: 16c. — According to information kindly supplied by Dr Frederik Grosser (Antikensammlung, Berlin), these objects no longer exist in the museum.

17 Murray et al. 1900: 14 f.; 15 fig. 25: *994; 25; 31; 53; 58; pl. II: 995. — Evans 1900b: 212. — Matthäus 1985: 42; 308; pl. 122: B. — Mountjoy 2008: 71.

18 Karageorghis 1974a: 79 cat. no. 292; 89; 93 f.; pl. 92: 292.

19 Catling 2020: 20 ff. cat. no. 30, 42, 69 and 132 (Asproyi, Tomb IV); 31 ff. cat. no. 86 (Asproyi, Tomb V); 59 ff. cat. no. 46 (Evreti, Tomb IIIA); 70 ff. cat. no. 10 (Evreti, Tomb IV); 83 ff. cat. no. 1, 9, 32 and 51 (Evreti, Tomb VIII).

20 Karageorghis 1990: 80 cat. no. 26 (Eliomylia, Tomb 119); 34 cat. no. 52 (Teratsoudhia, Tomb 104/N); 43 cat. no. 27 (Teratsoudhia, Tomb 105/B).

21 Benson 1972: 19 no. 20; 130 cat. no. B1385 (Tomb 16); 22 no. 6; 131 cat. no. B1389 (Tomb 19); 25 no. 3; 130 cat. no. B1381 (Tomb 25); 28 no. 13; 130 cat. no. B1387 (Tomb 32). — Bamboula, Tomb 17A, with an iron 'nail' or 'arrowhead', is an unreliable context. Tombs 17 and 17A (identical with British Museum Tombs 53 and 102) had been ransacked before excavation and the finds from the two chambers were partly mixed; the tomb contents included CG and Roman pottery, as well as a CG fibula. See Benson 1972: 21; 36; Waldbaum 1978: 85 note 215; Giesen 2001: 99 no. 40.

22 Gjerstad 1934: 163 f.; Georgiadou 2019: 103 note 8. I am grateful to Anna Georgiadou (Nicosia) for advice on the chronology of this find.

23 See Gjerstad 1935: 575 f.; 579; Gjerstad 1948: 132 ff.; 213 fig. 1.

24 See for example Catling 1964: 102; 125 ff.; Courtois 1984: 9 ff. ('poignards'). — See the discussion in Palermo 2018: 168 ff.

25 For the Cypriot knives see, e.g., Catling 1964: 102 ff.; Waldbaum 1982: 330 ff. — For the rather rudimentary bronze one-edged knives of LC II, see Palermo 2018: table 12 (Maa-Palaeokastro; Kalavasos-Ayios Dhimitrios; Kition). — The iron two-edged knife from Kouklia, Evreti, Grave IIIA (Figure 9: 1) is housed in the National Museums Liverpool; the author is very grateful to Dr Chrissy Partheni (Curator for Classical Antiquities) for her helpful assistance with this find. Jordan Poole (Liverpool) made the excellent drawing of the knife.

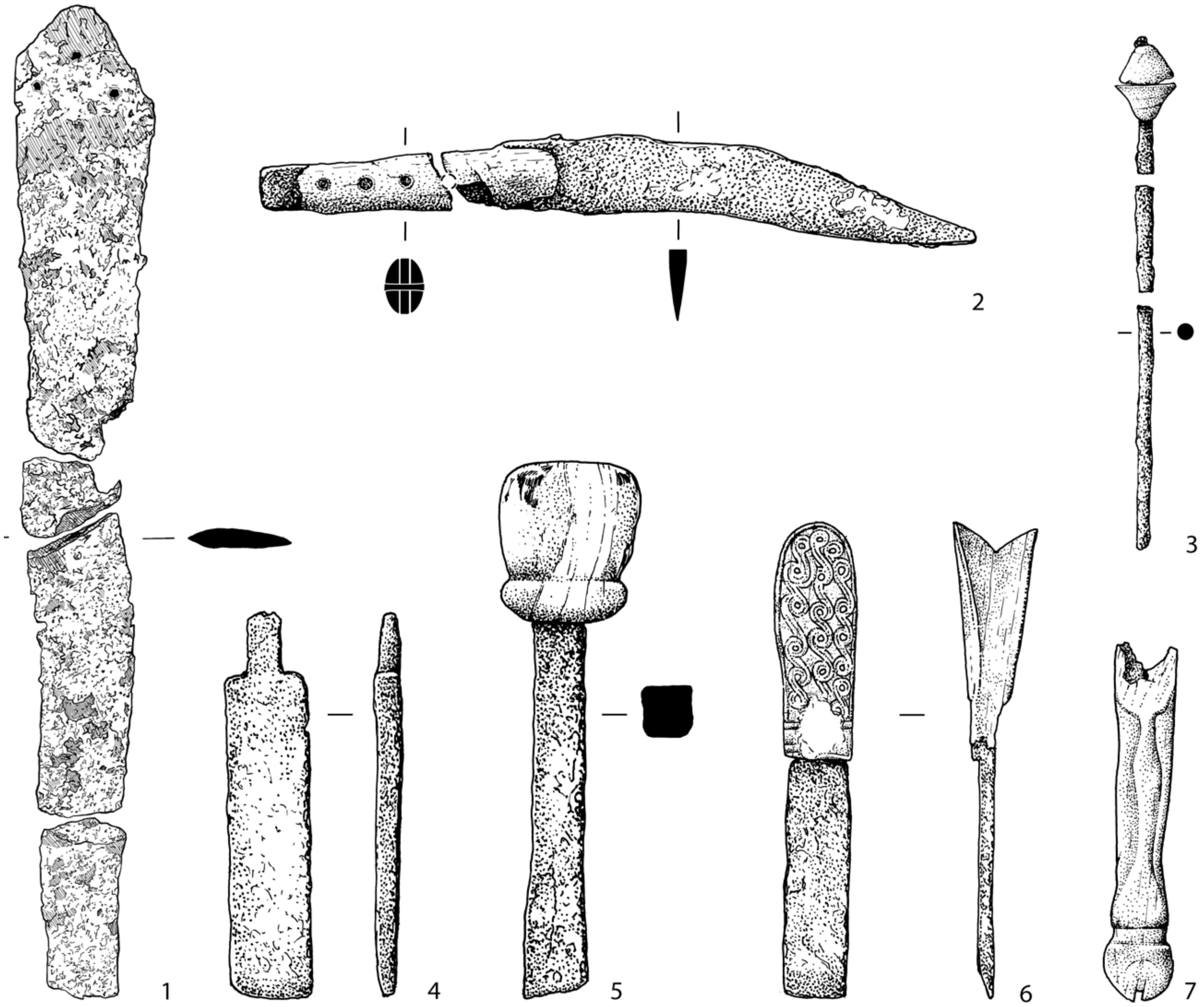

Figure 9. Selection of iron artefacts dating to Late Cypriot IIIA. — 1 Kouklia, Evreti, Tomb IIIA (drawing by Jordan Poole [Liverpool]). — 2 Enkomi, British Tomb 58 (after Matthäus 1985: pl. 122: B; and photographs in the digital inventory of the British Museum). — 3 Kourion, Bamboula, Tomb 19 (after photographs in the digital inventory of the Penn Museum, University of Pennsylvania). — 4 Kourion, Bamboula, Tomb 25 (after photographs in the digital inventory of the Penn Museum, University of Pennsylvania). — 5 Enkomi, British Tomb 74 (after illustrations in the digital inventory of the British Museum). — 6 Kouklia, Evreti, Tomb VIII (after Catling 2020: pl. 161; Maier and Karageorghis 1984: 74 fig. 57). — 7 Enkomi, British Tomb 58 (after a photograph in the digital inventory of the British Museum). — 2, 3, 5, 6 and 7 iron and ivory. — 1.2 Scale 1:2. — 3-7 Scale 2:3.

example, Figure 9: 2). Of the nine knives with surviving rivets, in eight cases they are of bronze and only one example has iron rivets.[26]

Following the knives, spatulae are the second most important category of iron artefacts. These implements have a flat rectangular blade with a simple tongue-shaped tang, and were often provided with an ivory handle (e.g. Figure 9: 4). The best-preserved example comes from Kouklia, Evreti, Tomb VIII. In this case the ivory handle has a bilobate or fish-tail shape, and is decorated with elaborate engraved interlinked spirals inset with tiny beads of glass paste (Figure 9: 6).[27] The two iron spatulae from this tomb were found

[26] Bronze rivets: Enkomi, British Tomb 58; Kouklia, Asproyi, Tomb IV; Eliomylia, Tomb 119; Evreti, Tomb IV; Evreti, Tomb VIII (two examples); Kourion, Bamboula, Tomb 16; Lapithos, Agia Anastasia, Tomb 501. — Iron rivets: Kouklia, Evreti, Tomb IIIA. — For discussion of the knives with bronze rivets, see Waldbaum 1982.

[27] Catling 2020: 85 cat. no. 32; pl. 161. — Maier and Karageorghis 1984: 68; 74 fig. 57.

in a cist along with other objects related to toiletry and cosmetics (including a mirror, an ivory unguent pot, an ivory toilet spoon, a large stone dish and a stone pestle), and it is most likely that the spatulae were used in preparing or applying make-up.[28] Priscilla Keswani has emphasized the importance of this aspect in burial ritual: "One of the most overt means of elite image construction may have entailed the use of distinctive modes of personal ornamentation and dress. The proliferation of Mycenaean and other ceramic vessels that were probably used for scented oils and unguents ..., ivory, glass and faience toiletry containers, stone mortars, pestles and bronze spatulae (items that may have been used for preparing cosmetics), along with bronze mirrors and ivory mirror standards, suggest that perfume and make-up were important elements of prestige in Cyprus as elsewhere in the Mediterranean world."[29] A similar bilobate ivory handle has been found in Kouklia, Asproyi, Tomb IV, doubtless originally fitted on the iron spatula from the same grave.[30] In the case of the handle fragment from Kouklia, Teratsoudhia, Tomb 105/K, which is very similar to the example from Evreti, Tomb VIII, no traces of the metallic spatula have survived.[31] Two further ivory handles of this type, with traces of the iron spatula tangs, are known from Enkomi.[32] Taking these finds into account, we should probably reckon with as many as nine iron cosmetic spatulae dating to LC IIIA. Similar ivory handles were already used at Enkomi during LC IIC with bronze spatulae.[33]

The beautifully crafted ivory bull's leg handle from Enkomi, British Tomb 58, measuring 7.5 cm in length, has traces of an iron tang, showing that it held an iron implement (Figure 9: 7).[34] Unfortunately, the iron implement has not survived, but judging from the small size and delicate nature of the handle, it is at least possible that it had a function related to cosmetics and toiletry – although this remains speculative. Like the spatulae discussed above, it shows that iron and ivory were used during LC IIIA for the production of small, prestigious implements for personal use. The iron wire inlay on the gold finger ring from the very richly furnished upper burial layer in Kition, Tomb 9, dated very early in LC IIIA or at the LC IIC/IIIA transition, is clearly further evidence for the prestigious nature of iron at this early stage of the metal's use.[35] A bimetallic (gold and iron) ring is also known from Megiddo, Tomb 39, from an Iron IA context; both the Kition and the Megiddo finger rings have a central iron band flanked on both sides by a twisted gold wire.[36] Although the design of the Megiddo ring seems more elaborate than the example from Kition, they do seem closely related, and as the Kition ring is one of the earliest iron artefacts in Cyprus, this could point to a Levantine origin for the new metal – which may first have arrived on the island in the form of this kind of ring jewellery.

In the case of another iron implement, from Enkomi, British Tomb 74, again with an ivory handle, the question of the original function is rather interesting (Figure 9: 5).[37] The preserved length is 11.2 cm, the mushroom-shaped handle is 3.2 cm in diameter, and the working end of the iron is flattened; the size and shape make an interpretation as a chisel-like tool most plausible.[38] The shape of the ivory handle indicates that the 'chisel' was not struck with a hammer, but pressure was applied by the hand. If these suggestions are accepted, then it would follow that the tool was used for working a fairly soft material, such as wood, bone or ivory. However, the function of the implement is uncertain, and it might have been

[28] Catling 2020: 88.
[29] Keswani 2004: 138.
[30] Catling 2020: pl. 66: AIV/69+101; pl. 69: AIV/42.
[31] Karageorghis 1990: pl. 57: K/32.
[32] From the French excavations in 1934: Caubet et al. 1987: 25; 30 f. no. 38; 31 fig. 3: 38. — An example in the British Museum (inv. no. 1897,0401.1382+).
[33] Enkomi, Swedish Tombs 3 and 19: Gjerstad 1934: 565 no. 92; pl. 76: 3; pl. 92: 92. — In contrast to the iron spatulae with their rectangular outlines, the LC IIC bronze spatulae have everted, trumpet-shaped blades. See for example: Enkomi (with ivory handle): Courtois 1984: 28 no. 229; 177 fig. 7: 1; Kourion, Bamboula, Tombs 6 and 12: Benson 1972: 14 no. 5 (Tomb 6); 16 no. 5 (Tomb 12); pl. 34: B1260.B1261; Alalakh (Tell Atchana): Woolley 1955: pl. 73: AT/8/243 ('kohl-stick').
[34] An excellent photograph of the bull's leg handle is available on the British Museum internet page (Museum number 1897,0401.995).
[35] For the chronology of this tomb, see Mountjoy 2018: 29; 588 ff. — Note that the iron wire only contained a trace of nickel, indicating that it was not meteoritic in origin; see Karageorghis 1974a: 89 note 2.
[36] For the finger ring from Megiddo, Tomb 39, see Guy 1938: 173; 172 fig. 176: 10; Harrison 2004: 77; pl. 28: 13.
[37] Paule 2018: 89 fig. 3. - For a good photograph, see also the British Museum internet page (Museum number 1897,0401.1123).
[38] I am grateful to Dr Anna Paule (Göttingen) for her helpful comments on the interpretation of this piece.

Table 4. Summary of the stratigraphy at major settlements in Late Bronze Age and Early Iron Age Cyprus. — HST: Hala Sultan Tekke.

	HST	Kourion	Idalion	Enkomi	Kition
LC IIC	3 2		1?	IIB	IV
LC IIIA	1	D E:1.2 E? (hiatus)	1 2 3	IIIA IIIB (early)	IIIA III
LC IIIB			3?	IIIB (late) IIIC	II
CG I		E:3		(hiatus) (CGI)	I

used in the preparation of cosmetics, like the spatulae discussed above. A very similar tool, but now in bronze and with a bone handle, was found in Shaft-Grave 24 at Enkomi, dated by Porphyrios Dikaios to LC IIIB.[39] In the British Museum there are two more bone or antler handles from Enkomi, apparently from comparable iron implements.[40] Another iron example, with a bone handle, was found during the French excavations at Enkomi, apparently dating to LC III.[41]

The use of ivory, sometimes elaborately crafted, is a clear indication that iron was used in LC IIIA for 'luxury' implements, particularly spatulae. The iron pin with a biconical ivory head from Kourion, Bamboula, Tomb 19, was also presumably a prestigious item (Figure 9: 3).[42] As mentioned above, the 'chisel' from Enkomi, British Tomb 74, was provided with an ivory handle, possibly suggesting that (fine) craftsmanship was accorded high status at this time.[43] The situation seems rather different in the case of the knives: only one bears the remains of an ivory handle (Figure 9: 2). In all the other examples nothing survives from the handles, which might indicate that they were made of a less prestigious organic material (wood?), and that the iron knives were not necessarily treated as luxury objects.

Cyprus also has important evidence for iron use from settlements, particularly from contexts dating to LC IIIA (for a summary of the stratigraphies from major settlement excavations, see Table 4). From settlement excavations, five knives/blade fragments and eight fragments of unidentified artefacts can be assigned to LC IIIA:

[39] Dikaios 1969: 151; 433 no. 1348; pl. 220: 8.
[40] For good photographs, see the British Museum internet page (Museum numbers 1897,0401.1346 and 1897,0401.1382).
[41] Courtois 1984: 50 no. 449; 177 fig. 7: 6. — For similar bronze implements (awls, burins or chisels) with bone handles, see Courtois 1984: cat. no. 194, 198, 291 and 366; 177 fig. 7: 2-5.
[42] Benson 1972: pl. 35: B1389. — Similar iron pins, but with bone rather than ivory heads, are otherwise unknown before CG I; compare the examples from Kouklia, Plakes (Tomb 144) and Skales (Tombs 78, 89 and 91).
[43] For the frequent occurrence of tools in Bronze Age graves in Cyprus (scrapers, awls, axes, spatulae, chisels, whetstones etc.), see Webb 1992: 90.

- Enkomi, Level IIIA: Area III/Room 72D (blade fragment).[44]
- Hala Sultan Tekke: Area A/Well OO (fragments); Trench 3 (two hook-shaped fragments); Area 8/ Room 95A (bimetallic fragment).[45]
- Idalion, Ambelleri/West Acropolis, Periods 1 and 2: Room XXXII (fragment); Room XXXVA (knife); Room XLVII (fragment).[46]
- Kourion, Bamboula, Area A, Levels D:2-3 and E:2: House VII(2)/Room 12 (blade fragment); House IV (fragment); House VIII/Room 3 (blade fragment); House V/Room 20 (knife).[47]

Further iron objects from settlement excavations are less precisely dated. Owing to the unsuitable methodology, most of the finds from the French excavations at Enkomi conducted by Claude Schaeffer between 1934 and 1974 do not have reliable stratigraphic contexts. Jacques-Claude Courtois suggested a date in LC III (Chypriote Récent) for four iron knives/blade fragments and an iron implement with a bone handle:

- Enkomi: Quartier 4E (blade fragment); 'sous point top. 122' (knife); Sondage XLI (blade fragment); Quartier 3W, 'point top. 355' (iron implement with bone handle); Quartier 6W, Room 8 (knife).[48]

In the case of Idalion, the upper levels of the settlement stratigraphy ("Period 3") seem to have been mixed with later material derived from Iron Age activity.[49] For this reason, the following iron finds from Idalion (two knives, four two-edged knives and two fragments) can only tentatively be assigned to LC III(A?):

- Idalion, Ambelleri/West Acropolis, Period 2-3: North of Room XLVIII (knife); Debris/Layer 6 (two-edged knife).[50] — Period 3: Area XL (knife); Corridor XLV (two-edged knife); North House/ Room XX (fragment); Room XLII (fragment).[51] — Unstratified (two two-edged knives).[52]

As our discussion of burial and settlement evidence has shown, the range of iron artefacts known from LC IIIA is rather narrow. Apart from fragments from artefacts of unidentified function, there are ca. 15 one-edged knives, two two-edged knives, six spatulae, one chisel-like implement and one dress pin. In addition, there are further, similar artefacts which are less reliably dated: six one-edged knives, four two-edged knives, three spatulae and remnants of three chisel- or awl-like implements. It is significant that the objects of uncertain date belong to the same types of artefacts as the reliably dated examples from tomb and settlement contexts. This suggests that these finds do, indeed, reflect the range of iron artefacts produced and used in Cyprus during LC IIIA.

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[44] Dikaios 1969: 279; 463; 519; 701 inv. no. 3458; pl. 163: 9.
[45] Aström et al. 1976: 117; 119 fig. 106-107; 123 ff. fig. 110-122; Kassianidou 2003: 11 f.; 17 fig. 1-2; Fischer and Bürge 2018: 59. — Note that the iron concretions in a pottery sherd, and the plaques from Hala Sultan Tekke cannot be accepted as metallic iron. — For the "grains of rusted iron" or "iron thread/wire" in the pottery sherd from Layer 1 in Trench 2, see Öbrink 1979: 23; 83 fig. 193; Tholander 1979: 106 ff. fig. 288-293; Åström et al. 1986: 37; Kassianidou 2003: 11. — For the 369 "iron plaques" from Pit B in Area A, see Fischer and Bürge 2015: 55; 71-72. I am grateful to Prof. Peter Fischer (Gothenburg) for additional information on the iron finds from Hala Sultan Tekke.
[46] Gjerstad 1935: 548 no. 591; 556 no. 929; 560 no. 1132; Tholander 1971: 18 fig. 1: centre; 19 fig. 2: centre.
[47] Daniel 1938: 268 f. fig. 9 ("Period 1"); Benson 1969: 11; 14; Benson 1972: 130 no. B1382 and B1383; 130 no. B1386; 131 no. B1389 and B1391. — For the location of House V/Room 20 (with inv. no. B1382), compare Daniel 1938: 263 fig. 2 with Mountjoy 2018: 785 fig. 387.
[48] Pelon et al. 1973: 113; pl. 4: 4; Courtois 1984: 50 no. 442, 445, 446 and 449; 177 fig. 7: 6.17.20; pl. 16: 16; Courtois et al. 1986: 62 f.; pl. 17: 3.8. — For further iron objects, dated to "Chypriote Récent III ou Fer I", see Courtois 1984: 50 no. 441, 443, 444, 447 and 448; 177 fig. 7: 16.18.21. — For comments on the excavation methodology, see Lagarce 1993: 97; 102 f. — I am grateful to Prof. George Papasavvas (Nicosia) for his helpful comments on the excavations at Enkomi.
[49] This is most obvious in the case of the iron sword from Period 3, which has good parallels in the Cypro-Archaic period. — See Gjerstad 1935: 537 no. 208; pl. 171: 1; Åström and Åström 1972: 473; 478 fig. 60: 1; 558. — Compare Karageorghis 1967: 212 no. 46; 236 fig. 21: 46 (Kouklia, Eliomylia).
[50] Gjerstad 1935: 534 no. 106; pl. 173: 6; Tholander 1971: 18 fig. 1: top; 19 fig. 2: top; 22.
[51] Gjerstad 1935: 546 no. 517; 555 no. 862 and 871; 559 no. 1068; Tholander 1971: 18 fig. 1; 19 fig. 2; 22.
[52] Gjerstad 1935: 541 no. 333; 558 no. 990; pl. 173: 4.

3.2 Iron in Late Cypriot IIIB

Very few iron objects from tombs can be assigned to LC IIIB, including three or four knives, a dagger and some fragmentary rod-shaped implements:[53]

- Enkomi, French Tomb 6 (knife); Quartier 5W/Tomb 108 (two knives).[54]
- Kouklia, Skales, Tomb 192 (five fragments of rod-shaped artefacts).[55]
- Kourion, Kaloriziki, Tomb 40 (dagger).[56]
- Owing to insufficient publication, the chronology of a further iron knife, from Katydhata, Tomb 89, is uncertain. The published fibula from this tomb would not be out of place in LC IIIB.[57]

The dagger from Kaloriziki, Tomb 40, is certainly the most important piece in this group, being the earliest definite weapon from Cyprus (Figure 10). As it is related to the 'Naue II/Allerona' family of swords, its interpretation as a weapon is beyond doubt, despite being only 25.5 cm long. Weaponry will be discussed in more detail in Chapter 4.3.

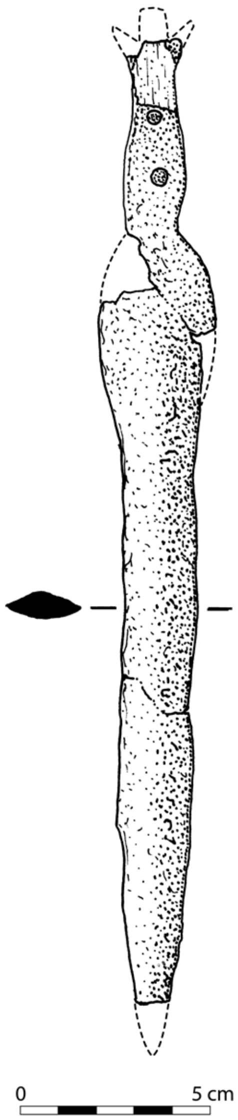

Figure 10. Iron dagger dating to Late Cypriot IIIB from Kourion, Kaloriziki, Tomb 40 (after Matthäus and Schumacher-Matthäus 2015: 54 fig. 43: 36). — Scale 1:2.

Unfortunately, the rod-shaped fragments from Kouklia, Skales, Tomb 192 are not so easy to understand. All the iron fragments are rectangular in cross-section. Four fragments (5-6 cm in length) were placed on the right breast of the female burial; a longer fragment (10.9 cm long) was found to the right of the skull. One end of one of the smaller fragments is shaped like a tang; this could be for an organic handle, if the artefact is interpreted as an implement. Similar fragmentary iron rods with rectangular cross-section were again found associated with a female burial in Skales, Tomb 197, dated to CG I; in the publication these are tentatively interpreted as tools(?) or chisels(?).[58] Unfortunately, the interpretation of the iron rods from both burials remains unclear.

The chronology of the two tombs from Enkomi is rather uncertain: although a position in LC IIIB is most likely for the knives, a slightly earlier position (in LC IIIA) is conceivable for the example from Tomb 6. While the knife from Tomb 6 has bronze rivets, one of the examples from Tomb 108 has a rivet-less tang with a ring-shaped terminal (length 23.9 cm).

From settlement contexts, there are again only few iron artefacts which can be assigned to LC IIIB, comprising six or seven knives/blade fragments and a possible 'dagger':

[53] The iron objects from the following tombs cannot be regarded as reliably dated to LC IIIB. — Kouklia, Xylinos, Tomb 186: iron nail among finds from a destroyed tomb collected from the side of the road (Karageorghis and Raptou 2014: 6; 23 no. 56). — Gastria-Alaas, Tomb 3: according to information from 'private collectors', an iron spearhead was among the finds looted from this LC IIIB tomb; considering that no other iron spearheads are known at this early date, this information seems doubtful (Karageorghis 1977: 141; 143 no. 10).
[54] Schaeffer 1936: 137 no. 13 (Tomb 6). — Courtois 1981: 260 no. 24-25; 262 f.; 268 fig. 165: 24.25; 269 fig. 166: 25 (Tomb 108).
[55] Karageorghis and Raptou 2016: 53 no. 23 and 32; pl. 28: 23.32.
[56] Matthäus and Schumacher-Matthäus 2015: 21 no. 36; 54 fig. 43: 36; 55 fig. 44.
[57] Åström 1989: 54; 98 fig. 70; 118 fig. 169; Giesen 2001: 275; 386 ("asymmetrische Fibeln ohne Wulstglieder").
[58] Karageorghis and Raptou 2016: 18; 66 no. 48B (in White Painted I amphora).

- Enkomi, Level IIIB/late and IIIC (Floor II and I): Area I, Ashlar Building, Room 8 (fragment of a large knife blade); Room 13 (knife); Room 19 (blade fragment); Room 24 (blade). — Area III, Room 89 (knife).[59]
- Kition, Floor II: Area II, Room 5A (blade fragment[?]); Room 15 (knife); Room 115 ('dagger').[60]

Even for these few objects, in some cases the chronology is problematical. According to Joanna Smith, Floor II at Kition could have been in use until the end of the 11th century BC; and Penelope Mountjoy has shown that the stratigraphy of the upper layers in Area III at Enkomi was disturbed.[61]

The most interesting of these objects is certainly the 'dagger' from Kition, Room 115. It has three bronze rivets and is slightly more than 25 cm in length. In its general design, it resembles the two-edged knives.[62] But it is rather long for this kind of knife, and the blade appears to have a thickened and profiled cross-section, which seems more suitable for a dagger.[63] However, the original thickness and profile is difficult to evaluate, owing to the corrosion of the iron; furthermore, on the published drawings, the object seems to be more elaborate than on the photographs. It is therefore difficult to reach a satisfactory conclusion; but perhaps this represents an early attempt – during LC IIIB – to produce a dagger-like weapon, while remaining true to the design of the traditional two-edged knife. There is a rather similar case of an iron implement from Megiddo, Tomb 1101B/Upper, dating to Iron I. The thin blade of this iron implement and the lack of a tang would suggest an interpretation as a two-edged knife, whereas the length (30 cm) would be more typical for a dagger.[64]

The interpretation of the blade fragment from Room 8 in the Ashlar Building complex at Enkomi is also interesting.[65] It survives with a length of 28 cm, but sadly the handle-end is incomplete, and there are no traces of rivets (Figure 14: 1). Porphyrios Dikaios called this implement a 'sickle', whereas Joseph Maran considers that a very similar large blade fragment from the Tiryns Treasure was used for cutting and apportioning meat (see Figure 14: 2).[66] The contexts from Enkomi and Tiryns are roughly contemporary (the Tiryns Treasure probably dates to a late stage of LH IIIC), and the close similarity of the two pieces suggests that they had a similar function. As agricultural tools have never otherwise been found at such an early date, either in the Near East or the Aegean, Maran's interpretation as a prestigious carving knife seems most convincing.

In summary, in the tombs and settlements of LC IIIB the range of iron artefacts comprises around nine knives, one 'carving knife', one or two daggers, and some rod-shaped implements. As in LC IIIA, the knives make up the lion's share of the iron products. Most of the artefacts in both LC IIIA and IIIB are small and simple to manufacture, such as the knives, spatulae, chisels and awls; when preserved, the rivets are almost always of bronze.[67] Larger and more complex artefacts – specifically the dagger, the 'carving knife' and the knife with ring-shaped terminal – first appear in LC IIIB.

The paucity of iron finds known from LC IIIB can be explained by the upheavals in Cyprus at the end of LC IIIA. Most of the known large settlements were abandoned, and at Enkomi and Kition only small sectors

[59] Dikaios 1969: 145; 193 f.; 296; 526; 725 inv. no. 647; pl. 135: 77; 172: 16 (Area I/Room 8). — Dikaios 1969: 296; 302; 468; 526; 762 inv. no. 203; pl. 172: 17 (Area I/Room 19). — Dikaios 1969: 201; 302; 714; 761 inv. no. 7; pl. 135: 76; 172: 5 (Area I/Room 13). — Dikaios 1969: 772 inv. no. 5509/7; pl. 147: 38; 176; 53 (Area I/Room 24). — Dikaios 1969: 302; 767 inv. no. 1455; pl. 176: 37 (Area III/Room 89).
[60] Karageorghis 1985: 189 no. 569; Karageorghis and Demas 1985: 134; pl. 153: 569; 216: 569 (Room 5A). — Karageorghis 1985: 189 no. 1127; Karageorghis and Demas 1985: 136; pl. 153: 1127; 216: 1127 (Room 15). — Karageorghis 1978: 916 f. fig. 84; Karageorghis 1985: 188 f. no. 5052; Karageorghis and Demas 1985: 133 f.; pl. 153: 5052; 216: 5052 (Room 115).
[61] See Smith 2009: xviii table 4; Mountjoy 2018: 145 table 36.
[62] See for example Catling 1964: 127 f.; especially pl. 15: e; Courtois 1984: 171 fig. 1: 9-11
[63] Compare a bronze example from Kition, Tomb 9, Upper Burial: Karageorghis 1974a: 82 cat. no. 340 (length 26 cm).
[64] See Chapter 2.3; Guy 1938: 164 f. fig. 171: 14; pl. 87: 5; Harrison 2004: 88; fig. 127: a; pl. 35: 8.
[65] Dikaios 1969: pl. 135: 77; 172: 16.
[66] See Chapter 4.2; Maran 2012: 123.
[67] Iron rivets are only found on two artefacts: the two-edged knife from Kouklia, Evreti, Tomb IIIA (see above), and the dagger from Kourion, Kaloriziki, Tomb 40 (Matthäus and Schumacher-Matthäus 2015: 55).

of the sites remained in use, particularly sacred areas used for ritual activity and feasting.[68] Following these disruptions, possibly caused by foreign migrants, new settlements and cemeteries were founded, and during these unsettled times – in LC IIIB – formal burial seems to have been less common.

3.3 Iron in Cypro-Geometric I

With CG I there is a radical change in the occurrence of iron in Cypriot tombs.[69] The quantity of iron increases massively, and a range of new artefacts enters the archaeological record, often of large size and requiring advanced blacksmithing skills. The following types of artefacts are present as tomb furnishings: knives, daggers/dirks, spearheads, arrowheads, a trunnion axe, roasting-spits (*obeloi*), a trident, rod-shaped implements (chisels?), fibulae, pins, a finger ring, a spindle and some minor items (two 'attachments', a pointed rod and iron rings on the sockets of two bronze spearheads):

- Kouklia, Plakes, Tomb 142 (two knives, two *obeloi*, trident); Tomb 144 (dagger/dirk, spearhead, ring on bronze spearhead, three arrowheads, two *obeloi*).[70]
- Kouklia, Skales, Tomb 43 (dagger/dirk); Tomb 48 (knife, ring on bronze spearhead); Tomb 49 (two knives); Tomb 61 (fibula); Tomb 78 (spindle, pin); Tomb 84 (knife); Tomb 85 (pin); Tomb 89 (two knives, dagger/dirk, pin, two attachments); Tomb 91 (finger ring, fibula, pin); Tomb 185 (two knives); Tomb 187 (knife, dagger/dirk); Tomb 188 (knife); Tomb 197 (knife, fragments of rod-shaped artefacts); Tomb 210 (dagger/dirk); Tomb 235 (two knives); Pyre 1 (knife).[71]
- Kouklia, Xylinos, Tomb 132 (knife, two *obeloi*, pin).[72]
- Kourion, Kaloriziki, Tomb 19 (knife); Tomb 39 (knife, spearhead, trunnion axe).[73]
- Lapithos, Kastros, Tomb 417 (*obelos*); Tomb 420 (two knives).[74]
- Salamis, Tomb 1 (two knives).[75]
- The date of the iron finds from the following tombs from Amathus is rather uncertain, a position around the CG I/II transition seems most likely: Amathus, Swedish Tomb 15 (knife, fibula); Swedish Tomb 21 (knife, pointed rod); Tomb 521 (knife, dagger/dirk); Tomb 523 (two knives, dagger/dirk).[76]

The most common weapons are either long daggers or short dirks (Figure 11: 2-3).[77] Apart from the examples listed above, two further daggers/dirks from Kouklia, Skales, Tombs 200 and 203 should also be mentioned. As the recently published tombs from the Plakes and Skales cemeteries at Kouklia were frequently excavated under unfavourable rescue conditions, the documentation is often incomplete and it is difficult to assign the grave furnishings to individual burials. In the case of Tombs 200 and 203, most of the finds from the tombs date to CG I, and this may well be true for the daggers/dirks. However, there are also some objects which indicate later use of the tombs, making the chronological position of these weapons somewhat uncertain.[78]

[68] See for example Steel 1996: 287; for the Ashlar Building at Enkomi, see Papasavvas 2014.
[69] I would like to thank Dr Anna Georgiadou (University of Cyprus) most warmly for her generous advice on the chronology of the Cypro-Geometric tombs with iron artefacts.
[70] Karageorghis and Raptou 2014.
[71] Karageorghis 1983 (Tombs 43-91); Karageorghis and Raptou 2016 (Tombs 185-235 and Pyre 1).
[72] Flourentzos 1997.
[73] Benson 1973: 27 no. 32; 124 no. K1106; pl. 40 (Tomb 19); 48 f.; 124 no. K1100, K1101 and K1109; pl. 40 (Tomb 39).
[74] Gjerstad 1934: 228 no. 12a; pl. 51: 1 (Tomb 417); 237 no. 23; 238 no. 46; pl. 53: 1 (Tomb 420).
[75] Yon 1971: 18 no. 36-37; pl. 15: 36.37; pl. 18: 36.37.
[76] Gjerstad 1935: 93 no. 60 and 63; pl. 23: 2 (Swedish Tomb 15). — Gjerstad 1935: 117 no. 19; 118 no. 46; pl. 25: 2 (Swedish Tomb 21). — Karageorghis and Iacovou 1990: 76; 82 fig. 5; 87 no. 98A-B; 97 f.; pl. 10: 98A-B (Tomb 521). — Karageorghis 1987: 719 ff.; 720 fig. 188-190 (Tomb 523).
[77] These weapons are often badly preserved, but the more complete examples suggest that they originally measured around 31-34 cm in length. For a discussion of the daggers and dirks, and an explanation of the terminology used here, see Chapter 4.3. — There is no reliable evidence for the use of iron swords in Cyprus in CG I. The swords from Kouklia, Plakes, Tomb 145 and Skales, Tomb 76 come from tombs which continued in use in CG II or even later. For the swords, see Karageorghis 1983: 216 no. 22 (Skales, Tomb 76); Karageorghis and Raptou 2014: 67 no. 61+67 (Plakes, Tomb 145).
[78] Karageorghis and Raptou 2016: 79; 88.

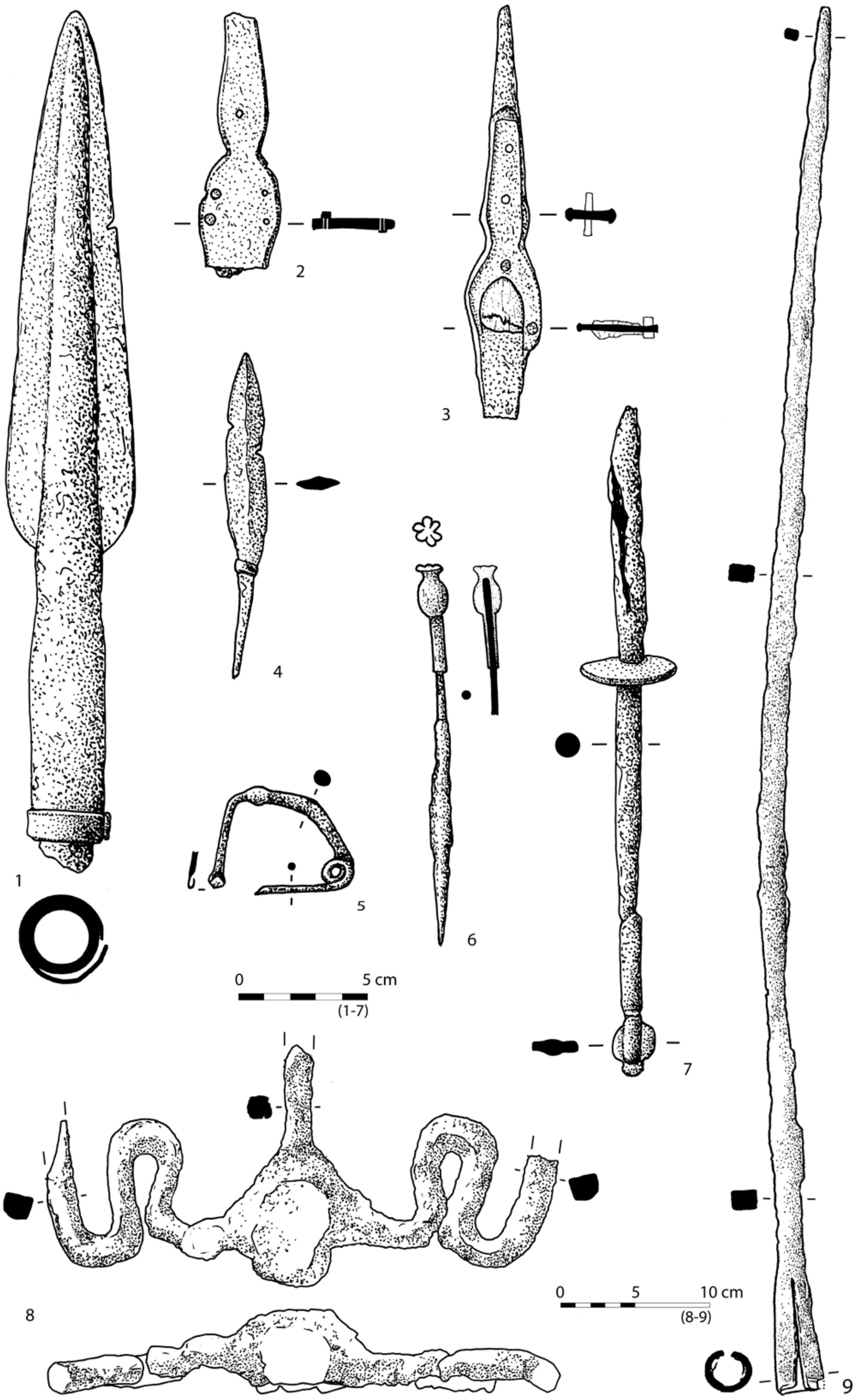

Figure 11. Selection of iron artefacts dating to Cypro-Geometric I. — 1 Kouklia, Plakes, Tomb 144: iron spearhead with bronze ring around the mouth of the socket. — 2 Kouklia, Skales, Tomb 210: fragmentary hilt from an iron dirk or dagger. — 3 Kouklia, Skales, Tomb 200: fragmentary hilt from an iron dirk or dagger. — 4 Kouklia, Plakes, Tomb 144: iron arrowhead. — 5 Kouklia, Skales, Tomb 61: iron fibula. — 6 Kouklia, Skales, Tomb 89: iron pin with an ivory head. — 7 Kouklia, Skales, Tomb 78: iron spindle with bronze disc. — 8 Kouklia, Plakes, Tomb 142: fragmentary iron trident. — 9 Kouklia, Plakes, Tomb 144: iron socketed roasting spit. — 1.4.8.9 after Karageorghis and Raptou 2014: pl. 83; 88; 89. — 2.3 after Karageorghis and Raptou 2016: pl. 91; 97. — 5.6.7 after Karageorghis 1983: pl. 117; 147; 193. — 1.7 iron and bronze; 6 iron and ivory; otherwise, iron.

Compared with the daggers/dirks, other iron weapons have been found less frequently (Figure 11: 1.4). These come from Kouklia, Plakes, Tomb 144 (spearhead and three arrowheads), and Kourion, Kaloriziki, Tomb 39 (spearhead and trunnion axe), which will be discussed in more detail in Chapter 4.3-4.[79] It seems that bronze spearheads were still predominant during CG I; sometimes they had iron rings on the ends of their sockets.[80]

Iron feasting equipment is a spectacular addition to the blacksmith's repertoire, and it appears earlier in Cyprus than anywhere else in the Ancient World. *Obeloi* are found in four tombs from Kouklia and Lapithos, often occurring in pairs.[81] An example from Plakes 144 is complete, a little over 91 cm in length, rectangular in cross-section and with a conical slit socket (Figure 11: 9). It is similar typologically to the well-known bronze *obeloi* from Kouklia, Skales, Tomb 49, one of which was engraved in the Cypro-syllabic script with the Greek name Opheltas.[82] The splendid trident from Kouklia, Plakes, Tomb 142 represents an even more ostentation use of iron (Figure 11: 8); it is 32.8 cm wide, but unfortunately the original length of the trident prongs, possibly comparable to the *obeloi*, is uncertain.[83] The iron spindle from Kouklia, Skales, Tomb 78 is another unique iron artefact illustrating how iron was used in CG I to made prestigious objects as markers of social distinction, but in this case for a woman (Figure 11: 7).[84]

Personal ornaments of iron are found in tombs of CG I, but they are less prominent (Figure 11: 5-6). Pins are most common, occurring in five or six tombs. In three cases, the iron pins have a bone upper shaft and head; their method of construction is quite different from the iron pin with biconical ivory head from Kourion, Bamboula, Tomb 19, which dates to LC IIIA.[85] The remnant of an iron pin with glass head was found in Kouklia, Xylinos, Tomb 132.[86]

The only settlement finds which can be assigned to CG I come from Kition, comprising a knife, an awl and an *obelos* fragment:

- Kition, Area II, Floor I: Temple 5/Temenos B (*obelos*); Temenos A/Room 16, Bothros 2 (knife, awl).[87]

There is some uncertainty about the chronology of this phase at Kition, and Joanna Smith has suggested a considerably later date, spanning the 10th and the first half of the 9th century BC.[88]

3.4 Discussion and conclusions

According to the archaeological record, iron was unknown in Cyprus before LC IIIA. Iron first appears in the form of simple implements (one-edged and two-edged knives, spatulae and 'chisels') and a dress-pin. The same spectrum of artefacts is found both in tombs and from settlement contexts, indicating that iron production was, indeed, at first restricted to these kinds of object, which were relatively easy for the

[79] Further iron spearheads are known from Kythrea and Marion, but these tomb contexts are not reliably dated to CG I. — Kythrea, Tomb 4, two iron spearheads (tomb used in CG I and CG II); see Nicolaou 1965: 62 no. 24; 63 no. 29. — Marion, Evrethades, Tomb 68, iron spear with bronze ring on the socket (stratigraphy unreliable, could belong to second burial period dating to CA I); see Gjerstad 1935: 384; 385 no. 21.
[80] Kouklia, Plakes, Tomb 144: Karageorghis and Raptou 2014: 51 no. 68. — Kouklia, Skales, Tomb 48: Karageorghis 1983: 54 no. 3.
[81] Kouklia, Plakes: Karageorghis and Raptou 2014: 31 ff. no. 38, 84-102 (Tomb 142); 49 ff. no. 37, 39-42, 46-47, 53, 67 (Tomb 144). — Kouklia, Xylinos, Tomb 132: Flourentzos 1997: 207 no. 13+72+82; 211 no. 73+115; pl. 43. — Lapithos, Kastros, Tomb 417, rich female burial: Gjerstad 1934: 228 no. 12a; pl. 51: 1.
[82] Karageorghis 1983: 61 no. 16-18; pl. 88: 16-18; Vonhoff 2011: 135 fig. 2.
[83] Karageorghis and Raptou 2014: 35 no. 160; 41 f.; pl. 13: 160; 83: 160.
[84] Karageorghis 1983: 236 no. 12+43; pl. 151: 12+43; fig. 147: 12+43.
[85] Pins with bone upper shaft and head, from Kouklia, Skales, Tombs 78, 89 and 91: Karageorghis 1983: fig. 147: 38; 193: 40+113; 199: 75. — Pin with biconical ivory head, from Kourion, Bamboula, Tomb 19: Benson 1972: pl. 35: B1389.
[86] Flourentzos 1997: 212 no. 101; pl. 44: 101. — Compare the pin with glass head from Perati, Tomb 108 (LH IIIC Middle-Late), discussed in Chapter 4.2: Iakovidis 1969: 394; pl. 116: α (Δ142).
[87] Karageorghis 1985: 217 no. 2856; Karageorghis and Demas 1985: 159; 246; pl. 170: 2856; 228: 2856; Maddin 1982: 310 no. 829 and 1041; Waldbaum 1999: 48 no. 9-10.
[88] Smith 2009: xviii table 4.

blacksmiths to make. In a number of cases, the artefacts had ivory handles or, in the case of the pin, an ivory head, which suggests that they were still valuable at this time. The spatulae, and possibly some of the 'chisels', were probably used in preparing cosmetics.

The knives represent the most prominent category of artefacts in LC IIIA, with at least 17 examples known from tombs and settlements. Knives remain prominent in LC IIIB. When both phases are taken together (LC IIIA and IIIB), the total number of knives from tombs and settlements exceeds 26.[89] Iron production in Cyprus was definitely innovative and dynamic during the 12th century BC, particularly in its focus on utilitarian implements, and especially knives. However, in view of the earlier history of iron production in the Near East, it can hardly be doubted that the technology was transferred to Cyprus during the Crisis Years, presumably by immigrant smiths. As we have seen in the previous chapter, the technology was certainly available in the Near East. For example, knives/daggers represent the most frequent iron artefacts listed in the Hittite palace inventories, and an iron knife was discovered during the excavations at Ugarit. The bimetallic gold and iron finger ring from Kition, Tomb 9 was quite likely imported to Cyprus, considering the similar ring known from Megiddo.

The dynamic development of iron production in Cyprus during the 12th century BC, and particularly the focus of Cypriot blacksmiths on the production of utilitarian implements, has been the subject of much discussion. A number of authors have suggested that the introduction of iron for the production of knives can be explained by the discovery of the technical advantages of carburization (steeling) and thermal treatment (quenching and tempering) by Cypriot blacksmiths. This was argued, for example, by Sydney Pickles and Edgar Peltenburg in an article published in 1998. Pickles and Peltenburg believed that carburization, and probably quenching, were systematically practised in Cyprus from ca. 1200 BC onwards.[90] This theory is based on research conducted in the 1970s and 1980s by a team from the University of Pennsylvania, including the metallurgist Robert Maddin and the archaeologists James Muhly and Tamara Stech.

It should be remembered that a degree of carburization always occurs in a bloomery furnace (see Chapter 1.1). But owing to the difficulty of maintaining the necessary reducing conditions and high temperature, the iron is normally heterogeneously carburized, with lower and higher carbon zones randomly distributed throughout the metal. However, in the blacksmith's forge, if an iron implement is kept at a high temperature in close contact with charcoal for a number of hours, carbon can diffuse into the material, resulting in a consistent degree of surface carburization or steeling. To demonstrate deliberate and systematic carburization, it must therefore be shown that the distribution of carbon is consistently high at the working edge of the implement, and this is obviously difficult in the case of severely corroded artefacts, in which the surface, at best, only survives in the form of relict or ghost structures.[91] It is even more difficult to demonstrate thermal treatment – quenching and especially tempering.[92]

Only very few artefacts of LC III have been subjected to metallurgical analysis: the hook-shaped fragments from Hala Sultan Tekke, a blade fragment (the so-called 'dagger tip') from Kition, and three knives from Idalion.[93] Metallurgical analyses are more numerous for CG I, comprising five artefacts from tombs at Amathus, Kouklia and Lapithos.[94] A knife and an awl fragment from Kition, Floor I, have also been analysed.[95]

[89] These figures include both knives and blade fragments. — When examples with uncertain chronology are included, the total for LC IIIA and IIIB reaches 38 knives/blade fragments.

[90] Pickles and Peltenburg 1998: 84 ff.; 91 ("carburization as the trigger for the full Iron Age").

[91] In the publications of Maddin, Muhly and Stech, the terminology used to describe the degree of carburization is often ambiguous (e.g. "slight", "mild", "moderate", or "extensive" carburization). See Maddin 1982; 2011; Stech et al. 1985; Åström et al. 1986.

[92] For a good discussion of the earliest evidence for carburization, quenching and tempering, see Erb-Satullo 2019: 576-580.

[93] Tholander 1971: 18 f.; 22; Maddin 1982: 306; 310; Åström et al. 1986: 30 f.; 37; Maddin 2011: 206. — As mentioned above, these finds from Idalion are not reliably dated, as they come from levels of the settlement which appear to have been mixed with Iron Age material; see Gjerstad 1935: cat. no. 106 (isolated find, Per. 2-3), cat. no. 517 (Per. 3) and cat. no. 1068 (Per. 3).

[94] Amathus, Swedish Tomb 21; Kouklia, Skales, Tomb 49; Lapithos, Kastros, Tomb 417 and 420. See Maddin 1982: 306 f.; Stech et al. 1985; Åström et al. 1986: 33 f.

[95] Maddin 1982: 307; 310; Åström et al. 1986: 37.

For these artefacts, evidence for carburization is very uneven. As Robert Maddin notes, only a few of the 21 analysed artefacts from Kouklia (Palaepaphos-Skales) and Kition had clear evidence of carburization, and this was the case not only for the Geometric, but also for the Archaic and Classical periods.[96] For example, in Kouklia, Skales, Tomb 49, both knives showed no signs of deliberate carburization. And in Tomb 76, with burials of both CG I and II, while two of the knives were thoroughly carburized, the other analysed artefacts (two awls and two knives) showed no evidence of deliberate carburization.[97] None of the artefacts from Kouklia, Skales preserved evidence for quenching or tempering. The situation is similar for the artefacts analysed from Amathus and Lapithos, with 'moderate' carburization only observed in one knife. Evidence for extensive carburization and thermal treatment (quenching) was only reported in the case of the three knives from Idalion which, however, were found in the disturbed upper levels of the settlement stratigraphy, which also contained later finds.[98] Considering that the evidence for carburization and thermal treatment is inconclusive even during the Cypro-Geometric and Phoenician periods, the evidence from Idalion cannot be regarded as reliable.

In summary, there is little evidence for intentional steeling and thermal treatment in Cyprus during the first centuries of iron production, and the arguments of Pickles and Peltenburg do not appear to be convincing. This agrees with the wider picture in the Near East, as reviewed in the previous chapter. Summarizing the evidence from the southern Levant, eastern Anatolia and Iran, Nathaniel Erb-Satullo concludes: "... there is little evidence for the contention that consistent carburization and quenching, which are needed to make iron much harder than bronze, were driving factors in the initial surge of iron adoption."[99] Clearly, we must find alternative explanations for the rapid dissemination of iron production around the Crisis Years.

In a number of publications, Susan Sherratt developed an interesting and influential model for the early development of iron production in Cyprus, in which knives play an important role.[100] Contradicting Snodgrass's 'bronze shortage' theory (see above), she argued that there was instead an excess of bronze in circulation in Cyprus during the 12th century BC. As mentioned above, Sherratt was a proponent of the view that the early iron knives were regularly produced as a by-product of copper-smelting – basically using a waste material generated in the course of bronze production. As a marketing strategy for iron, the Cypriot workshops focused on the production of knives, specifically designed for sub-élite consumers. In her words: "Initially produced as a by-product of copper smelting, from what might almost literally be regarded as waste in a local context, it seems to have been deliberately marketed as a primarily value-added sub-élite or substitute élite product within an east Mediterranean social and cultural context which still regarded iron as a rare élite material of immense preciosity."[101] Furthermore, the coastal centres of Cyprus were at the vanguard of a new kind of decentralized, entrepreneurial trade: iron "formed one of the most strategically crucial landmarks in a steadily progressive (and inevitable) commercial revolution which gradually evolved during the Bronze Age in the eastern part of the Mediterranean, and which was to ensure that the centralised, bureaucratic, palace-based economies of the Bronze Age, in which economic and political control were very closely identified, could not successfully re-emerge in the 1st millennium."[102] Sherratt believes that during the 12th century BC the knives might have been produced in just one or two well-organized workshops (presumably at Enkomi and Kouklia/Palaepaphos).[103] Furthermore, she argued that the Cypriots first created a market for their utilitarian iron in the Levant

[96] Maddin 1982: 307; 309 f.; Maddin 2011: 206.
[97] See Stech et al. 1985.
[98] Naami Yahalom-Mack and Adi Eliyahu-Behar (2015: 297) doubt the validity of the Idalion evidence. See also Eliyahu-Behar and Yahalom-Mack 2018: 460.
[99] Erb-Satullo 2019: 559. — See the discussions in Pigott (1985) for Iran; McConchie (2004) for eastern Anatolia; and Eliyahu-Behar and Yahalom-Mack (2018) for the southern Levant.
[100] Sherratt 1994a; 1998: 294 ff; 300 ff.; 2000: 82 ff.; Sherratt and Sherratt 2001: 29 ff.
[101] Sherratt 1998: 300.
[102] Sherratt 1994a: 85.
[103] Sherratt 1994a: 71.

in the 12th century; when this was lost, they proceeded to create a new market in the Aegean during the 11th and 10th centuries BC.[104]

Today, some of the details of Sherratt's model must be revised or rejected. This is certainly the case for the idea that the iron was obtained as a by-product of copper smelting (see above). And we have seen in the previous chapter that utilitarian iron objects (knives) were still extremely rare in the Levant during the 12th century BC. Both in the Levant and the Aegean, 'Cypriot' knives gradually appear during the second half of the 12th century, and become more common in the 11th century BC. Apart from these points of detail, Sherratt's explanation for the dynamic early development of iron production in Cyprus is original, stimulating and convincing. As she noted, Cyprus was probably the sole producer of utilitarian iron objects during the 12th century BC, and her model is very important for understanding Cypriot trade in the Mediterranean after the Crisis Years.[105] The so-called 'knife horizon', which is of crucial importance for the dissemination of iron, can be traced back to the beginning of Cypriot iron manufacture in the early 12th century BC.

The dynamic development of iron production in Cyprus continued during the 11th and 10th centuries BC. As explained above, there is much less evidence available for LC IIIB than for LC IIIA – this applies both to tombs and settlements. Even so, there are indications that the range of iron artefacts changed in LC IIIB, now including larger and more elaborate artefacts, including the dagger from Kourion, Kaloriziki (Figure 10), the 'carving knife' from the Ashlar Building at Enkomi (Figure 14: 1), and the knife with ring terminal from Enkomi, Tomb 108. This process is even more impressive in CG I, when weapons (daggers/dirks, spears, arrows), a trunnion axe, a spindle and feasting equipment (*obeloi*, the trident) show how the Cypriot blacksmiths had learned to make even larger and more complex iron objects (Figure 11). At this time, the large iron artefacts, such as the daggers/dirks, the *obeloi*, the spindle and the trident, probably had the status of prestigious markers of social distinction, and were produced for members of the élite. In Chapter 4.3, a review of warrior graves illustrates how Cyprus was clearly in close contact with the Aegean at this time, where iron weaponry also plays a prominent role (see also Table 6). These developments in iron production in Cyprus and the Aegean seem to take place earlier than in the Near East – at least according to the evidence from the southern Levant, where the widespread adoption of iron for utilitarian implements and weapons only took place during the second half of the 10th century BC.

[104] Sherratt 1994a: 68 ff.; 75; 83 f.; 1998: 304.
[105] For further discussion of the role of Cyprus in the Mediterraneanization process, see Chapter 12.3.

Chapter 4
The Aegean

The introduction of iron in the Aegean has been the subject of a number of specialist studies, particularly by Jane Waldbaum and Jean-Louis Zimmermann.[1] The subject is now quite well understood, and the following pages should be seen as a summary of the present state of research; there are few new discoveries, which have hardly changed the general picture as outlined by previous authors. The basic outlines were briefly sketched by Susan Sherratt thirty years ago in the following passage:

"[The] development of iron use and technology – and resulting cultural attitudes to iron – show a relatively clear pattern in the Aegean. In the period between ca. 1600 and ca. 1200 we have several small objects of iron in Aegean contexts, of a size and nature which required a minimum in the way of working. Most of these are personal ornaments or other trinkets: iron rings with gold or gold-plated bezels, bronze rings plated with gold and iron, and iron studs set in gold. The frequent combinations of iron and gold suggests that iron was regarded at this time as an exotic luxury with intrinsic value as a precious metal ... From ca. 1200 BC onwards, the first small iron blades appear in the Aegean in the form of knives with bronze rivets which are almost certainly imports from the East Mediterranean. The breakthrough in blade technology in Greece itself comes sometime around the middle of the 11th century when the first all iron dagger ... appears, closely followed by full-sized iron swords."[2]

As Sherratt concludes, the process of innovation can be divided into fairly distinct stages, which will now be described in more detail. In my study of the evidence, I have critically reviewed the contexts and chronology of the early iron objects. Quite frequently, this critical approach shows that iron objects which have been considered as evidence for the early use of iron by previous authors are in fact unreliable, and should be rejected. By means of this 'source criticism', the stages in the introduction of iron in the Aegean become even clearer.

4.1 Iron before 1200 BC

For a period of up to six centuries, iron is preserved in the archaeological record mainly in the form of signet rings.[3] In total, at least 15 rings with iron elements are known from Crete and the Peloponnese. The earliest dates to the 18th century BC, but the majority come from contexts of the 16th-14th centuries BC. Many of the rings are polymetallic, combining elements of gold, silver, bronze and/or lead as well as iron. The 'stratigraphy' evident in their construction is significant: the most valuable materials, namely gold and iron, were displayed on the surfaces of the bezels and hoops, while silver, bronze and lead were used for the basic substructure and obviously had a lower status in the hierarchy of value. The rings have all been discovered in famous contexts of the royal or courtly élite of the Minoan and Mycenaean palatial cultures, demonstrating the exclusive nature of iron as a precious metal during this period.

The earliest example comes from the famous sanctuary of Anemospilia near Archanes in central Crete. The ring was discovered on the hand of the 'priest', who was killed in the earthquake which destroyed the site in MM IIIA. The ring had a silver hoop riveted to a silver bezel, which in turn had a layer of iron sheet attached to its outer side.[4] In LH IIA, around the 16th century BC, signet rings with iron reached the Peloponnese, for example in the famous 'princely' tombs from Kakovatos-Pylos in Triphylia and Vapheio in Laconia.[5] But the most spectacular examples are the four so-called 'bi-bezel' rings of the

[1] Waldbaum (1978; 1980; 1999); Zimmermann (2001). — See also Joanna Palermo's unpublished dissertation (2018).
[2] Sherratt 1990: 810-811.
[3] For a good introduction to the use of iron in Minoan and Mycenaean signet rings, see Palermo 2018: 91-109.
[4] Varoufakis 1981: 25 no. 1; Effinger 1996: 126; Sakellarakis and Sapouna-Sakellaraki 1997: 650 f. fig. 717; Müller 2012: 467; pl. CXVI: e; Becker 2018: 449 f. cat. no. R99.
[5] Kakovatos-Pylos, Tholos A: Varoufakis 1981: 25 no. 4; 26 fig. 1: 4; 1982: 315; pl. 30: 1. — Vapheio, stone cist in Tholos Tomb: Tsountas 1889: 147; Kilian-Dirlmeier 1987: 200; Gallou 2020: 11 ff.; 123; 129 ff.

15th/14th century BC; these have decorated bezels split into two fields of gold and iron.[6] In the case of the example from Phaistos, Kalyvia, Chamber Tomb 10 the bronze hoop is covered with gold and iron; the hoop was riveted to the bezel, which was again of bronze, but the outer surface bore sheets of gold and iron decorated with three figure-of-eight shields.[7] The bi-bezel signet ring from Mycenae, Chamber Tomb 58, has a gold hoop inlaid with iron, and the upper half of the gold bezel is again covered with iron. The bezel is decorated with two reclining bulls; the decoration is well preserved on the golden half of the bezel, and traces of the upper parts of the bulls' bodies are still visible on the corroded surface of the iron sheet.[8] Two bi-bezel signet rings were discovered in the lavishly furnished Chamber Tomb 1 at Asine in the Argolid; their construction is similar to the ring from Phaistos, with a bronze substructure covered with gold and iron. The gold and iron surfaces of the bezels bear bull-leaping scenes.[9] In the other signet rings with iron elements, signs of decoration have mostly not survived on the bezels. In Chamber Tomb 7 at Aidonia, in Corinthia, the ring is made of silver; the outer side of the hoop is inlaid with an iron band, and the oval bezel originally had an iron surface.[10] The combination of silver and iron is found on another ring, from Chamber Tomb 68 at Mycenae.[11] The 'stratigraphy' in the construction of three signet rings from the Royal Tholos at Dendra is especially significant.[12] The hoops of the rings are made of silver and lead. Axel Persson provides the following description of the bezels: "They are formed of thin layers of metal, one laid on top of the other, the innermost of silver, then lead, copper, and finally iron".[13] Once again, iron is used on the outer surface of the bezel, and according to Persson traces of decoration are still preserved on the corroded iron surface. While most of the signet rings come from contexts dating to LH II and IIIA, an example from House M, Room 2, on the citadel of Mycenae might be later. It was found in a context together with ritual equipment in the debris of the LH IIIB2 destruction; however, as the finds in the debris range in date from LH IIIA to IIIB, the ring could have been manufactured one or two centuries before the downfall of the palace. Here, the silver bezel has unfortunately lost its inlay; the hoop is made of bronze inlaid with a band of iron.[14]

Further iron finger rings have been found in Melathria and Mycenae. At Melathria, near Skoura in Lakonia, the ring came from Chamber Tomb A1 in a context dating to LH IIIA2-B1.[15] In Mycenae, the rings were excavated by Christos Tsountas in Chamber Tombs 10 and 28.[16] And two more unprovenanced remnants of lead and iron rings are housed in the National Archaeological Museum in Athens.[17] A Mycenaean date is plausible for all four of these rings, although a more precise estimate of the chronology is today impossible.

Apart from the finger rings, there is one other ornament combining gold and, apparently, iron. This is a cylindrical 'iron' bead or pendant with gold mountings bearing granulation at either end (length 2.5 cm),

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6 The term 'bi-bezel' ring was coined by Joanna Palermo (2018: 99 ff.). — A bi-bezel ring from Mycenae, Chamber Tomb 71 also seems to have iron components: Agnes Xenai-Sakellariou mentions three small iron nails visible on the rear side of the gold bezel. Perhaps these were used to fix an iron sheet to the upper surface of the bezel? See Sakkelariou 1964: no. 108; Xenaki-Sekallariou 1985: 206 note 81. I am grateful to Vassiliki Pliatsika (National Archaeological Museum, Athens) for this information.

7 Savignoni 1904: 593 fig. 55; Varoufakis 1981: 25 no. 2; 26 fig. 1: 1; Platon and Pini 1984: 130 f. no. 113; Effinger 1996: 279; pl. 57: a.b; Müller 2012: 467; pl. CXVI: a; Becker 2018: 438 ff. cat. no. R89. — Kalyvia, Chamber Tomb 10 contained a second undecorated iron signet ring; in the literature some doubts have been expressed about this piece. See Savignoni 1904: 594 fig. 56; Vagnetti 1972: 191 note 7; Waldbaum 1978: 81 note 46; Varoufakis 1981: 25 no. 2; 26 fig. 1: 2; Effinger 1996: 280; pl. 15: g.

8 Sakellariou 1964: 107 no. 91; Varoufakis 1982: 315; pl. 30: 2; Xenaki-Sakellariou 1985: 182 f.; Müller 2012: 467; pl. CXVI: b; Becker 2018: 404 ff. cat. no. R58. — Chamber Tomb 58 contained a second signet ring with an iron hoop, but the bezel has not survived. See Varoufakis 1981: 29 no. 4; 27 fig. 2: 4; Varoufakis 1982: 316; pl. 30: 6; Xenaki-Sakellariou 1985: 182 f.

9 Sakellariou 1964: 229 f. no. 200-201; Becker 2018: 419 ff. cat. no. R71-72.

10 Demakopoulou 1996: 27; 51 no. 20; Becker 2018: 424 ff.

11 Varoufakis 1981: 25 no. 5; 26 fig. 1: 5; Varoufakis 1982: 315 f.; pl. 30: 5; Xenaki-Sakellariou 1985: 195.

12 Persson 1931: 16; 33; 56 f. fig. 35; Varoufakis 1981: 25 ff. no. 1-2; 27 fig. 2: 1.2; Varoufakis 1982: 315; pl. 30: 3.4.

13 Persson 1931: 56.

14 Pliatsika 2015: 601 f. fig. 2.

15 Gallou 2020: 28 f.; 123 (supposedly 'meteoritic iron').

16 Tsountas 1888: 135; 140 f.; 147 f.; Xenaki-Sakellariou 1985: 68 ff.; 100 ff.

17 NAM Athens, inv. no. 2337 and 2347: Varoufakis 1981: 29 no. 3 and 5; 27 fig. 2: 5; Varoufakis 1982: 316; pl. 30: 7. — The National Archaeological Museum in Athens has three more iron finger rings from excavations of tombs at Mycenae in 1887/88, unfortunately their exact contexts are unknown (inv. no. P 2346, personal communication from Vassiliki Pliatsika, NAM Athens).

from Chamber Tomb II at Dendra in the Argolid.[18] In this case a date ranging between LH IIIA and IIIB is possible, with an absolute date within the 14th century BC being most likely.[19] Without scientific analysis, it seems rather uncertain whether the bead was truly made of metallic iron. It is difficult to imagine how an iron bead could have been perforated (drilled); perhaps it is actually made of an iron mineral.

In four tombs dating between the 18th and 15th century BC, objects have been found which appear to be 'iron-like'. In Burial Building 9 at Archanes, dating to MM IIA/B, a tiny bead of 'meteorite' belonged to a necklace of sea-shells, and in a pit in Tomb 17B in the Mavro Spelio cemetery at Knossos, the excavators found a small corroded 'iron cube'.[20] Two beads from Tholos A at Archanes-Phourni (LM IIIA1) have flat, facet-like surfaces and, according to the published photograph, certainly do not seem to be made of metallic iron.[21] And finally, in the monumental Chamber Tomb 1 at Pellana, 'Spelies', in Laconia, dating to LH IIA, a lump of 'meteoritic iron' has been reported.[22] In all four cases, without analytical evidence it is quite uncertain whether the objects are made of an iron-rich mineral, such as chalcopyrite, or smelted or even meteoritic iron. But in none of these four cases does it seem at all plausible that we are dealing with metallic iron.

Apart from the ornaments which have been described so far, there is only one utilitarian iron implement known from the Aegean before the 12th century BC. This is the pointed iron rod (length 3.4 cm) from Room B in the Kadmeia at Thebes.[23] This was described as a "drill point" in the publication by Sarantis Symeonoglou, but judging from the published photograph it could equally well be an awl, a graver or a burin. This room has been interpreted convincingly as a jewellery workshop: the finds show that gold, lapis lazuli and rock crystal were worked there, and a kiln could have been used for heating metals. The pottery from the workshop indicates a date in late LH IIIB1 or early LH IIIB2.[24]

Before discussing this earliest evidence for iron in the Aegean further, it is necessary to comment briefly on the objects which have not, so far, been mentioned in our review. A number of artefacts have been included by previous authors in their catalogues of early iron, but a critical revision of their find contexts and chronology shows that they should be rejected:[25]

- Asine (Argolid): an iron nail (length 7.2 cm) was found in the fill of cist grave 12/1970. As the position of the nail was not recorded, and it did not belong among the MH III burial furnishings, the date of the nail is uncertain, and it could be a much later intrusion.[26]
- Gla (Boeotia): one of the 30 lead clamps used for attaching the door-jambs to the walls of the palace was broken; André de Ridder described 'traces of iron' visible in the fracture. There is no plausible reason to think that metallic iron was used in the construction of the lead clamp; perhaps an iron-containing mineral was accidently mixed with the lead during production.[27]
- Knossos (Crete): a "finely-shaped nail, with a flat ornamental top decorated with a typical Mycenaean rosette" made of iron was mentioned by Arthur Evans in a preliminary report on his excavations in Knossos.[28] But the 'nail' was never mentioned by Evans in his subsequent publications, and is missing in the comprehensive Index to the Palace of Minos, published in 1936.[29] However, there is a description and sketch of the 'nail' in Evans' unpublished notebook

[18] Persson 1931: 79; 102 f. no. 14; pl. 33.
[19] For a discussion of the chronology, see Matthäus 1980: 44-46.
[20] Sakellarakis and Sapouna-Sakellaraki 1997: 627 fig. 675. — Forsdyke 1927: 246; 279; 296; pl. 23: 2; Alberti 2001: 174-176.
[21] Varoufakis 1981: 25 no. 3; 26 fig. 1: 3; Sakellarakis 1970: 150; 153 note 82, no. 202-203; 155. Sakellarakis and Sapouna-Sakellaraki 1997: 624 fig. 671.
[22] Gallou 2020: 19-21; 123.
[23] The 14 Oedipus Street site was excavated in 1964/65. See Symeonoglou 1973: 15; 70 pl. 93, fig. 274: 8; Waldbaum 1978: 19.
[24] Vitale 2006: 191.
[25] For the objects listed below, see: Waldbaum 1978: 18-19; 1980: 77-78; 1999: 46; Zimmermann 2001: 113; Palermo 2018: 84; 87-90; 109-110 (cat. no. BA.30, 80, 90, 170, 270, 330).
[26] Dietz 1980: 30 no. 21; 52 fig. 59: 21; 84.
[27] De Ridder 1894: 293 f.
[28] Evans 1900a: 66.
[29] Evans and Evans 1936.

for the year 1900, which he later crossed out. Evans had obviously dismissed this find, probably believing it to be late and intrusive.[30]
- Nichoria (Messenia): an iron bracelet and iron scrap were discovered during excavations. The contexts of these objects are regarded by the excavators as "obscure", and they assume them to be of Dark Age or Byzantine date.[31] They are not included in the treatment of the Bronze Age small finds, and it is clearly stated in the publication that no iron artefacts were found in pre-Dark Age Nichoria.[32]
- Thermi (Lesbos): an iron knife. According to Winifred Lamb, the knife was found "in earth which was probably disturbed. Whether it belongs to the Bronze Age is uncertain." The knife resembles Medieval or modern examples.[33]
- Volos-Kapakli (Thessaly): square iron plaque. Robert Avila explains that there is no record of where the plaque was found, and he concludes that it is uncertain whether it belonged to the inventory of the tholos tomb.[34]

When these objects are dismissed, a remarkably clear picture emerges. It transpires that almost all the objects incorporating iron dating before 1200 BC are items of jewellery, often combined with other precious metals (gold and silver), and almost all come from graves or ritual contexts associated with the Minoan or Mycenaean 'princely' élite. The distribution reaches from central Crete in the southern Aegean to Laconia, Tryphilia, the Argolid and Corinthia in the Peloponnese (Figure 12). It can hardly be a coincidence that the single exception, the 'awl' from Thebes, in Boeotia, comes from a jewellery workshop. It is difficult to avoid the conclusion that iron was used exclusively for the production and consumption of exclusive and precious ornaments for the aristocracy.

The question of the origin of the iron used in these early rings – meteoritic or terrestrial – has generated much discussion. A lump of rock from the Minoan palace at Aghia Triada was once thought to be an iron meteorite. As it had signs of sawing on its sides it seemed as though small pieces had been removed, possibly for making jewellery. However, George Varoufakis demonstrated that, instead, it consists largely of Al_2O_3, and it is now believed to derive from a stony meteorite.[35] Subsequently, discussion has hinged on the analyses by Varoufakis of six signet rings from Kakovatos-Pylos, Dendra and Mycenae, which date to LH IIA and IIIA1, and two further finger ring fragments in the National Archaeological Museum in Athens without known provenance (Table 5).[36] These have (calculated) levels of between 1.4% and 4.94% Ni, and some contained significant amounts of cobalt. One ring had an even higher nickel content estimated at 10.77%.[37] When considering these results, it is important to note that these figures give the estimated original concentrations of nickel in the artefacts; the analysed quantities were actually much lower, and Varoufakis compensated for the effects of corrosion and contamination by scaling up the Ni/Fe levels to approach 100%. Despite the problems arising from the poor state of preservation of the rings, Varoufakis' results are generally accepted as evidence for significantly high levels of nickel in the iron.

In their discussions of these results, George Varoufakis and Effie Photos concluded that the nickel concentrations, being below 5%, were not high enough to justify a meteoritic origin, and they considered favourably the possibility that the iron had been smelted from nickel-rich ores.[38] For Varoufakis and

[30] I am very grateful for information provided by Tod Whitelaw (UCL, London). In the notebook, Evans had crossed out the description and sketch of the 'nail'. For reasons which are today unclear, he obviously believed that it was not a genuine find from the Bronze Age palace. As this part of the site had been disturbed by earlier excavations, it is likely that the 'nail' was a later (Iron Age, medieval, modern?) intrusion.
[31] Catling et al. 1983: 273; 283 ff.; 310 cat. no. 85; 311 cat. no. 105; 302 fig. 5-49; Rosser 1983: 407 cat. no. 528; 416 fig. 12-19.
[32] Catling 1992: 618-624; Cooke and Nielsen 1978: 211.
[33] Lamb 1936: 207; pl. 25; 47 (no. 30.16).
[34] Avila 1983: 36; 32 fig. 6: 7.
[35] Varoufakis 1981: 30; 1982: 317; Buchwald 2005: 24.
[36] Varoufakis analysed the bulk chemical composition using Atomic Absorption Spectroscopy: Varoufakis 1981; 1982; Waldbaum 1999: 30.
[37] Unfortunately, this ring is unprovenanced and was very badly preserved, with an analysed iron content of only 26.92%, making the estimate of the original level of nickel unreliable.
[38] Varoufakis 1981; 1982; Photos 1989.

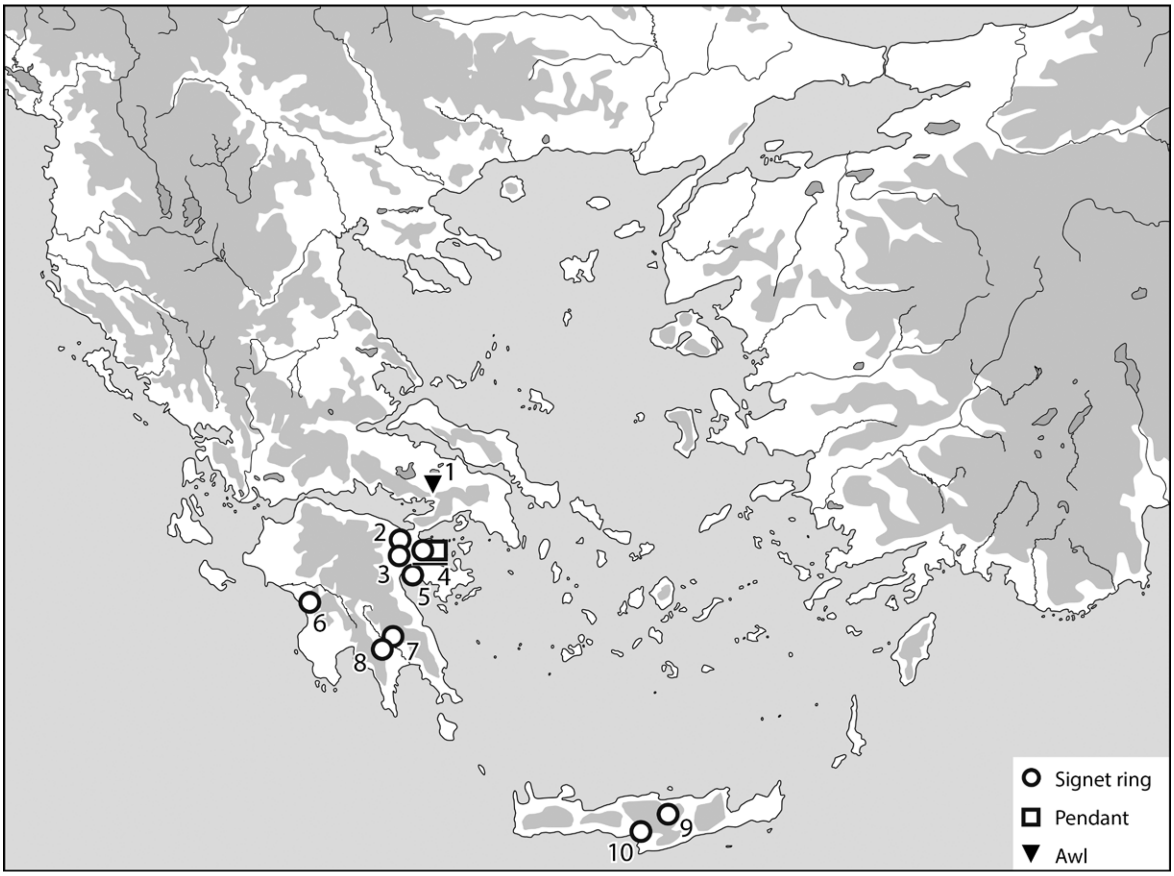

Figure 12. Distribution map of iron artefacts in the Aegean area, 18th-13th century BC. — 1 Thebes, Kadmeia. — 2 Aidonia. — 3 Mycenae. — 4 Dendra. — 5 Asine. — 6 Kakovatos-Pylos. — 7 Melathria. — 8 Vapheio. — 9 Archanes, Anemospilia. — 10 Phaistos, Kalyvia.

Table 5. Analyses of nickel and cobalt in iron artefacts from the Mycenaean period, conducted by George Varoufakis (after Varoufakis 1981; 1982).

Provenance	Sample	% Ni (anal.)	% Ni (calc.)	% Co (calc.)
Kakovatos-Pylos	Bezel	-	4.74	2.25
Dendra I	Bezel	1.68	2.77	-
Dendra I	Hoop	0.67	1.48	-
Dendra II	Bezel	0.63	1.4	-
Dendra II	Hoop	0.78	1.57	-
Mycenae, T.58/NM2866	Hoop	2.72	4.94	-
Mycenae, T.58/NM2856	Bezel	-	2.2	-
Mycenae, T.68/NM2986	Hoop	-	1.86	1.29
Unknown/NAM2337	Hoop	3.28	10.77	-
Unknown/NAM2347	Bezel	0.78	3.18	-
Perati, T.38	Knife	-	0.03	-
Tiryns	‘Sickle’	-	0.34	-

Photos, the most likely candidates are the lateritic iron ores, which are found in Greece, for example near Chalkis in Euboea, Atalanti in Locris and at several locations in western Macedonia. But these arguments have recently been strongly criticised by Albert Jambon, who noted that the effects of corrosion on meteoritic iron had not been taken into account sufficiently in previous studies.[39] According to his compilation of analytical results, 'fresh' (unweathered) iron meteorites contain between 5.8% and 40% (average: 10.2%) Ni. But he showed that weathering of meteoritic iron effects both the nickel content and the Ni/Fe ratio, and corroded meteorites can have levels of nickel even below 1%. He concludes that while a nickel content of over 5% can still be taken as evidence for a meteoritic origin, lower values for nickel in weathered objects do not automatically exclude the possibility of meteoritic iron. Furthermore, Jambon can think of no conceivable reason why metalworkers should have chosen to smelt nickel-rich lateritic iron ores; the resulting blooms are very difficult (or impossible) for blacksmiths to forge and could only produce a very low yield of iron.[40] In fact, during the Iron Age, nickel-rich ores were consistently avoided by metalworkers, and nickel contents in iron artefacts never exceed 1%.[41] Analyses by Varoufakis of two iron knives from Perati and an iron 'sickle' blade from Tiryns, all dating to LH IIIC, show that in 12th century BC Greece iron artefacts have much lower values for nickel (Varoufakis' estimates range between 0.03% and 0.34% Ni).

So why was nickel-rich iron used in the Bronze Age, and why was it not used later? The available facts allow two possible answers to these questions: either the Mycenaean metalworkers abandoned the scarce meteoritic iron as soon as they learned to smelt iron ores; or, if they had been smelting lateritic ores, they happily changed to more advantageous types of ore as soon as they learned about them, ca. 1200 BC.

In view of the fact that meteoritic iron was definitely used during the Bronze Age in the Near East and Egypt for manufacturing prestigious artefacts, a meteoritic origin for the Aegean examples appears highly likely. But from another point of view, the true origin of the iron might not be of prime importance. Perhaps the Bronze Age élites had no precise knowledge of the production of the iron, for example if it had been imported from far away, but nevertheless believed it to be meteoritic – which would explain its treatment as such a valuable metal. This might account for the occurrence of the other 'iron-like' objects mentioned above from Archanes, Mavro Spelio and Pellana, which could also have been regarded as meteoritic; and it is perhaps no coincidence that they come from areas (central Crete and Laconia), where iron jewellery has also been found.

It remains to mention one final difficulty in understanding this early use of iron. On the bi-bezel rings, the iron side of the bezel must have borne a decoration comparable in precision and artistic quality to that on the golden side.[42] Considering that nickel-rich iron is hard and brittle, it must have been a daunting challenge for the metalworkers. Apart from the matter of gaining suitable experience of working with the unfamiliar metal, the craftsmen must have had tools hard and sharp enough to chase (not engrave) the sheets of iron. Perhaps experimental work could solve the mystery of how this task was mastered.

4.2 The 12th and the first half of the 11th century BC

The situation changes profoundly in the 12th century BC, when a very different selection of iron artefacts appears in the archaeological record in the Aegean (see Figure 13). Knives form the most important category, but the rings from Ialysos, the main Mycenaean centre on Rhodes, will be discussed first as they constitute a case study different from any other location in the Aegean.

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[39] Jambon 2017.
[40] See the analyses and experimental work by Effie Photos on the slags and bloom from Petres in western Macedonia: Photos 1989; Photos et al. 1988: 35 "the local smiths did not know how to work nickel-rich iron".
[41] Jambon 2017: On Line Supplementary material, section A1. — Jambon discusses the possibility that some iron artefacts from Iron Age levels at Kaman-Kalehöyük in central Turkey, containing up to 0.7% Ni, could have been smelted from lateritic ores.
[42] Apparently, the iron bezels of the Dendra signet rings were also decorated (see above).

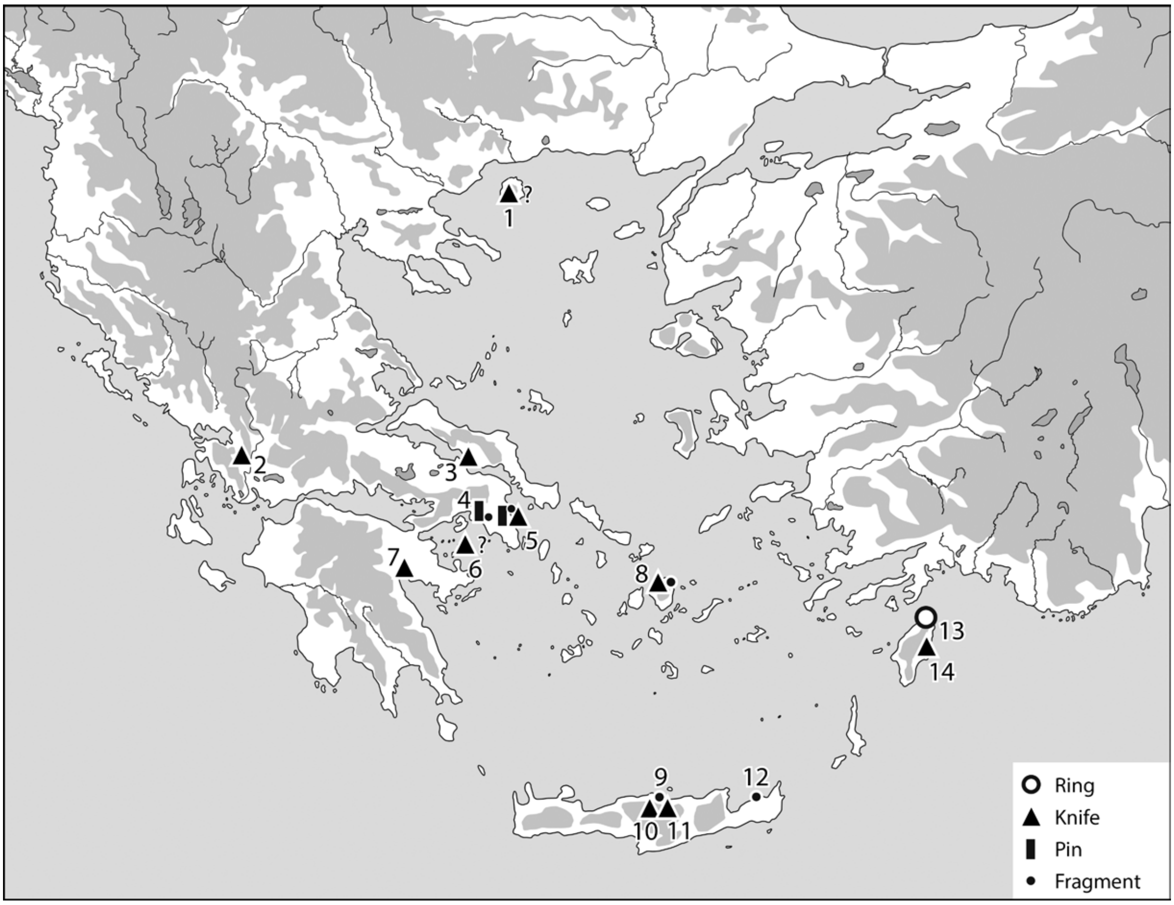

Figure 13. Distribution map of iron artefacts in the Aegean area, 12th century and first half of the 11th century BC. — 1 Thasos. — 2 Kouvaras. — 3 Lefkandi. — 4 Athens. — 5 Perati. — 6 Aegina, Oros hoard. — 7 Tiryns. — 8 Naxos. — 9 Katsambas. — 10 Tylissos. — 11 Knossos. — 12 Mouliana. — 13 Ialysos. — 14 Aghia Agathe.

The case of Ialysos

In Ialysos at this time, iron is represented exclusively in the form of ring jewellery, which was discovered in three different chamber tombs from the cemetery.[43] An iron bracelet with a diameter of 8 cm was discovered in New Tomb (NT) 17, very likely dating to LH IIIC.[44] Unfortunately, the iron finds from the other tombs have been lost, and our only information comes from the report by Giulio Jacopi and the unpublished excavation diary. An iron ring of unknown size came from NT 66, a tomb used both in LH IIIB and IIIC; and iron fragments, "perhaps from earrings", came from NT 69, from a context probably dating to LH IIIC Advanced.[45] Apart from the knife from Aghia Agathe, which will be discussed below, iron only starts to occur regularly on Rhodes in the developed Protogeometric period (MPG or LPG). For this reason, it is likely that the iron rings from Ialysos were imported.

After the Crisis Years, when sea-borne trading resumed in LH IIIC, there are few signs of direct trading contacts between Ialysos and mainland Greece, but imports from the East Mediterranean were common. For example, no less than five tanged bronze mirrors of Catling's type 2a, and three stone tripod mortars from Ialysos are clear evidence for contact with Cyprus. However, as iron rings are unknown in Cyprus in LC IIIA and IIIB (apart from the bimetallic finger ring from Kition), a different source for the Ialysos

[43] See for example Benzi 1988: 260. — Additional information on the iron finds and the chronology of all three tombs was generously supplied by Mario Benzi (Pisa).
[44] Maiuri 1924: 117 ff.; Benzi 1992: 194; 266; pl. 117: g.
[45] Jacopi 1931: 274 ff.; 281 ff.; Benzi 1992: 374.

ring jewellery must be sought. It is surely significant that the tombs from Ialysos contain a large number of 'eastern' objects, including gold jewellery, scarabs, cylinder seals, glass vessels and ivory.[46] While it is true that some of these exotic imports might be antiques or heirlooms, they nevertheless show the importance of the harbour of Ialysos during the 12th century BC.[47] Because of the wide range of foreign commodities, the commercial activities in post-palatial Ialysos have been described as "haphazard, sporadic and entrepreneurial", compared to the earlier, more regular mode of trading.[48] In this scenario, it is easy to imagine seafarers travelling from the Levant along the southern coast of Asia Minor, bringing with them iron jewellery of the Near Eastern 'ring horizon', which presumably would have been an attractive novelty.

Iron knives

The most important new category of iron artefacts is the flange-hilted knife, including six examples with bronze rivets from Naxos, Perati, Lefkandi, Knossos and Tylissos. Scholars have often, and in my opinion rightly, suspected that these objects were imported from Cyprus.[49] It is surely significant that the early knives have been found in exceptionally important sites, which were closely bound together by trade and exchange relations. The first knives evidently appeared in the Aegean at a time of renewed prosperity in the second half of the 12th century BC (LH IIIC Middle). Susan Sherratt sums up the situation as follows: "By the mid-12th century a trans-Aegean pattern of contacts that were essentially multidirectional had established itself; and Cyprus certainly participated in this".[50] Apart from Ialysos, the exchange relations with the East Mediterranean (Cyprus, the Levant and Egypt) are most clearly demonstrated by the finds from Naxos and Perati, where a wide variety of imports has been discovered, including cylinder seals; Egyptian faience scarabs, amulets and plaques; ivory ornaments; gold and silver jewellery; and beads of gold, glass and semi-precious stones. Finely decorated pictorial pottery was also shared between major centres in Cyprus and the Aegean at this time.

The iron knife with bronze rivets from Naxos was found associated with a female burial in Kamini, Chamber Tomb A; the associated grave goods, including a bronze symmetrical arched fibula, allow a date in LH IIIC Advanced.[51] The Aplomata and Kamini cemeteries, with their warrior burials and rich finds, belong to the fortified settlement at Grotta, which was clearly an important trading centre.[52]

Two further iron knives with bronze rivets come from Tombs 28 and 38 in the cemetery of Perati on the eastern coast of Attica; while the former tomb can only be broadly dated to LH IIIC, the latter knife was associated with burials of Iakovidis' phase III (LH IIIC Late).[53] Perati, overlooking a good anchorage on the northern side of the Bay of Raphti, has the largest collection of East Mediterranean imports in the Aegean at this time.[54] Although the associated settlement has yet to be found, it was clearly one of the most important post-palatial centres of the 12th and early 11th century BC, involved in wide-ranging trade.

An iron knife was also probably included in the late Mycenaean Oros hoard, from the island of Aegina. In the inventory book of the Aegina Museum, the knife is listed together with the bronzes of the hoard;

[46] For the East Mediterranean imports from Ialysos, see: Benzi 2009; Cline 1991: 136 f.; 139; Macdonald 1986; Triantafyllidis 2008: 296.
[47] Objects dating to LH IIIC Late are rare in Ialysos, suggesting that the harbour lost importance after the end of the 12th century BC. See Benzi 2013: 541 f.
[48] Macdonald 1986: 149.
[49] See for example Desborough1964: 25 f.
[50] Sherratt 1994b: 42; and see the schematic representation of these relations, as reflected in ceramic typology, on page 41 fig. 1.
[51] Vlachopoulos 2006: 370; pl. 25: 3574 (length 10.6 cm). — I am grateful to Andreas Vlachopoulos (Ioannina) for his helpful comments on this tomb.
[52] For a general introduction, see for example Deger-Jalkotzy 2006: 162; Vlachopoulos and Georgiadis 2015; Vlachopoulos 2016: 128 ff.
[53] Iakovidis 1969: 18 no. M75; 283 f. no. M85; pl. 3: α; 82: γ; Iakovidis 1970b: 342 fig. 147: M75; 344 fig. 149: M85. — For Tomb 38, see also Deger-Jalkotzy 2006: 155 f. — I am grateful to Florian Ruppenstein (Freiburg) for helpful advice on the iron finds from Perati.
[54] For the 'oriental' imports, see Kilian-Dirlmeier 2000: 156 f.; Murray 2018a.

however, as there is no precise record of the hoard's discovery, the provenance is unfortunately not certain.[55]

Like Perati, Lefkandi, on the west coast of Euboea, commands excellent harbours. In this case, though, the iron knife with bronze rivets was found in a settlement context. The knife can be assigned to phase 2a in the stratigraphy of Xeropolis, which approximately corresponds to the third quarter of the 12th century BC according to the current chronology (LH IIIC Developed/Advanced).[56] Following the destruction of the palace at Thebes, Xeropolis flourished during the 12th century BC; but because the cemeteries have not been discovered, far fewer imported prestige objects are known from Lefkandi at this time, compared with the sites discussed previously. Nevertheless, finds from the excavation suggest that the settlement was prosperous, including a lapis lazuli scarab and two gold rings, and this is underlined by the large quantity of fine pictorial pottery; the site was also an important centre of bronze-working.[57]

An iron blade fragment from the Tiryns Treasure, found in 1915 in the Lower Town, just to the east of the palace's citadel, has been interpreted as coming from a sickle or a large knife (Figure 14: 2). The 'treasure' or hoard has often been discussed, and a date for its deposition in LH IIIC is favoured by most authors.[58] Only a fragment of the iron blade, 21.5 cm long, survives, but judging from its shape it is clear that it was originally much larger, and can hardly have been less than 30-40 cm in length.[59] The blade is quite thick; unfortunately, owing to its corroded state, it is impossible to tell for certain if the cutting edge was on the inner (concave) or the outer (convex) side.[60] In his 1930 publication of the hoard, Georg Karo described it as a sickle or chopping knife ("Hackmesser"), and thought that the inner edge had probably once been sharpened; Joseph Maran believes it could have been used for cutting and apportioning meat.[61] As the Tiryns blade fragment is similar in size and shape to a curved knife fragment from the Ashlar Building at Enkomi, the interpretation as a large 'carving knife' seems most likely (Figure 14: 1).

Turning to Crete, iron knives with bronze rivets are known from Knossos and Tylissos.[62] These are exceptional settlements in the Cretan context, both being situated in a lowland setting, and both apparently not abandoned during LM IIIC. Although it was reduced in size in LM IIIC and Subminoan, Knossos remained the most important centre in Crete, and became a major settlement once again in the Protogeometric period.[63] The Knossos knife comes from Tomb VII in the Upper Gypsades cemetery.[64] It was found with an inhumation burial in a clay larnax, in a re-used chamber tomb. Close by the larnax were two amphorae, five stirrup jars and four bronze pins, which apparently belong to the inhumation burial. The larnax burial probably dates around the transition from LM IIIC to Subminoan.[65] The Pit Tomb from Tylissos, 'Atzolou', excavated by Spyridon Marinatos in 1929, is located only 13 km west of Knossos. The grave contained a cremation in a hemispherical bronze basin, provided with an iron knife with bronze rivets, a bronze spearhead, two bronze fibulae and a stirrup jar.[66] In the literature, the finds are dated between the end of LM IIIC and Subminoan; in my opinion, the fibulae indicate a relatively

[55] Gauss 2007: 130 ff. — The iron knife is at present not available for study; it is not known if it had bronze or iron rivets. The hoard cannot be precisely dated, Walter Gauss suggests a deposition at some time between LH IIIB2 and IIIC.

[56] Evely 2006: 62 no. 16; 284; 287 fig. 5.10: 5; pl. 89.3.

[57] Lemos 2006; Sherratt 2006.

[58] Maran 2006: 130; 140; Maran 2012: 125; Dickinson 2006: 147. — A Submycenaean date has been proposed by Reinhard Jung et al. 2017: 87 note 27; 88 note 42; see also Sherratt 1994a: 92 (11th century BC?).

[59] Karo 1930: 135 f. no. 6228α; 136 fig. 6; Varoufakis 1981: 26 fig. 1: 7; Varoufakis 1982: 316; pl. 31: 3; Maran 2006: 139 fig. 8.4b. — For the discovery of the hoard and an authoritative discussion of the contents, see Maran 2006: 129 ff.

[60] Constantinos Paschalidis (National Archaeological Museum, Athens) kindly provided photographs of the iron blade.

[61] Maran 2012: 123.

[62] There is great difficulty in dating the pottery in Crete at this time, and it is important to stress that at present it is only possible to suggest a provisional, rather schematic outline. In this study, latest LM IIIC and the transition from LM IIIC to Subminoan are assigned to the first half of the 11th century BC; Subminoan lasts from the middle of the 11th century to ca. 970 BC, and Early Protogeometric from ca. 970 to ca. 920 BC. — See for example the chronological table in Karageorghis and Kanta 2014: 10.

[63] See Cutler and Whitelaw 2019: 17 ff.; 18 fig. 18; Kotsonas 2019.

[64] Hood et al. 1959: 197; 205 ff.; 248 f. no. VII.12

[65] See for example: Popham 1965: 333 note 36 (LM IIIC Advanced); Desborough 1964: 26; 61 (SM, contemporary with LC IIIB); Coldstream and Catling 1996: 307 (SM); Antoniadis 2017: 36 (SM).

[66] Marinatos 1931.

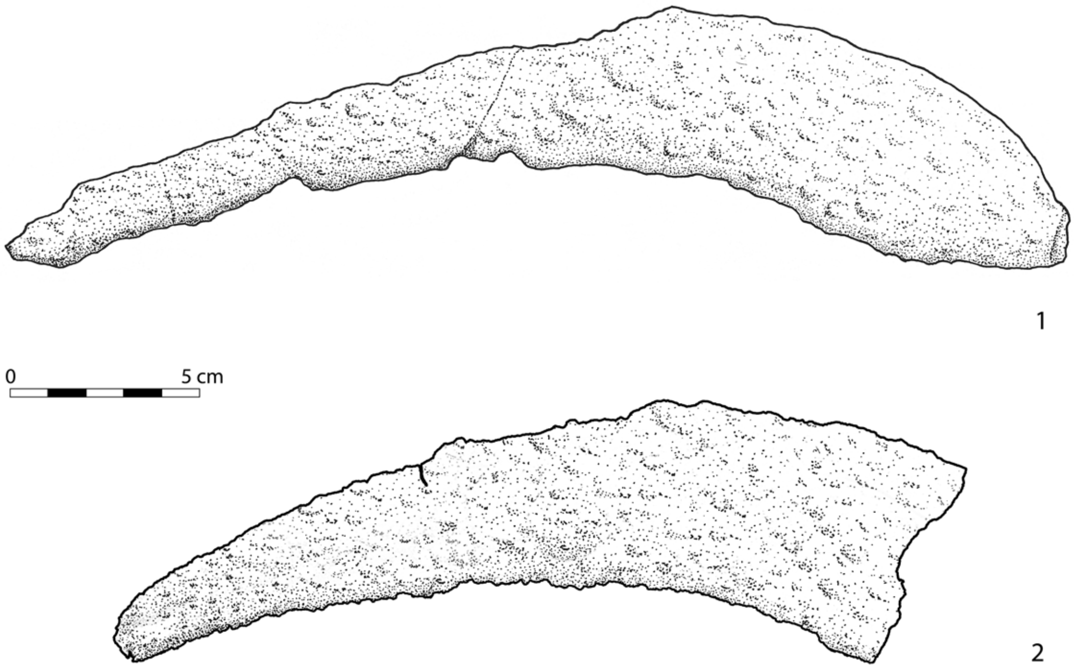

Figure 14. Fragments of large iron knives from Enkomi (1) and Tiryns (2). — Scale 1:2.

early position, still in the first half of the 11th century BC.[67] These two graves exemplify the changes in burial ritual taking place in central Crete at the transition from the Bronze Age to the Iron Age. While in Gypsades Tomb VII the deceased was buried in the traditional Late Minoan manner (inhumation in a re-used chamber tomb), cremations in Pit Tombs and Pit Caves signal a fundamental change. In these graves, emphasis is on (male) individual burial rather than the family or clan, and weapons and prestige goods often served to emphasize the high status of the deceased.[68] So while the Gypsades tomb conforms to LM IIIC traditions, the Tylissos grave is an early example of new practices which herald the transformed social organisation of the Subminoan period.

Iron knives with bronze rivets continued to be used later, not only in the second half of the 11th century, but with examples also known from the 10th, 9th and even 8th centuries BC.[69] Certain examples from eastern Crete have sometimes been regarded as belonging to the Subminoan period, but their chronology is far from certain. For example, a knife with bronze rivets was excavated in Vrokastro, Kopranes, Chamber Tomb V, a tomb which had been robbed and disturbed.[70] A reappraisal of the pottery has shown that the tomb was used from LM IIIC Late until EPG, with some vessels apparently even later.[71] The situation is similar in the case of Karphi, Ta Mnemata, Tomb M11, where two fragments of an iron knife blade and an iron fibula were found among the grave goods.[72] Once again, a Subminoan date has often been proposed for the knife.[73] But a more recent study of the pottery indicates that the tholos tomb was used for a long period, between LM IIIC and EPG, and, like the Vrokastro example, a precise date for the knife

[67] See for example: Davaras 1973: 166 (later than LM IIIC); Kanta 1980: 10 f.; 316 (SM); Ruppenstein 2013: 191 note 59 (end of LM IIIC). — For the fibulae, see: Sapouna-Sakellarakis 1978: 52 no. 219-220; pl. 7: 219.220. — Compare the examples from Mouliana, Tomb A (Sapouna-Sakellarakis 1978: pl. 8: 221-222) and Vasiliki (Tsipopoulou et al. 2003: 105; 104 fig. 11: 29).
[68] These developments in burial practices have been discussed in detail by Katia Perna (2009: 42; 2011: 142-146).
[69] For Knossos, North Cemetery/Medical Faculty, Tomb 186 (SM), see Coldstream and Catling 1996: 529 f.; fig. 163: f2; pl. 274: f2. — The subject has been discussed authoritatively by Gail Hoffman (1997: 102-104; 139-141); see also Waldbaum (1982).
[70] Hall 1914: 149 f.; pl. 21: A. — For proposals of an early chronological position, see for example: Desborough 1952: 262 f. (SM); Coldstream and Catling 1996: 529 (SM); Dickinson 2006: 148 fig. 5.18 (before 1000 BC).
[71] Hayden 2002: 6-8; 33-59 (see comments on cat. no. 53, 58-60, 90-92, 99 and 146).
[72] Pendlebury et al. 1938: 106 no. 383-384; 121; pl. 28: 3 (no. 383-384).
[73] See for example: Waldbaum 1978: 33 (SM); Sherratt 1994a: 91 (SM); Dickinson 2006: 148 fig. 5.18 (before 1000 BC).

is therefore impossible.[74] The practice of collective burial in eastern Crete, often coupled with the poor documentation typical of early excavations, hinders a more precise interpretation of these finds, and this might account for the under-representation of early iron artefacts in this part of the island.[75]

Turning to the Dodecanese, an iron knife has been reported from the cemetery of Aghia Agathe, near Lindos on Rhodes. The knife was discovered in Pit Tomb 9, for which only a preliminary report has been published. However, the importance of the cemetery is underlined by the richly furnished female burial in Pit Cave 3, with faience scarabs, gold jewellery, a bronze mirror and a Proto-White Painted lekythos indicating trade with Cyprus, and possibly other areas of the East Mediterranean.[76] The cemetery has been dated provisionally to the first half or mid-11th century BC. It is possible, indeed probable, that the knife was imported from the East Mediterranean.

Early iron knives have been reported from the Troad, but sadly these are in both cases uncertain. Nevertheless, in view of the importance of Troy and the Troad, and the long history of research, it is worth examining these examples in some detail. An iron knife was mentioned by Machteld Mellink, from Beşik-Yassıtepe, a settlement site located on a coastal promontory about 7 km south-west of Troy. According to her, in the second season of Manfred Korfmann's excavations, in 1983, the knife was found in a pit, associated with LH IIIB-IIIC pottery.[77] However, this find was never mentioned in the preliminary reports published by Korfmann and his team.[78] The suspicion arises that, after further study of the finds, the excavators came to the conclusion that the context was not secure. However, until publication of the excavations, it seems wise to withhold judgement. The second iron knife was published by Heinrich Schliemann; it was found during his excavations at Troy "13 Fuss unter der Oberfläche". As he explained, this would indicate a date in Troy IV-V, although he suggested that, considering the shape of the knife and the use of the new metal, the "Lydian City" (Troy VI) would seem to be more appropriate.[79] The knife has a humped back and a short handle with a discoidal terminal which is perforated to hold a ring. A rivet is visible, located between the blade and the handle. The knife is interesting, because rather similar knives, both in bronze and iron, are known from Cyprus, dating to the 12th or the first half of the 11th century BC.[80] However it is also possible that the knife is much later (medieval, modern?).[81] Considering the intensive excavations at Troy over the last one and a half centuries, it is very significant that no reliable evidence has come to light for the use of iron in the Troad before the 1st millennium BC.[82]

Excavations at Kastri on Thasos have brought to light important evidence for the gradual introduction of iron on this island in the northern Aegean. Two bimetallic knives (with bronze handles and iron blades) are especially interesting. The knives come from the Kentria and Tsiganadika cemeteries at the foot of the acropolis of Kastri. The knife from Tsiganadika, Tomb 18B/II, is almost completely preserved, with a length of 15.6 cm, whereas only the handle has survived on the example from Kentria, Tomb 5B/II (see Figure 29: 1).[83] While the Kentria example is dated by Chaido Koukouli-Chrysanthaki to her phase Kastri IIA, the chronology of the Tsiganadika knife is less certain. It was found in a large built chamber

[74] Day 2011: 232 f.

[75] However, Melissa Eaby (2007: 45) mentions a small tholos tomb excavated in 1991 at Vrokastro, Poros, with iron knives, which apparently dates to LM IIIC-SM. Unfortunately, these finds have not yet been published.

[76] For Aghia Agathe, Tomb 9, see Zervaki 2011: 774; for Tomb 3, see Zervaki 2014. — For the cemetery of Aghia Agathe, see also D'Acunto 2017: 439; Bourogiannis 2018: 61; 73. — According to information kindly provided by Foteini Zervaki (Rhodes), the iron knife has been misplaced, and more detailed information (for example on the rivets) is not available at present.

[77] Mellink 1984: 446. — See also Muhly et al. 1985: 71; Mitchell 1990: 94; Sherratt 1994a: 88; Yener et al. 1996: 383; Jean 2001: 178.

[78] Korfmann et al. 1985; 1986.

[79] Schliemann 1881: 674 fig. (no. 1421).

[80] The Cypriot examples have a longer handle. See for example: Enkomi, Foundry Hoard (bronze): Catling 1964: 102 f.; fig. 10: 11; pl. 11: f.; Matthäus 1985: pl. 122: F1. — Enkomi, French Tomb 108 (iron): Courtois 1981: 259 f. cat. no. 25; 268 fig. 165: 1; 269 fig. 166: 1. — Kouklia, Skales, Pyre 1 (iron): Karageorghis and Raptou 2016: 98 no. 4; pl. 100: 4.

[81] See for example the comments in Muhly et al. 1985: 70; Jean 2001: 178.

[82] According to Muhly et al. (1985: 70), no iron artefacts were found in Bronze Age contexts during the University of Cincinnati excavations at Troy. — Iron figurines have been reported from Bronze Age ('Hittite') layers at Küçükçekmece (Istanbul), but the contexts do not appear to be reliable. See Aydingün 2021: 181.

[83] Tsiganadika, Tomb 18B/II: Koukouli-Chrysanthaki 1992: 202 no. 55; 407 fig. 91; pl. 109: 55. — Kentria, Tomb 5B/II: Koukouli-Chrysanthaki 1992: 90 no. 33; 407 fig. 91; pl. 39: 33; 353: 8.

tomb, with scattered remains of at least 90 individuals, and this understandably led to considerable problems for the excavators. Koukouli-Chrysanthaki explains that the stratigraphic context could not easily be defined; a date in phase IB seemed more likely, but a position in phase IIA is also possible.[84] Because the two knives are so similar, it is likely that they were produced close together in time, which, in my opinion, suggests a probable date for both of them in phase IIA, corresponding roughly to the 11th century BC.[85] The question remains, whether these two knives were imported or manufactured locally. It is interesting that the handles of the two bimetallic knives were made using copper with a Lead Isotope signature consistent with Cypriot ores.[86] However, as most of the bronze knives from the Thasos cemeteries were made of imported copper, this observation loses significance, and there is no compelling reason to believe that the bronze handles of the bimetallic knives were not cast in a local workshop. Jean-Louis Zimmermann noted that the flanged appearance of the handle of the knife from Tsiganadika bears a certain resemblance to a bronze knife handle from Enkomi; however, the rather vague similarity is not sufficient to demonstrate that the Thasian knife originated in Cyprus.[87] The form of the knife is more closely related to a bronze example from Hordiivka in the Ukraine, which suggests that the Thasos example was not made in an East Mediterranean workshop (see below, and Figure 29).[88] On the basis of the available evidence, it seems most likely that the bronze handles of the knives were made locally, but it is impossible to tell if the iron blades were imported or made from metal smelted from Thasian ores. Chaido Koukouli-Chrysanthaki assigned a further fragmentary iron knife blade to Kastri phase IIA.[89] The fragment, from a knife of her type E.VIII, was found in Tsiganadika Tomb 1/I; the tomb is placed on the combination table at the very end of phase IIA or at the transition from phase IIA to IIB; apart from the iron example, Tsiganadika, Tomb 1 also contained at least nine bronze knives, which is a clear sign that iron was still rare at this time.[90] As explained below, iron knives became increasingly frequent in the graves from Thasos during the 10th century BC.[91]

Turning to western Greece, two iron knives from the defended hilltop settlement of Teichos Dymaion, near Araxos in western Achaea, have sometimes been mentioned in the literature as evidence for iron use in the 12th or 11th centuries BC.[92] The knives were unearthed during excavations by Efthymios Mastrokostas between 1962 and 1966.[93] Unfortunately, his preliminary reports and excavation diaries provide no information on the contexts of the knives, and their chronology is uncertain.[94] Although a late Mycenaean date is possible, they could equally well be much later, considering that the site continued to be used during the Geometric, Hellenistic, Roman, Byzantine and Venetian periods.

The earliest reliably dated iron knife in the west was discovered at Kouvaras in Acarnania. It has a bimetallic construction, with an iron blade and a bronze flanged hilt terminating in a swallow-tail shape. The ivory handle with a ring-shaped or flabelliform terminal still survives; it was attached to the flanged hilt by five bronze rivets. The knife was found in 2007 in a stone cist housing a crouched inhumation.[95] The other grave goods, suggesting a Submycenaean date, are exceptional, comprising an antique gold kylix, a bronze tripod cauldron, four pottery vessels, and the following items of bronze weaponry: a

[84] Koukouli-Chrysanthaki 1992: 422; 681. — For a good discussion of these finds, see Ilieva 2019: 71 f.
[85] Chaido Koukouli-Chrysanthaki (1992) proposed the following dates: phase IB/LH IIIC1 (ca. 1180-1100 BC), phase IIA/LH IIIC2 (ca. 1100-1050 BC). — Reinhard Jung has compared the pottery from Kastri and Kastanas, and arrived at somewhat different dates: phase IB/Kastanas, layers 14-13 (ca. 12th century BC), phase IIA/Kastanas, layer 12 (ca. 11th century BC); see Jung 2002: 240-242.
[86] See Koukouli-Chrysanthaki 1992: 681; Stos-Gale and Gale 1992: 791 and fig. 3 (sample numbers 181 and 247).
[87] Zimmermann 2001: 114; for the Enkomi knife fragment, see Catling 1964: 103; pl. 11: e.
[88] Hordiivka, Vinnytsia Oblast, Tumulus 38: Berezanskaya and Klochko 1998: pl. 80: 1.
[89] Koukouli-Chrysanthaki 1992: 424; 431 ff. with fig. 116 (type E.VIII).
[90] For Tsaganadika, Tomb 1/I see Koukouli-Chrysanthaki 1992: 125 no. 23 ("type EVII"); pl. 59: 23; fig. IX (combination table).
[91] Note that the iron knives from Kentria, Tomb 3A and Tsiganadika, Tomb 19A are mistakenly dated by Joanna Palermo to LH IIIB and LH IIIB/C (Palermo 2018: 116; 144; 146 f.; cat. no. BA.360 and BA.370). These contexts are dated by Chaido Koukouli-Chrysanthaki to phase IIΓ. See Koukouli-Chrysanthaki 1992: fig. IX (combination table).
[92] See for example Sherratt 1994a: 88; Zimmermann 2001: 115 note 31; Dickinson 2006: 148 fig. 5.18.
[93] Mastrokostas 1966: 67.
[94] See for example Moschos 2009a: 236 note 7; 2009b: 365 note 95. — The author is very grateful to the present excavator at Teichos Dymaion, Michalis Gazis (Patras), for helpful advice on Mastrokostas' excavations.
[95] Stavropoulou-Gatsi et al. 2012; Jung et al. 2017.

Mycenaean short sword (type F2) with ivory hilt plates, a sword of Allerona type with gold wire wound around the hilt, a spearhead, an arrowhead, and a pair of greaves.[96] Both the form of the flanged hilt and the ivory handle have close parallels in Italy on bronze knives of Matrei type.[97] Clearly, the handle was fitted to the iron blade by a craftsman working in an Italic tradition. On the other hand, the use of ivory shows that exchange relationships were being maintained with the East Mediterranean, and the iron blade of the Kouvaras knife may have derived from an imported Cypriot knife whose handle had broken off, indeed this seems quite likely. The knife constitutes a fascinating example of cultural hybridity in the production of an object which was obviously highly prestigious. Seafarers were travelling between Italy and Cyprus in the 11th century BC, and the creation of the Kouvaras knife can only be understood in this context. For example, greaves related to the examples from Kouvaras are known from Calabria, Achaea and Cyprus.[98] And the surprisingly large quantity of ivory in Italy at this time must have arrived in ships from the east. Ivory was then used to produce typically Italic artefacts, such as knife-handles and combs. The Italic comb from Enkomi, French Tomb 6, dating to LC IIIB, made of ivory, is a well-known example demonstrating this long-distance Cypriot trade.[99] The example from Kouvaras shows the great importance of prestigious knives during the 12th and 11th centuries BC. Not only in Greece, but also in Cyprus and the southern Levant, the elaborate knives of bronze or iron often exhibit the influence of Italic traditions of knife production.[100]

Other iron artefacts

Apart from the knives, and the rings from Ialysos, hardly any other iron objects are known from the Aegean in LH/LM IIIC. The following iron fragments seem to be reliably dated to the 12th or early 11th century BC. A fragment of iron is preserved in a perforated glass bead from Perati, Grave 108, and this can presumably be interpreted as the head of an iron pin.[101] This kind of pin is otherwise unknown at this time in the Aegean, but possible parallels in Cyprus have been noted by Georg Nightingale.[102] Otherwise, there are only a few iron fragments, reported from Naxos, Aplómata, Chamber Tomb Γ;[103] Perati, Tomb Σ2;[104] Mouliana, Tholos Tomb B;[105] and from the harbour settlement of Knossos at Katsambas.[106] As no further information is available on the original form and function of these iron fragments, it is difficult to interpret their significance in the introduction of iron.

It remains to mention some finds from settlements which have previously been claimed as evidence for the early use of iron, but for which the chronology is either incorrect or insecure. In the case of Troy, a confused situation has recently been clarified. In 2001 Ralf Becks and Diane Thumm mentioned an iron trunnion axe from Troy VIIb1 (ca. 1190-1130 BC), but two years later, Becks wrote that reliably stratified iron artefacts, including small implements and knives, first appear in Troy VIIb2 (ca. 1130-1050/30 BC).[107] However, subsequent research has shown that all these iron objects are later than Troy VIIb, and presumably date to the Protogeometric period or later.[108] In the settlement of Karphi in eastern Crete,

[96] In their recent publication, Reinhard Jung, Mathias Mehofer and Maria Stavropoulou-Gatsi (2017: 90) argue for a Submycenaean date, although they note that a slightly later date in Early Protogeometric cannot be excluded.
[97] Jung et al. 2017: 98; Zanini 2005: 86 fig. 2; 88 fig. 3: 1-2.
[98] See Clausing 2002: 162-168.
[99] The comb belonged to the second phase of use of Tomb 6, dating to LC IIIB. For the Enkomi comb and its Italic parallels, see Bettelli and Damiani 2005: 17 ff.; 22 fig. 1: B12; Vagnetti 2005. — For the iron knife from Enkomi, French Tomb 6, see Chapter 3.2.
[100] Particularly knives of the Matrei and Scoglio del Tonno types. See Jung et al. 2017: 90.
[101] The 'pin' is assigned to LH IIIC Middle-Late. See Iakovidis 1969: 394; pl. 116: α (Δ142).
[102] Nightingale 2009: 501.
[103] Two pieces of iron, from a tomb dating to LH IIIC Developed/Advanced. See Vlachopoulos 2006: 454; 456.
[104] Two pieces of iron from a tomb in use during LH IIIC Late. — See Iakovidis 1970b: 376; 463. — The author is grateful to Florian Ruppenstein (Freiburg) for his advice on the chronology of this tomb.
[105] One piece of iron from a tomb dating to LM IIIC Late. — See Xanthoudides 1904: 49; Kanta 1980: 175. — For the chronology, see for example D'Agata 2007: 91 f. tables 1-2.
[106] The piece of iron was found lying on the floor of a store-room belonging to the second phase of a house excavated in 1955; the context dates to LM IIIC. — See Kanta 1980: 27 f.
[107] Becks and Thumm 2001: 421; fig. 482; Becks 2003: 50.
[108] The author is very grateful to Prof. Peter Pavúk (Prague) and Dr Magda Pieniążek (Tübingen) for their generous information on the current state of research on the Troy excavations.

which had its *floruit* in LM IIIC, two iron fragments were discovered in Rooms K69 and K88. However, as their stratigraphical context was not recorded, it is possible that they are intrusive finds of much later date.[109] The last example is the iron arrowhead from stratum X near the Lion Gate at Mycenae; while this context dates to LH IIIC, the excavators regarded the arrowhead as a later, intrusive find, and its chronology must be regarded as uncertain.[110]

Iron finds of the Submycenaean period

The graves of the Submycenaean period in central Greece demand a separate treatment, because they contain a very different selection of iron artefacts compared to those discussed so far. As Florian Ruppenstein has noted, during the Submycenaean period iron was used only sporadically for items of jewellery, and especially for finger rings. The situation changed radically in the following Transitional SM/EPG phase when further categories of artefacts, most importantly weapons, were produced from the new metal.[111] For this reason, the Submycenaean graves, approximately dating to the second quarter and the middle of the 11th century BC, appear to form a distinct stage in the emergence of iron in the archaeological record.

As Ruppenstein observed, apart from the finger rings, very few other kinds of iron artefact have been found. A curved blade-like fragment (length ca. 8 cm), perhaps an amulet, was found in Kerameikos, SM Grave 87; while Ruppenstein assigned the assemblage to the start of the Submycenaean period, Penelope Mountjoy argued for a date in LH IIIC Late.[112] The only other items are the two iron pins from Kerameikos, SM Grave 113, one with an ivory head still preserved; this grave is generally dated to the late Submycenean period.[113] These are the earliest iron pins known from the Athenian cemeteries, and Ruppenstein discussed the possibility that they might be imports from Cyprus, or at least represent Cypriot 'inspiration'.[114] Considering the use of ivory, which was certainly imported, the suggestion is plausible.

Otherwise, iron has only been found in graves in the form of finger rings, which are known from cemeteries in Attica,[115] Thessaly,[116] Boeotia,[117] Phocis,[118] Corinthia,[119] and probably the Argolid[120] (Figure 15). The two rings in Athens, Agora, Grave 63 are exceptional, because they have a bimetallic construction with a bronze hoop and an iron shield-shaped bezel. This combination, in which bronze was used for the functional part of the ring, and iron for the decorative bezel, suggests that iron was still valued more than bronze at this time. It is surely significant that this, along with Kerameikos, SM Grave 87,

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[109] See Pendlebury et al. 1938: 122 no. 448-449; Waldbaum 1978: 33; Day 2011: 154; 159 f.

[110] See Wace and Heurtley 1923: 34; Waldbaum 1978: 31.

[111] Ruppenstein 2009: 329.

[112] Athens, Kerameikos, SM Grave 87: Kraiker and Kübler 1939: 40 f.; 87. — Ruppenstein 2007: 232 (phase I); Mountjoy and Hankey 1988; note that iron is otherwise absent in the 13 Kerameikos graves assigned by Mountjoy to LH IIIC Late. — For an introduction to research on the chronology of the Kerameikos cemetery in the 11th and 10th centuries BC, see Dalsoglio 2014.

[113] Athens, Kerameikos, SM Grave 113: Smithson 1961: 175. — For the chronology, see: Smithson 1961: 176 f.; Snodgrass 1971: 221; 229; Kilian-Dirlmeier 1984: 77; Coldstream and Catling 1996: 530; Lemos 2002: 107 and note 37; Ruppenstein 2007: 228.

[114] Ruppenstein 2007: 228.

[115] Athens, Agora, Grave 63 (2 bimetallic rings): Papadopoulos and Smithson 2017: 420 ff.; 924 f. — Athens, Erechtheiou Street, Grave VII (4 rings): Dimitriadou 2019: 498 f. — Athens, Kerameikos, PG Grave 3 (N) (several rings); SM Grave 20 (1 ring); SM Grave 83 (3 rings); SM Grave 84 (2 rings); SM Grave 108 (1 ring); SM Grave 146 (1 ring): Kraiker and Kübler 1939: 16; 39; 47 f.; Kübler 1943: 47; Ruppenstein 2007: 33 cat. no. 13. — Athens, Makrygianni Street/Acropolis Station, Grave 57 (2 rings): Dimitriadou 2019: 468 f.; 31 fig. 2.12; Kalligas 2001: 45. — Athens, Olympeion, Grave 6 (1 ring): Styrenius 1967: 84. — Salamis, Arsenal cemetery (1 ring): Kraiker and Kübler 1939: 136; Müller-Karpe 1962: 128.

[116] Theotokou, Tomb C (1 ring): Wace and Thompson 1912: 213 f.; fig. 146-147; Lemos 2002: 6 note 30. — Voulokalyva, Tomb 46 (ring fragments): Tsiouka 2008: 40 f.

[117] Thebes, Electrai Gates, Tomb 4 (1 ring): Keramopoullos 1917: 28; for the cemetery, see Symeonoglu 1985: 234 f.

[118] Elateia-Alonaki, Tomb XXIV (1 ring and fragment of a possible second ring); another iron ring was found with a Submycenaean burial in a tomb from Elateia-Alonaki excavated by the Ephorate of Lamia. — Deger-Jalkotzy 2009: 88; 96; the author is grateful for information generously provided by Prof. Sigrid Deger-Jalkotzy (Vienna).

[119] Corinth, Race Course, Child's Grave (1 bimetallic ring with an iron hoop and bronze shield-shaped bezel): Williams 1970: 14; pl. 6: 10-12.

[120] Tiryns, Prophitis Elias, Tomb V (flat, band-shaped fragment, length 3.1 cm, remains of a finger ring?): Rudolph 1973: 40 no. 22; 122; pl. 18: 5 no. 22; for Submycenaen pottery from Tomb V, see Hägg 1974: 82 note 319.

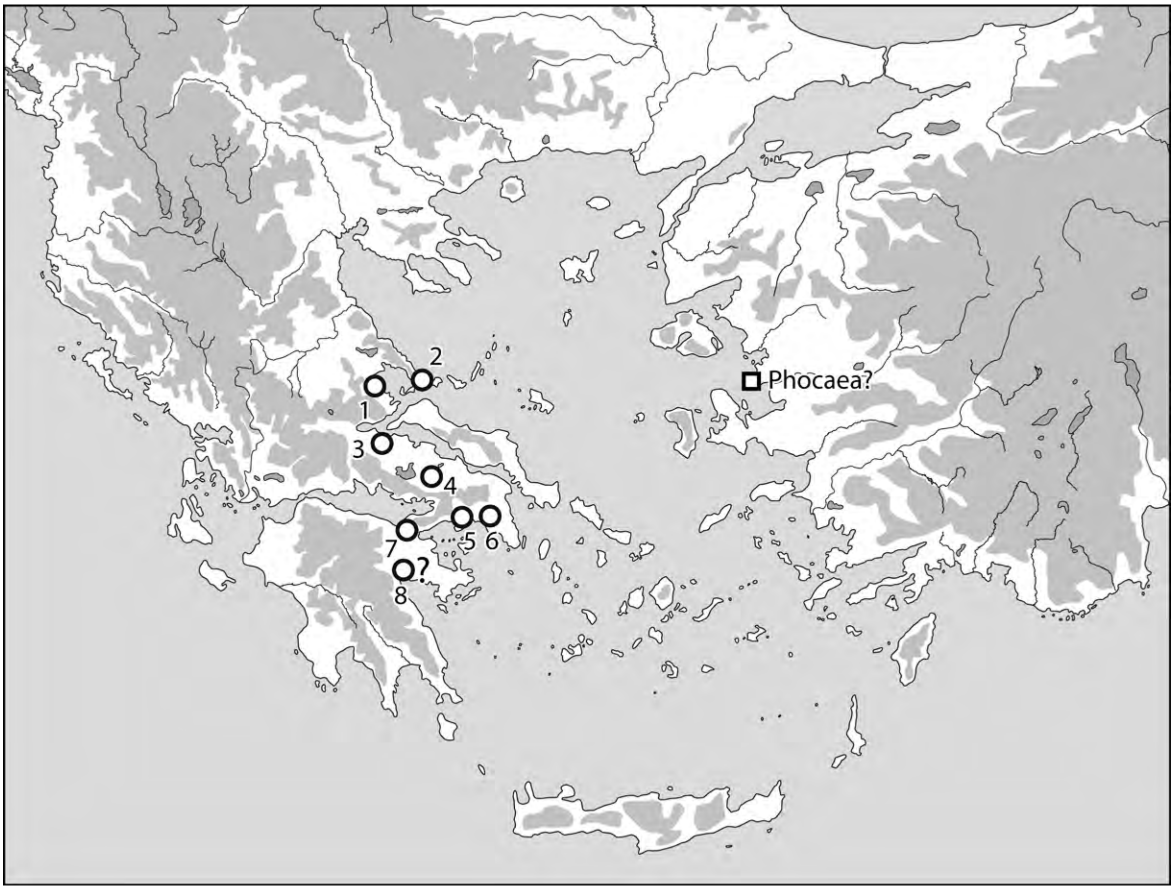

Figure 15. Distribution map of iron finger rings of the Submycenaean period. The ironworking site at Phocaea is also included on the map. — 1 Voulokalyva. — 2 Theotokou. — 3 Elateia-Alonaki. — 4 Thebes. — 5 Salamis. — 6 Athens. — 7 Corinth. — 8 Tiryns.

with the 'amulet' mentioned above, is the only grave with iron from Ruppenstein's earliest stage of the Submycenaean period. Iron still seems to have been a rare and precious metal around the time of the LH IIIC/SM transition, perhaps because it could not be produced locally, and still had to be imported from the East Mediterranean.

Although iron is still rare in Submycenaean graves, the finger rings form a consistent feature, occurring in about a dozen tombs (not counting the graves which can be assigned to the Transitional SM/EPG phase). The cemeteries with iron finger rings form a distinct regional concentration, strongly suggesting that iron was manufactured locally in the area between Thessaly and the Argolid (Figure 15).

The finger rings of the Submycenaean period therefore indicate local manufacture of iron in central Greece. At this point, the important excavations at Phocaea should to be mentioned, because they apparently demonstrate intensive iron production in Ionia at this time.[121] At Phocaea, a blacksmithing area was discovered below two Protogeometric apsidal houses, and stratified above late Mycenaean (LH IIIC) structures. Eight horseshoe-shaped hearths were found, surrounded by hammerscale and lumps of slag, which probably derived from hammering blooms to make iron billets or artefacts. There were also two stone anvils close to the hearths. According to the excavator, a large amphora with painted decoration found in or on the surface containing the hearths demonstrates a Submycenaean date for the iron production workshop.[122] As these important finds have only been described in a preliminary report,

[121] See: Özyiğit 2011: 28; 30 f.; Yalçin and Özyiğit 2013; Verčík 2017: 33 f.; Mokrišová and Verčík 2022: 18 f.
[122] Yalçin and Özyiğit 2013: 241 fig. 6.

there is some uncertainty concerning the chronology, although a position in the 11th century BC seems most likely, based on the information currently available.[123]

Summary

In the Aegean, evidence for iron in the 12th and the first half of the 11th century BC is dominated by the knives, of which around ten examples have been found. Because their distribution is scattered between the Dodecanese and the Ionian Sea, without significant geographical concentrations, it seems justified to conclude that there were no local centres of production, and they were imported from Cyprus; this conclusion is supported by the bronze rivets on six of the knives, a typical feature of the early Cypriot production. In many of the sites with these early iron knives there are also signs of trade with the East Mediterranean, especially in the form of 'luxuries' made of gold, ivory or other precious materials. According to the present state of research, the 'knife horizon' in the Aegean started around, or shortly after, the mid-12th century BC.

Apart from very few exceptions (a few pins and an 'amulet'), the other iron artefacts of the 12th and the first half of the 11th century BC comprise items of ring jewellery. While the rings from Ialysos were probably imported from the Levant, and represent outliers of the Near Eastern 'ring horizon', the Submycenean finger rings were manufactured in central Greece. Judging from the large number of rings in the Athenian cemeteries, it is most likely that these rings were made in Athens or in the vicinity. According to the preliminary excavation report, the blacksmithing hearths at Phocaea would also demonstrate local production at this time.

Unlike the earlier signet rings, which were discussed in Chapter 4.1, there is little doubt that the artefacts of the post-palatial period were made of smelted iron, as the scientific analyses of the knives from Perati and Tiryns indicate. However, it is worth emphasizing that while the archaeological evidence allows us to recognize the first signs of local manufacture of iron objects in central Greece and potentially in Ionia during the Submycenaean period, there is no indication if or where iron ores were smelted in the Aegean area at this early stage. It is possible that much of the iron was still being imported from the East Mediterranean (Cyprus?) in the form of billets during the first half of the 11th century BC.

4.3 The second half of the 11th and the early 10th century BC

Before discussing the new categories of iron artefacts found in burial contexts after the mid-11th century BC, a brief explanation of the chronology is required. It was explained above that Submycenaean can be assigned to the time around the second quarter and the middle of the 11th century BC. The subsequent Transitional SM/EPG and EPG phases are held to occupy the second half of the same century.[124] In the context of this study, Transitional SM/EPG and EPG are treated together. This is justified by the simple fact that no significant differences can be discerned in the spectrum of iron artefacts known from the two phases. Furthermore, although the distinction between Transitional SM/EPG and EPG is recognized and utilized by most specialists, there are differences of opinion concerning the precise dating of the pottery from some graves to one or the other chronological stage, so the distinction between the two stages is not as clear as one would wish.[125] The chronology is less precise for Crete, but there is a general consensus in the specialist literature that the Subminoan period started around the middle of the 11th century BC, and therefore ran parallel with Transitional SM/EPG and EPG. However, according to the conventional chronology, pottery of Subminoan type continued in use rather longer, until the early part of the 10th century BC, thereby overlapping with MPG on the mainland.[126]

[123] Florian Ruppenstein considers a Submycenaean date for the amphora to be plausible (Ruppenstein 2022: 169 note 21). — For a possible alternative date in the Archaic period, see Yalçin and Özyiğit 2013: 245.
[124] See Lemos 2002: 3-14; Ruppenstein 2007: 269 ff. (phases IV and V).
[125] In her fundamental study of the Protogeometric Aegean, Irene Lemos considers Transitional SM/EPG and EPG tombs as "two stages of one phase" (Lemos 2002: 9 note 59).
[126] See for example the chronological table in Karageorghis and Kanta 2014: 10.

Jewellery

Evidence for iron increases markedly in the second half of the 11th century BC (Figure 16). Apart from finger rings, which continued to be provided as grave goods (as previously in Submycenaean), iron is now found in the form of additional types of jewellery and, most significantly, weapons and occasionally knives.[127] In the second half of the 11th century BC, iron pins become relatively frequent in graves, and are known from Attica,[128] Thessaly,[129] Euboea,[130] Phocis,[131] the Argolid,[132] and Crete;[133] iron pin fragments are also known from two graves in Caria.[134] And for the first time, iron fibulae appear in graves in Thessaly, Euboea and Crete.[135] Other kinds of iron jewellery are hardly ever found in graves of this date.[136] Iron pins are the predominant form: at least 46 examples are known from 26 graves. As the pins were normally not fitted with a bronze head, it seems that the iron was valued intrinsically for its appearance.[137]

At this point, it is worth emphasizing some aspects of the emergence of iron jewellery in the archaeological record. The geographical distribution of iron jewellery is similar in Submycenean, Transitional SM/ EPG and EPG, concentrated mainly in the region between the Argolid and southern Thessaly. In Crete, the finds of iron jewellery begin around the middle of the 11th century BC, possibly slightly later than the earliest (Submycenaean) iron finger rings known from the mainland; unfortunately, the precise chronological position of the two burials with iron pins from Caria is unclear. In view of this geographical concentration, it seems that by the second half of the 11th century BC iron jewellery was being produced in the region between the Argolid and southern Thessaly, on Crete, and possibly also in Caria.

Iron was used for categories of jewellery – rings, pins and fibulae – which were previously made of bronze. Considering the uninterrupted practice of furnishing graves with rings, pins and fibulae throughout the 12th-10th centuries BC, the gradual adoption of the new metal for these items of jewellery seems to be particularly significant, and appears to provide a direct insight into the adoption of iron in Greece. However, in an interesting article, Ian Morris discussed the conspicuous prevalence of iron jewellery in Protogeometric graves, and questioned the assumption that this is a reliable reflection of the importance of iron in Greek everyday life.[138] He believes that, initially, iron was used for the production of prestige goods, and only later gradually attained a wider role in economic activity. According to this view, iron objects were deposited in graves to emphasize the status of the deceased at a time when the new metal was still a scarce commodity. Morris' argument is based on his critical analysis of the find circumstances of the iron artefacts in the Submycenaean and Protogeometric Aegean, which without exception come from graves. So, strictly speaking, the occurrence of iron grave goods provides us primarily with information about developments in burial customs ("the choices of actors creating the material record")

[127] For an authoritative review of metal furnishings in Protogeometric graves, see Lemos 2002: 101-134.

[128] Athens, PG Graves 11, 13, 22, 23 and 25; Grave hS 92a (Kübler 1943; Lemos 2002: 103-109; Ruppenstein 2007: 228; pl. 47); Agora, Graves 67 and 68 (Papadopoulos and Smithson 2017: 435 ff.; 438 ff.); Makrygianni Street/Acropolis Station, Grave 57 (Dimitriadou 2019: 468 f.; 31 fig. 2.12; Kalligas 2001: 45).

[129] Nea Ionia, Grave 202 (Lemos 2002: 106); Voulokalyva, Grave 46 (Tsiouka 2008).

[130] Lefkandi, Skoubris Graves 10, 16 and 38 (Popham et al. 1980: 112 f.; 114 f.; 122 f.; pl. 237, b).

[131] Elateia-Alonaki, Graves XLIV and XLIX (Deger-Jalkotzy 1999: 197 ff.; 2009: 89; 96 f.; 2013: 223; 226).

[132] Mycenae, PG Grave 601 (Desborough 1954: 259; Lemos 2002: 13 note 87). — Tiryns, Philaki Grave VI; Grave 3/1974 (Kilian-Dirlmeier 1984: 71 no. 219-220; 72 no. 247-248; pl. 8: 219-220; 10: 247-248; Lemos 2002: 104; 116).

[133] Knossos, Fortetsa Grave Π (Brock 1957: 8 ff.); North Cemetery/Medical Faculty, Graves 2, 40 and 201 (Coldstream and Catling 1996: 59; 89; 195). — Prinias, Siderospilia, Tomb BA (Perna 2011: 145; Perna 2015: 266 f.).

[134] It is presently impossible to determine the exact chronological position of the pottery from the two graves. — Hüsamlar/ Keramos, Grave 342: iron dagger and iron pin, possibly from a fibula (Özer 2019: 168 fig. 9). — Pedasa, Grave 13: iron pin fragment and two small iron blade fragments, from a knife or dagger (Özer 2018: 50 f.; 41 fig. 13).

[135] Lefkandi, Skoubris Graves 20, 32 and 46; Nea Ionia, Grave 202 (Popham et al. 1980: 117; 120; 126; Lemos 2002: 10-12; 109 ff.). — Knossos, North Cemetery/Medical Faculty Grave 40 (Coldstream and Catling 1996: 89). — Pantanassa (Kanta 2003: 180 f.; Perna 2009: 43).

[136] See for example the iron bracelet from Nea Ionia, Grave XXXVIII (= Grave 12/1961) and the iron 'spirals' from Argos, Perrouka Street, Grave 1 (Lemos 2002: 115-116). — For Crete, note the iron finger ring, iron spiral and small bimetallic object from Vasiliki, Kamaraki Tholos/1990 which date to the time-span LM IIIC-SM (Tsipopoulou et al. 2003: 107 f.; 104 fig. 11, 39-41). The iron spiral has a parallel in Knossos, North Cemetery/Medical Faculty, Grave 40 (Coldstream and Catling 1996: 89 (f5); fig. 173).

[137] Iron pins with bronze heads were found in Tiryns, Philaki Grave VI and Elateia-Alonaki, Grave XLIX.

[138] Morris 1989.

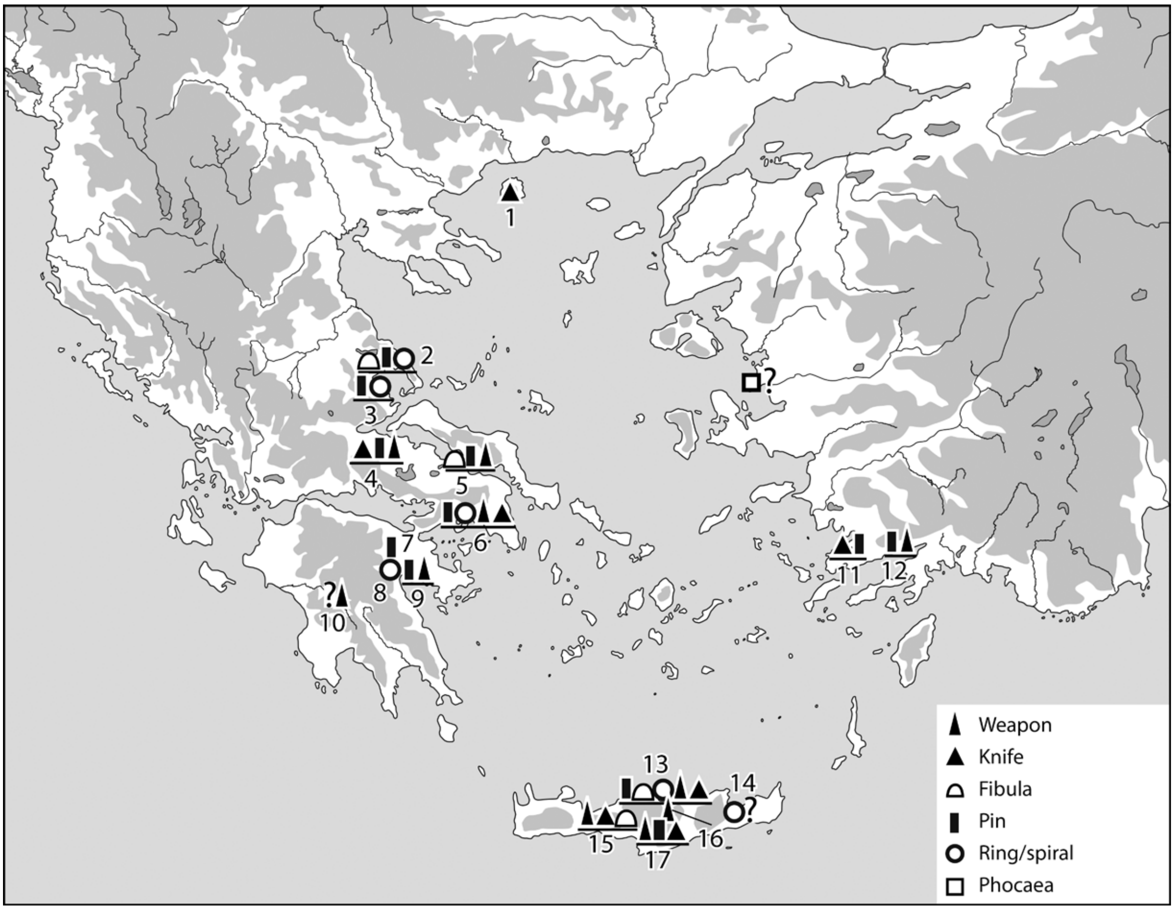

Figure 16. Distribution map of iron artefacts in the Aegean area, second half of the 11th and early 10th century BC. The ironworking site at Phocaea is also included on the map. — 1 Thasos. — 2 Nea Ionia. — 3 Voulokalyva. — 4 Elateia-Alonaki. — 5 Lefkandi. — 6 Athens. — 7 Mycenae. — 8 Argos. — 9 Tiryns. — 10 Palaiokastro-Gortyna. — 11 Pedasa. — 12 Hüsamlar. — 13 Knossos. — 14 Vasiliki. — 15 Pantanassa. — 16 Archanes. — 17 Prinias.

and not directly about the volume of production of metal goods, either of bronze or iron.[139] Morris is quite correct, and it is obviously true that the selection of jewellery present in the archaeological record was determined by burial customs and modes of social distinction. The large amounts of iron jewellery, particularly in the Protogeometric period, should not lead us to exaggerate the importance of the new metal in daily life, for example for the production of tools and implements.

Weaponry

Apart from jewellery, iron objects are not very numerous in the Aegean during the second half of the 11th and the early 10th century BC, and come almost exclusively from weapon graves. Compared with jewellery, there is a fundamental difference when studying the introduction of iron for weaponry. Whereas bronze continued to be used for jewellery throughout the Iron Age, iron replaced bronze in the production of weapons. For this reason, in the case of weaponry we can study the bronze/iron transition from two points of view: on the one hand, the disappearance of bronze weapons; and on the other hand, the appearance of iron weapons in the archaeological record. While it seems clear that the earliest iron weapons known in the Aegean date to Transitional SM/EPG, as Florian Ruppenstein has explained,[140] we

[139] For the quotation, see Morris 1989: 502.
[140] Ruppenstein 2009: 329; 2013: 192; see also Lemos 2002: 117-126.

will see that it is much more difficult to define when bronze ceased to be used for the manufacture of weaponry.

The warrior graves of the second half of the 11th and the early 10th century BC which contain iron objects were furnished with the following array of bronze and iron arms: swords, daggers, dirks, spears, arrows, axes, phalerae and helmets. In the Aegean, iron knives of this period have, with one or two exceptions, only been found in weapon graves and, although they are generally too small to be effective as weapons, in burial customs they were strongly associated with the warrior.[141] As Table 6 shows, the weapons deposited in warrior graves in the Aegean and Cyprus are rather similar during this period, and for that reason they will be discussed together. As immediately apparent from the table, daggers/dirks and spearheads are most important as indicators of a warrior's status.

The earliest iron weapons (belonging to Transitional SM/EPG and EPG on the mainland, and Subminoan on Crete) have been found in the same areas as the contemporary iron jewellery (Figure 16): Attica: Athens;[142] Euboea: Lefkandi;[143] Phocis: Elateia-Alonaki;[144] Argolid: Tiryns;[145] Crete: Archanes,[146] Knossos,[147] Pantanassa,[148] and Prinias;[149] and Caria: Hüsamlar.[150] Outside this area, an iron 'sword' has been reported from a cremation grave in the cemetery of Palaiokastro-Gortyna in Arcadia; however, since the grave furnishings have not yet been published, there are no further details available on the nature of the weapon or the precise date of the burial.[151] While some of these weapon graves have exceptional sets of grave goods, and have frequently been discussed in the specialist literature (e.g. Tiryns, Philaki, Tomb XXVIII; Knossos, North Cemetery/Medical Faculty, Tombs 186 and 201; Pantanassa, Amari, Tholos/1995; Prinias, Siderospilia, Tomb BA), others are quite simple, containing little more than an iron weapon and pottery vessels (e.g. tombs from Athens, Elateia-Alonaki, and Hüsamlar).

In the specialist literature, a number of other iron weapons from Crete have sometimes been mentioned as possibly belonging to the Subminoan period.[152] These come from Arkades, Panagia;[153] Kaliviani Phaistou;[154] Kavousi, Vronda;[155] Knossos, Agios Ioannis;[156] and Vrokastro.[157] However, in all these cases, the chronology

[141] The exception is a knife from Elateia-Alonaki, Tomb XLV: personal communication from Prof. Sigrid Deger-Jalkotzy (Vienna). — See also the possible knife from Pedasa, Grave 13: Özer 2018: 50 f.; 41 fig. 13.
[142] Athens, Kerameikos, PG Graves A and B and PG Grave 2 (North): Kraiker and Kübler 1939: 100-104; pl. 31-32; Kübler 1943: 47; pl. 38. — An iron 'sword' was discovered in Kriezi Street, Tomb LXXIX, a cremation burial probably dating to the Transitional SM/EPG phase; unfortunately, the grave remains unpublished. — See D'Onofrio 2011: 647 note 6; 659 (with further literature).
[143] Lefkandi, Skoubris, Tomb 46: Popham et al. 1980: 126; pl. 245: e.
[144] Elateia-Alonaki, Tomb XLIV: Dakoronia 2009: 96 fig.; Deger-Jalkotzy 1999: 197-199; 2013: 223; 226; Ruppenstein 2013: 189 note 21.
[145] Tiryns, Philaki, Tomb XXVIII: Verdelis 1963: 10 ff.
[146] Archanes, Kanari, Katô Lakkos, cremation in stone ash-urn: Sapouna-Sakellaraki 1990: 75 f.; 76 fig. 15; Orlandos 1978: 61 fig. 70.
[147] Knossos, North Cemetery/Medical Faculty, Tombs 2, 186 and 201: Coldstream and Catling 1996: 58 f.; 190 ff.
[148] Pantanassa, Amari, Tholos/1995: Tegou 2001.
[149] Prinias, Siderospilia, Tomb BA: Rizza 1996: 1105 f.; 1107 fig. 5; Perna 2011: 143-146; 2015: 266 f.; 2019.
[150] An iron dagger (preserved length ca. 20.3 cm) has been found in Grave 342 at Hüsamlar. However, the precise date of the grave is difficult to ascertain. See Özer 2019: 168 fig. 9. — The author is grateful to Irene Lemos (Oxford) and Florian Ruppenstein (Athens) for advice on the pottery from this burial.
[151] Palaiokastro-Gortyna, 'Submycenaean' cremation grave with iron 'sword'. — See Gadolou and Paschalidis 2020: 843; 847 (with further literature).
[152] See for example: Waldbaum 1978: 33-34; Sherratt 1994a: 91; Zimmermann 2001: 118-120; Dickinson 2006: 148 fig.; Palermo 2018.
[153] Arkades, Panagia, 'tou Kophina to Kephali', near Tholos α/1924: iron weapons and knives, Protogeometric. — Levi 1929: 389-400; 399 fig. 517.
[154] Kaliviani Phaistou, Chamber Tomb/1979: iron and bronze weapons, LM IIIC-PG. — Catling 1988: 67; Eaby 2007: 139.
[155] Kavousi, Vronda, Tombs II and III, and 'Building A': the iron weapons and tools cannot be dated with any precision and could be of Subminoan, Protogeometric or Geometric date. — Boyd 1901: 132 ff.; 137 fig. 4; Day et al. 1986: 355; 360; Day 2016: 166 f. — The author is grateful to Leslie Day (Wabash College, Crawfordsville) for advice on the iron finds from Kavousi.
[156] Knossos, Agios Ioannis, Tombs IV and VIII: the iron daggers and spearhead cannot be closely dated (SM-MPG). — Boardman 1960.
[157] Vrokastro, Kopranes, Chamber Tomb VI: iron dagger with bronze rivets; the tombs at Kopranes were used in LM IIIC, Subminoan and Protogeometric, the dagger cannot be more precisely dated. — Hall 1914: 152 f.; pl. 21: F; Kilian-Dirlmeier 1993: 107 cat. no. 284; Hayden 2002: 6 ff.; for parallels for the dagger from Knossos, dating to the 9th/8th century BC, see Kilian-Dirlmeier 1993: 107 f. cat. no. 281, 283, 286 etc.

is unclear, and it is possible, and sometimes likely, that they belong to the Cretan Protogeometric period, and some of the iron objects could be even later. Owing to the disturbance caused by grave robbers, the date of the finds from Knossos, North Cemetery/Medical Faculty, Tomb 208, including fragments of a dagger, a knife and a pin, all of iron, is also unclear.[158] Finally, it should be emphasized that the iron objects from graves at Asarlık (Caria) and from the 'House of Bronzes' at Sardis (Lydia) are not securely dated to the 11th or early 10th century BC, but could be considerably later.[159]

The abandonment of bronze and the adoption of iron for making weapons is obviously a crucial step in the Bronze/Iron transition, and the subject deserves detailed treatment. As will become apparent, regional differences, varying burial customs and changes in combat all play an important role, and make careful analysis necessary. As Table 6 indicates, the range of iron weapons is quite limited: apart from spears, only dirks and daggers occur regularly. It has been found useful to distinguish between dirks and daggers, because the length of the weapons was of fundamental importance for their efficacy on the battlefield. In general terms, the weapons in question are chiefly designed for thrusting/stabbing (the daggers and dirks) or for cutting/slashing (the swords). The terminology used here is based on that of Douglas Hamilton Gordon, distinguishing between daggers (length less than ca. 33 cm), dirks (length ca. 33 cm to 51 cm), short swords (length ca. 51 cm to 71 cm) and long swords (length over 71 cm).[160] In the following discussion, the swords will be analysed first, followed by the dirks and the daggers.

Swords

In her 1993 monograph on swords, Imma Kilian-Dirlmeier discussed the reasons why, in most areas of Greece, the production of bronze swords apparently stopped after the end of the Mycenaean period. She considered that this might have been caused by problems with the supply of copper and tin; or a general economic impoverishment might have led to reduced expenditure on burial furnishings, so that swords were no longer deposited in graves.[161] Alternatively, the knowledge of iron, the new metal, may have led to the cessation of bronze sword production; perhaps bronze weapons no longer had the prestige that they previously enjoyed. But it is also possible that, in some areas, methods of combat changed, and the cutting/slashing sword was abandoned in favour of a new method of fighting with spears, together with dirks or daggers used for stabbing at close quarters. In the following, the evidence on the latest bronze swords in Greece will be reviewed.

The grave from Kouvaras in Acarnania, with its remarkable bimetallic knife, has already been mentioned above. The weapons in the grave, all made of bronze, included a sword of Allerona type, a dirk of Sandars' type F, a spearhead, an arrowhead and a pair of greaves.[162] The contents of the grave show that bronze swords and dirks of Mycenaean type were still occasionally used by élite warriors in western Greece during the Submycenaean period. A bronze sword and a bronze dirk were also found in the warrior grave from Liatovouni in north Epirus; however, in this case it is uncertain whether the tomb dates to LH IIIC or Submycenaean.[163]

Imma Kilian-Dirlmeier provided a list of post-Mycenaean bronze swords, which are later than Submycenaean; the most characteristic feature is the pair of rivets on the shoulders of the swords.[164]

[158] Coldstream and Catling 1996: 199 f.; Snodgrass 1996: 576; 579; 586 (SM-EPG).
[159] Asarlık/Termera: iron spears, knives and fragments of other weapons from Tombs A, B, C and D (probably PG-MG). See Paton 1887: 68-72; Sherratt 1994a: 91 note 41; Carstens 2008: 71 ff.; 2011. — Sardis, 'House of Bronzes': iron knife, sickle and trunnion axe. See Hanfmann 1963: 7; Hanfmann 1983: 21; 24; 26; Waldbaum 1983: 46; 48; 54 f.; 178 ("probably no later than the late 11th or 10th century BC"); Ramage et al. 2021: 39-49.
[160] The lengths include both blade and hilt; see Gordon 1953. — The size range for the dirks has been altered to correspond with the Mycenaean 'swords' of Sandars' type F, which (with one exception) measure between 33 and 51 cm in length (see Kilian-Dirlmeier 1993: 78 fig. 19). — Compare the terminology developed by Marco Pacciarelli for Italian weapons of the Final Bronze Age: *pugnale*, *daga*, *spada corta*, *spada media*, *spada lunga* (defined according to blade length); see Pacciarelli 2006.
[161] Kilian-Dirlmeier 1993: 123 f.; 154.
[162] Jung et al. 2017.
[163] See Douzougli and Papadopoulos 2010. For the possibility of a Submycenaean date, see Jung et al. 2017: 87.
[164] See Kilian-Dirlmeier 1993:101; 124 f.; 154; 170; Bräuning and Kilian-Dirlmeier 2013: 30 f. — The swords in question are: Kilian-

Table 6. Finds from selected graves of the 11th and 10th century BC from Cyprus and Greece with swords, dirks and daggers.

	Sword	Dirk	Dagger	Spear	Knife	Arrowhead	Axe	Phalera	Helmet	Whetstone
Knossos, NC 201	1 br			1 br	1 ir	6 br		1 br		
Kourion, Kal. 40			1 ir	1 br				3 br	1 br	1
Tiryns, Phil. XXVIII			1 ir	1 br	1 ir			1 br	1 br	
Knossos, NC 186			1 ir	1 br	1 ir			1 br		1
Pantanassa			1 ir	2 br	1 ir					
Prinias, Sid. BA			1 ir	3 br	1 ir		1 br			
Athens, Ker. PG B			1 ir	1 br						
Athens, Ker. PG A_2			1 ir	1 br	?1 ir					
Kouklia, Skales 89			1 ir	2 br	2 ir					1+
Kouklia, Skales 43			1 ir	1 br						1
Amathus 523			1 ir	1 br	2 ir					
Kouklia, Skales 203			1 ir	2 br	1+ ir					1
Kouklia, Plakes 144			1 ir	1 br, 1 ir	1+ ir	3 br, 3 ir		3 br	1 br	1
Archanes, K.-L.		1 ir	1 ir	1 br, 1 ir						
Knossos, NC 2			1 ir	1 ir	1 ir					
Lefkandi, Toumba	1 ir			1 ir	1 ir					1

These 'Protogeometric' bronze swords are mainly found in Macedonia, but isolated examples have been found in Albania, Epirus and Boeotia, and more are known further north in the Republic of North Macedonia and in Bulgaria. In view of this distribution, it is clear that bronze swords continued to be used longer in northern Greece than in areas further to the south. Considering the fact that bronze swords had fallen out of use in central and southern Greece, the example from Knossos, North Cemetery/Medical Faculty, Tomb 201 is exceptional.[165] Antonis Kotsonas has argued that the furnishings of this warrior were consciously selected to imitate the equipment of the Homeric hero Meriones, so presumably a bronze weapon was considered to be more authentic for a warrior of the Heroic Age than an iron one.[166]

With this example in mind, the bronze sword from Vergina, Tumulus C, Grave Δ, which is assigned to the earliest phase of use of the cemetery, may have belonged to an analogous 'founder hero' of the

Dirlmeier 1993: cat. no. 231, 232, 235, 236, 248, 249, 250, 255, 264, 268A; Harding 1995: cat. no. 189 (possibly also the re-used sword, cat. no. 99). — Another 'late' sword has subsequently been discovered at Elati in the Kozani region of western Macedonia: Karamitrou-Mentesidi 2008: 879; 892 fig. 1. — The swords from Boeotia are from Steni and Vranezi (Kilian-Dirlmeier 1993: cat. no. 248 and 249).

165 For the sword, see Kilian-Dirlmeier 1993: cat. no. 255.

166 Kotsonas 2018.

community.[167] And the bronze swords from Vranezi in Boeotia, and Aghios Panteleimon in western Macedonia, which were also found in Iron Age cemeteries, could be interpreted in a similar way.[168] In the extensive Iron Age cemetery of Aghios Panteleimon, the bronze sword was found in a tumulus with 14 tombs, none of which contained iron furnishings.[169] It is probably significant that the Vranezi sword-grave also appears to have been buried under a tumulus.[170]

Apart from Tomb 201 from Knossos, which can be assigned to the mid-11th century BC, most of the post-Mycenaean bronze swords lack associated finds, making this last stage in the use of bronze for swords difficult to date precisely.[171] For this reason, it is worth noting that the sword from Vranezi in Boeotia is closely related not only to the sword from Vergina, but also to an example from Castellace (Oppido Mamertina, Calabria), from a cemetery dating to the Final Bronze Age; according to these parallels, a date in the second half of the 11th century BC seems most likely for the Vranezi sword.[172] Unfortunately, the chronological position of the bronze sword from Vergina is rather uncertain, despite the efforts of many scholars since publication of this important cemetery in 1969. Although there is general agreement that the grave with the bronze sword belongs to the first phase of use of the cemetery, it is at present impossible to date this precisely. A few bronze pins, finger rings and fibulae are closely related to jewellery of the Submycenaean period found further south in Greece, indicating that the earliest burials in the cemetery can hardly be dated later than the 11th century BC.[173] However, in the next phase of use of the cemetery the male burials are regularly furnished with iron weaponry which, for most authors, rules out a date before the 10th century BC. Against this background, it is not surprising that there has been a degree of consensus, ever since the original publication 50 years ago, that the cemetery began in the late 11th century or around 1000 BC.[174] This view is shared by the authors of the most recent study, who date the start of the cemetery around 1000 BC.[175]

In summary, bronze swords were still in use in Boeotia and Macedonia during the second half of the 11th century, probably until around 1000 BC. Otherwise, in most areas of Greece and the Aegean, bronze swords are unknown after the end of LH IIIC (the few exceptions, from Acarnania and Crete, have been mentioned above).

Dirks

During the late Palatial and post-Palatial period (LH IIIB-C) dirks, i.e. stabbing weapons between 33 cm and 51 cm in length, played an important role in the warriors' armament, in the form of Sandars' type F in the Mycenaean sphere, and the 'Ugarit' type in the Levant.[176] Dirks of Mycenaean type remained in use in the west during the Submycenaean period: the bronze dirk from Kouvaras in Acarnania has already been mentioned above, and two further examples are known from Elis in the north-western Peloponnese.[177]

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167 Bräuning and Kilian-Dirlmeier 2013: 30 ff.; 305 fig. 267: 20. — Anthony Snodgrass (1971: 255) regards the sword as an heirloom.
168 Aghios Panteleimon, near Amintaio (Florina), length 68 cm; Kilian-Dirlmeier 1993: 99 cat. no. 268A. The sword was discovered during the Russian excavations in 1899; according to Hammond, the excavations of 1898 and 1899 uncovered 376 graves, with 1 bronze and 9 iron swords, 25 iron spears, 4 iron arrowheads and 72 iron knives. See Hammond 1972: 340 f. (Pateli). For a brief mention of the recent excavations in the cemetery, see Whitley et al. 2007: 48. — According to a sketch kindly provided by Siegwald Schiek (Stuttgart), the Aghios Panteleimon sword, presently located in the Istanbul Museum (inv. no. 1700), is very similar to the example from Elati. — Vranezi, near Livadeia (Boeotia), length 66.5 cm. Kilian-Dirlmeier 1993: 97 cat. no. 249; for the cemetery, see Desborough 1972: 202; 273; Coldstream 1977: 38 f.; Lemos 2002: 170 f.
169 Hammond 1972: 340 f.
170 Machowski 2007: 11.
171 For two unprovenanced late bronze swords from 'Bodrum' and 'Cilicia', see Dietz et al. 2015: 39 f. no. 104; pl. 15: 104; Müller-Karpe 1994b: 440 f.; 433 fig. 2: 4.
172 Pacciarelli 2000a: 197 fig. 114: 3. — For an introduction to the chronology of the Final Bronze Age in Italy, see Pare 2008b.
173 Rather confusingly, this earliest phase at Vergina is referred to as 'phase II' (today, phase I is redundant and no longer used). See Bräuning and Kilian-Dirlmeier 2013: 30 ff.
174 See for example: Desborough 1972: 217-220; Kilian-Dirlmeier 1993: 124 f.
175 Bräuning and Kilian-Dirlmeier 2013: 138; 148; 150.
176 For Sandars Type F, see: Kilian-Dirlmeier 1993: 76 ff.; Papadopoulos 1998: 24 ff. (Variant D); 56 ff. — For the 'Ugarit' type, see Jung 2009: 144 fig. 8 (distribution map); Jung and Mehofer 2009: 122-123.
177 For the dirks from Elis (lengths 34.3 and 46.5 cm), see Eder 2001: 25 cat. no. 4; 32 f. cat. no. 2.

Following the cessation of bronze sword production in most areas of Greece and the Aegean after LH IIIC, dirks and daggers became increasingly important. This trend towards shorter weapons, and away from the longer cut-and-thrust swords, is widespread in the central and eastern Mediterranean, reflecting changes in combat, and particularly the rise of the spear as the dominant weapon on the battlefield. In Cyprus and the Aegean, evidence of this change in combat – in the form of long spears and new kinds of dirks and daggers – can be detected since the mid-11th century BC, and in Italy, the transition to dirks rather than swords took place in Final Bronze Age 2.[178] In an interesting discussion, Marco Pacciarelli suggested that this change in weaponry reflects the extension of arms-carrying to broader sections of society: "The emergence of warriors armed with heavy spears indicates a mode of combat that no longer resembles the sum of individual skirmishes, but real head-on collisions between organized infantry, even if not yet necessarily in tight formation. This therefore appears to be a turning point in military practice, significantly coinciding with the transition to new forms of political-territorial and certainly socio-economic organization."[179] If most of the serious fighting was carried out with spears (lances and javelins), then the daggers and dirks would only have been used for close, hand-to-hand combat. Use of daggers and dirks was probably restricted to warriors of high status, and they very likely served as markers of social and military distinction and as prestige goods. This change in combat is important for our discussion, because the earliest iron weapons, particularly dirks and daggers, can only be understood in this context.

The bronze and the iron post-Mycenaean daggers and dirks are often typologically related to each other, indicating a network of relationships reaching from southern Italy and southern Albania, to central and southern Greece, Cyprus and even as far as the Levant. Because they are made of bronze, the dirks from Sicily, southern Italy and southern Albania are better preserved, and typological groups have been identified (post-Allerona, Contigliano and Torre Galli variants).[180] As shorthand for these dirks and the related dirks and daggers in the Aegean and East Mediterranean, I use the term 'post-Naue II/Allerona'. The details of the typological relationships cannot be discussed in detail here, but it should be emphasized that the latest bronze dirks and daggers, and the earliest iron examples, indicate a close network of contacts linking different regions in the central and East Mediterranean during the 11th and 10th centuries BC.

In central Greece, only one post-Mycenaean bronze dirk is known, from a Submycenaean cist grave at Ellopia in Boeotia.[181] Typologically, it is ultimately derived from the Allerona type of swords, but its hilt with 'hunched' shoulders has parallels among weapons in the East Mediterranean, and it could well have been imported.[182] In south Albania, production of 'post-Naue II/Allerona' bronze dirks continued longer, probably lasting into the first half of the 10th century BC, if not longer.[183] As mentioned above, they often resemble the bronze dirks from southern Italy and Sicily, which date to Final Bronze Age 2-3a. The dirk from Kakavijë (Gjirokastër County) is particularly interesting in our context, because it was found in a

[178] For Italy, see Pacciarelli 2006; and Abbate 2014: 83 fig. 2.

[179] Pacciarelli 2006: 256: "L'emergere di figure di armati di lance pesante si concilia con scenari bellici somiglianti non più a una somma di scaramuce individuali, ma a veri e propri urti frontali tra fanterie organizzate, anche se non ancora necessariamente in formazione serrate. Questa dunque appare una fase di svolta negli assetti militari, significativamente coincidente con il passagio a nuove forme di organizzazione politico-territoriale e certamente anche socio-economica."

[180] For Italy, see Bianco Peroni 1970: pl. 26-28 (Contigliano and Torre Galli types); Pacciarelli 2000a: 195 fig. 113: B2; 197 fig. 114: 4 (Castellace); Bietti Sestieri and Macnamara 2007: pl. 48: 226; pl. 72: 358 (unprovenanced); Albanese Procelli et al. 2015: 458 f. (Molino della Badia, Madonna del Piano, Tombs 26, 40 and 194); Orsi 1900: pl. 12: 1.5 (Modica); Guzzo 1982 (Roggiano Gravina); La Rosa 1989: 16; 24 fig. 18 (Molino della Badia). — The bronze dagger from the destruction layer of the south gate at Megiddo (Megiddo VIA) should presumably be interpreted as an import from the central Mediterranean. See Shalev 2004: pl. 23: 180.

[181] For Ellopia, Cist Grave 1, see Aravantinos 2010: 138 (colour photograph); for the Submycenaean date, see Bräuning and Kilian-Dirlmeier 2013: 30; 137. — A bronze dirk of Subprotogeometric date from Lefkandi, Toumba Pyre 13 is regarded as an heirloom; see Popham and Lemos 1996: pl. 127: Pyre 13, 4.

[182] For similar weapons in the East Mediterranean, see for example the dirk from Enkomi, British Excavations, Tomb 47 (Matthäus 1985: 364 cat. no. 2; pl. 140: 2); a dirk from Hama (Riis 1948: 120 fig. 136: B); and for the 'hunched' shoulders, see also an unprovenanced sword, supposedly from 'Cilicia' (Dietz et al. 2015: 39 f. cat. no. 104; pl. XV: 104).

[183] For the Albanian weapons, see the discussion in Kilian-Dirlmeier 1993: 101; Bräuning and Kilian-Dirlmeier 2013: 31. — The dirks in question are: Kilian-Dirlmeier 1993: cat. no. 234, 251, 252, 253, 254, 270, 271. — For another dirk, from Prodani (Kolonja County), see Aliu 1984: 55 pl. 1: 13.

grave associated with an iron knife with bronze rivets; the dirk has close parallels in the cemetery of Castellace in Calabria, and in this case, a chronological position in the second half of the 11th century BC seems most likely.[184] A bronze dirk has also been found in the important cemetery at Stamna in Aetolia.[185] Since 1994 more than 700 graves have been excavated at this site on the Aetoliko lagoon, containing an important collection of dirks, short swords and daggers – which, with the exception of the bronze dirk, are otherwise all made of iron. Unfortunately, only preliminary reports have appeared so far, and the finds have not yet been published comprehensively.[186] The start of the cemetery may reach back to the 11th century BC, as a few pins and fibulae of Submycenaean character suggest. Apart from the dirk, bronze spearheads are quite numerous, and Ioannis Moschos refers to a "bronze phase" at Stamna, which he suggests might correspond to Early Protogeometric in Aetolia.[187] Unfortunately, without comprehensive publication of the cemetery, it is presently impossible to give a precise estimate of the date of the Stamna dirk, although a position in the first half of the 10th century BC seems plausible.

In summary, during the second half of the 11th and the first half of the 10th century BC, bronze dirks continued in use in western Greece (Stamna), southern Albania, and southern Italy. In the rest of Greece and the Aegean, production of bronze dirks does not seem to have outlived LH IIIC, with the Submycenaean example from Ellopia being the only known exception.

Iron dirks have only been found rarely in the Aegean in contexts of the second half of the 11th century BC. The example from Athens, Kerameikos, PG Grave 2 (N) is particularly important, being one of the earliest iron weapons in the Aegean, as it dates to the Transitional SM/EPG phase (Figure 17: 1).[188] Vincent Desborough believed that this weapon might have been imported from Cyprus, and it does indeed share some features with iron daggers from Cypriot tombs from the second half of the 11th and the 10th century BC (Cypro-Geometric I-II).[189]

The shape of the hilt of the Athenian weapon also resembles the bronze hilt of the bimetallic dirk from the tomb of Psusennes I in Tanis in the Nile Delta (Figure 17: 2).[190] The dirk in the tomb of Psusennes has a flat bronze hilt with simple arched shoulders and a long extension to hold a pommel; three bronze rivets survive, which originally fastened organic hilt plates. As Psusennes reigned between ca. 1039 and ca. 991 BC, the dirk was presumable made sometime before his death, perhaps around 1000 BC or in the later 11th century BC.[191] In view of the late adoption of iron metallurgy in Egypt, it is most likely that the dirk from Tanis was a prestigious gift to Psusennes or his general Wendjebaendjed. The Tanis dirk has a very unusual method of bimetallic construction, with the flat bronze hilt cast onto the iron blade. As this would only have formed a weak joint between hilt and blade, it is quite likely that it constitutes a repair; perhaps a broken iron dirk was provided in Egypt with a bronze hilt. A similar explanation was suggested above for the iron knife from Kouvaras (Acarnania), which also has a flanged bronze hilt.

[184] Kakavijë: Kilian-Dirlmeier 1993: pl. 35: 234; Castellace: Pacciarelli 2000a: 195 fig. 113: B2; 197 fig. 114: 4. — The dirk from Kakavijë is also related to the sword from Vranezi (Boeotia) and an unprovenanced sword, supposedly from 'Bodrum'; see Kilian-Dirlmeier 1993: pl. 38: 249; Müller-Karpe 1994b: 433 fig. 2: 4.
[185] The weapon is 55 cm long, but considering that ca. 8 cm of this length is represented by the unusually long pommel tang, it should be classified as a dirk with a very long pommel tang, rather than as a short sword. It is illustrated in the unpublished doctoral dissertation of Gioulika Christakopoulou; see Christakopoulou 2009: 1239 f. — This weapon has a rather close parallel from the tumulus of Prodani (Kolonja County, Albania); see Aliu 1984: 55 pl. 1: 13.
[186] For preliminary reports, see Christakopoulou 2001; 2009; 2016; 2018; Kolonas et al. 2017.
[187] Moschos 2009a: 236 note 9; 240; 245 f.; 2009b: 364 ff. — Ioannis Moschos refers to a number of possible iron finds which might date to Achaean EPG, but none of these examples have reliable and well-dated contexts: three spearheads from unsystematic excavations of a chamber tomb at Trapeza, near Aigion; an iron pin from the tholos tomb at Kallithea-Laganidia; and two iron knives from Vrysarion, Chamber Tomb 4. See Moschos 2009a: 236; 245; 2009b: 365 note 95. — I am grateful to Birgitta Eder (Athens) and Elisabetta Borgna (Udine) for advice on these finds.
[188] Kilian-Dirlmeier 1993: 106 cat. no. 273; pl. 40: 273.
[189] Desborough 1972: 311; 310 fig. 39: A.B. — See also the comments in Snodgrass 1971: 224; 229 f.; Snodgrass 1980: 347; Sherratt 1994a: 75. — For the Cypriot weapons, see Kouklia, Skales, Tombs 64, 89, 200, 203 and 210: Karageorghis 1983: fig. 120: 5; 193: 105+106; Karageorghis and Raptou 2016: pl. 91: 15; 92: 55+69+76; 97: 17A. — Amathus, Tomb 523: Vonhoff 2013: 200 fig. 6.
[190] The two dirks are also similar in length (Athens: 48.2 cm, Tanis: 47 cm).
[191] Tomb of Psusennes: Montet 1951: 80; pl. 53; Grajetzki 2003: 98. The sword bears an inscription with the name of the general Wendjebaendjed.

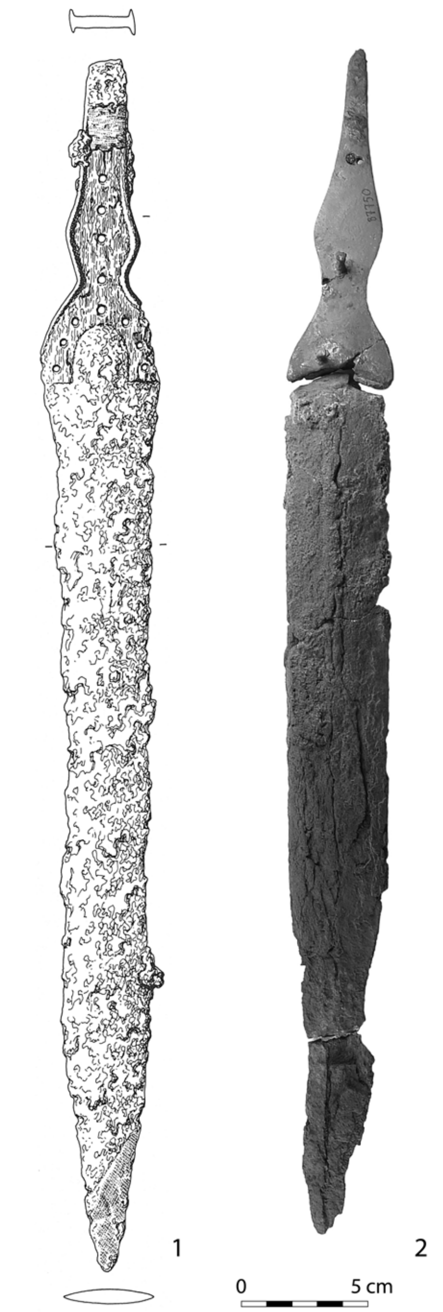

Figure 17. The dirks from (1) Athens, Kerameikos, PG Grave 2(N), and (2) Tanis, Tomb of Psusennes I. — 1 after Kilian-Dirlmeier 1993: pl. 40: 273. — 2 Museum of Egyptian Antiquities, Cairo; photograph kindly provided by Christian Eckmann (Mainz). — Scale 1:3.

In both cases, the iron objects were probably valuable imports at a time when iron was still rare, and for this reason they were carefully repaired. Although it cannot be proven, it is quite likely that both the Athens and the Tanis iron dirks were imports from Cyprus.

A second iron dirk was found in Archanes, Katô Lakkos in Crete, in a pit tomb with a stone urn containing a cremation burial (Figure 18).[192] The iron dirk is complete except for the pommel tang, which is lost to corrosion. The tomb also contained a fragment of an iron dagger with a flanged hilt, one bronze and one iron spearhead, and a stirrup jar. With the characteristic diamond-shaped profile of the hilt, the dirk from Archanes is obviously related to the later Cretan Protogeometric iron daggers and dirks, but also to iron daggers dating to Cypro-Geometric I from Cyprus, and to the examples from Athens and the tomb of Psusennes discussed in the last paragraph.[193]

Daggers

Daggers have a very prominent place among the earliest iron weapons in the Aegean and Cyprus. Table 6 summarizes the arms found in the most important weapon graves with early iron objects, and iron daggers, together with bronze or iron spears, clearly occur with remarkable regularity.

Whereas bronze daggers were apparently hardly ever used as weapons in the Aegean and Cyprus at the end of the Bronze Age, they were very common in the Levant.[194] The Levantine examples mostly measure ca. 30-35 cm in length, and occur in a wide range of typological variants.[195] In the southern Levant, the transition to the use of iron for daggers is heralded by the examples from Tell el-Far'ah (S) and Tell Dor (discussed in Chapter 2.3), which probably date between the second half of the 12th and the first half of the 11th century BC. As noted above, daggers were hardly ever used as weapons in Cyprus during the Late Bronze Age, and only gained popularity during the 11th century BC – manufactured in iron.[196] This indicates a change in combat techniques and, judging from the long tradition of dagger-use in the Levant, the daggers possibly reflect the influence of Levantine practices in

[192] Archanes, Katô Lakkos (preserved length 37.9 cm): Orlandos 1978: 61 fig. 70; Sapouna-Sakellaraki 1990: 75 f.; 76 fig. 15; Kilian-Dirlmeier 1993: 108 cat. no. 289; pl. 43: 289.

[193] For the Cretan daggers and dirks, see for example Kilian-Dirlmeier 1993: pl. 42-44, cat. no. 282-305; Rethemiotakis and Englezou 2010: pl. 63: 192; 70: 211 (Eltyna). — Owing to its similarity with a weapon from Phoinikia, the Archanes dirk should probably be dated to a late part of Subminoan, or to the Subminoan/EPG transition. For Phoinikia, see Kilian-Dirlmeier 1993: 108 no. 290; pl. 43: 290; Karageorghis and Kanta 2014: 263 ff. — For the Cypriot weapons, see for example Karageorghis 1983: fig. 51: 80 (Kouklia, Skales, Tomb 43); Karageorghis and Raptou 2014: pl. 88: 43 (Kouklia, Plakes, Tomb 144); Karageorghis and Raptou 2016: pl. 91: 15; 92: 55+69+76; 97: 17A (Kouklia, Skales, Tombs 200, 203 and 210).

[194] The so-called 'Peschiera' daggers, measuring ca. 22-24 cm in length, are too short to have been used as weapons. See for example Papadopoulos 1998: 29 f.; pl. 22.

[195] See for example Shalev 2004: 51 ff.; pl. 17: 161; 18: 162-163; Schulz 2014: 46 ff.; pl. 11-15 (types F-H).

[196] For a rare exception, see an unprovenanced bronze dagger in Nicosia Museum (originally ca. 30 cm in length): Catling 1964: 128; fig. 15: 18; pl. 15: m.

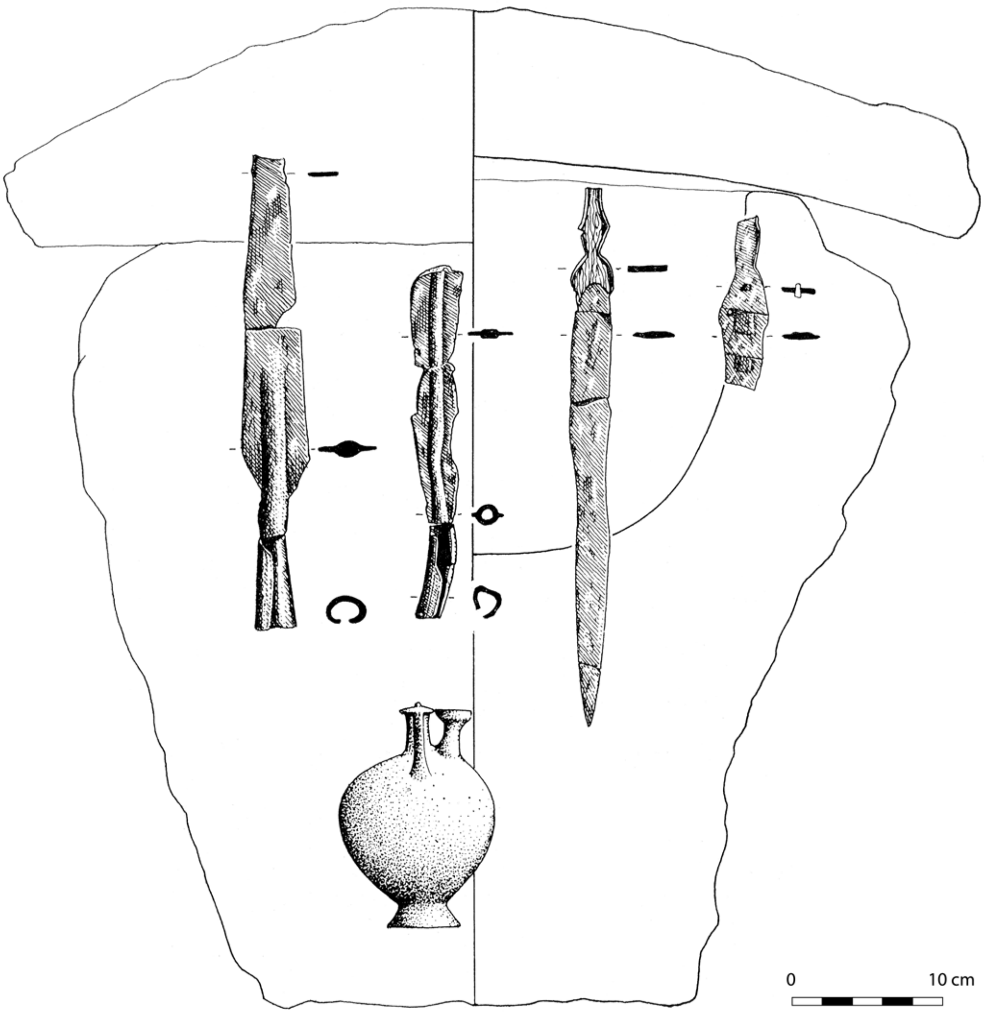

Figure 18. Grave furnishings and stone urn from Archanes, Katô Lakkos, Crete. — After Orlandos 1978: 61 fig. 70. — Scale 1:5.

warfare. However, the new weapons are not related typologically to Levantine daggers, instead they belong to the 'post-Naue II/Allerona' tradition typical for weaponry in the central and East Mediterranean.

The earliest 'true' iron dagger from Cyprus is the example from Kourion, Kaloriziki, Tomb 40, dated by Louise Steel to a late stage of LC IIIB.[197] The dagger has a "rounded shoulder, a bulged hilt without flanges, fish-tail finials and remnants of a pommel spur"; originally, the bone hilt-plates were affixed by four iron rivets.[198] The design of the hilt shows that it was ultimately derived from bronze swords and dirks of the 'post-Naue II/Allerona' tradition, such as those mentioned above from Ellopia, Enkomi, 'Cilicia' and Hama.[199]

While the dagger from Kourion, Kaloriziki, Tomb 40 was originally probably not longer than 26-27 cm, in the second half of the 11th and in the 10th century BC, longer iron daggers of ca. 30-33 cm in length became more common. Examples are known from Cyprus (Kouklia, Plakes; Kouklia, Skales),[200] Crete

[197] Steel 1996: 297 f.
[198] The description quoted is from Matthäus and Schumacher-Matthäus 2015: 55; for illustrations of the daggers, see Matthäus and Schumacher-Matthäus 2015: 54 fig. 43: 36; 55 fig. 44.
[199] See footnotes 181-182.
[200] For the Cypriot daggers, see footnotes 189 and 193.

(Knossos, Agios Ioannis, Tomb VIII; probably Prinias, Siderospilia, Tomb BA),[201] mainland Greece (Tiryns, Philaki, Tomb XXVIII; Elateia-Alonaki, Tomb XLIV),[202] and perhaps also from Caria (Hüsamlar/Keramos, Tomb 342).[203] Shorter daggers, ca. 21-26 cm in length, are known from Crete (Knossos, North Cemetery/Medical Faculty, Tomb 186; Pantanassa)[204] and mainland Greece (Athens, Kerameikos, PG Graves A_2 and B; Lefkandi, Skoubris, Grave 46).[205] Unfortunately, in other cases the daggers are so badly preserved that the original length is today unknown.[206]

While iron daggers seem to have been introduced first in the southern Levant and Cyprus, the earliest examples from Crete and mainland Greece are not much later, dating around the third quarter of the 11th century BC (Transitional SM/EPG on the mainland; early Subminoan on Crete).[207] Considering this rather sudden introduction of iron weapons in the Aegean, it is quite likely that some of these daggers were not made locally, but were imported as prestigious novelties. The longer daggers have most in common, for example those from Elateia-Alonaki; Tiryns; Knossos, Agios Ioannis; Amathus, Tomb 523; and Kouklia, Skales, Tombs 43, 64 and 89. Furthermore the angular shape of many Cretan dagger hilts resembles those on some Cypriot weapons, suggesting that at some point, Cypriot daggers were known and imitated on Crete.[208] The hilt of the dagger from Athens, Kerameikos, PG Grave A_2 is quite closely related to the hilts of the dirks from Kerameikos, PG Grave 2 (N) and from the tomb of Psusennes in the Nile Delta, which might both have been manufactured in Cyprus. Considering the 'delicate' design of all three, and the impractical bimetallic construction of the Egyptian piece, it seems certain that they were primarily markers of distinction, rather than functional weapons.[209]

However, the small number of iron daggers and dirks and their poor preservation, most being severely corroded, make precise typological comparisons difficult. It is more apposite to emphasize the overall similarity of these weapons, and the remarkable consistency of the weapon combinations in the graves at this early stage of iron use (see Table 6).

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[201] For Knossos, Agios Ioannis, Tomb VIII, see: Boardman 1960: 142 no. 16; 141 fig. 9: 16; pl. 39: 16; Kilian-Dirlmeier 1993: 108 cat. no. 288; pl. 42: 288. — For Prinias, Siderospilia, Tomb BA, see: Rizza 1996: 1105 f.; 1107 fig. 5; Perna 2011: 143-146; 2015: 266 f.; 2019 (only the blade of the dagger is preserved, length: 27.3 cm; I am grateful to Prof. Hartmut Matthäus [Erlangen] for this information).

[202] For Tiryns, Philaki, Tomb XXVIII, see: Verdelis 1963: 14 ff.; 13 fig. 8; Beilage 5: 4. — For Elateia-Alonaki, Tomb XLIV, see: Dakoronia 2009: 96 fig. 11; Deger-Jalkotzy 1999: 197-199; 2013: 225 f.; Ruppenstein 2013: 189 note 21.

[203] For Hüsamlar/Keramos, see: Özer 2019: 155; fig. 9. The three fragments of the dagger have a combined length of 20.3 cm; a reconstruction as a long dagger (ca. 30-33 cm) is possible, but by no means certain.

[204] Knossos, Tomb 186, preserved length 25.9 cm: Coldstream and Catling 1996: 190 f. no. 5; fig. 163: f5; pl. 274: f5. — Pantanassa, hilt not preserved, length of blade 17 cm: Tegou 2001: 136 no. 16.

[205] Athens, PG Graves A and B: Kraiker and Kübler 1939: 101 f.; 104; pl. 31; 32. The dagger from Grave B is 21 cm long; the original length of the weapon from Grave A is unknown, but judging from the narrow and delicate handle, it was probably not much larger than the example from Grave B. — Lefkandi, Skoubris, Tomb 46: Popham et al. 1980: 126 no. 7; pl. 106: 7; 245: e.

[206] See for example the fragments from the western cemetery at Amathus: Tomb 521: Karageorghis and Iacovou 1990: 87; 82 fig. 5: 98A; pl. X: 98A; Tomb 523: Karageorghis 1987: 719; 721 fig. 188; Vonhoff 2013: 200 fig. 6. — Two fragments of a dagger blade (8 cm and 5 cm in length) were found in Knossos, North Cemetery/Medical Faculty, Tomb 2; the grave was robbed and it is uncertain if all the iron objects (dagger, spearhead, knife, pin) belonged to the primary burial of the Subminoan period. See Coldstream and Catling 1996: 58 f.

[207] Iron daggers of the 11th century BC: Cyprus (LC IIIB-CG IA): Kourion, Kaloriziki, Tomb 40; Kouklia, Skales, Tomb 89; Kouklia, Plakes, Tomb 144. — Crete (Subminoan): Knossos, North Cemetery/Medical Faculty, Tombs 2(?) and 186; Pantanassa; Prinias, Siderospilia, Tomb BA. — Mainland Greece (Transitional SM/EPG and EPG): Athens, Kerameikos, PG Graves A and B; Elateia-Alonaki, Tomb XLIV; Lefkandi, Skoubris, Tomb 46; Tiryns, Philaki, Tomb XXVIII. — Possibly also Tomb 342 from Hüsamlar/Keramos in Caria. — As explained above, the iron dirk from Athens, Kerameikos, PG Grave 2 (N) is also assigned to this earliest horizon of iron weapons. — Similar types of dagger remained in use in Cyprus and Crete during the 10th century BC.

[208] For the Cretan daggers, see for example Kilian-Dirlmeier 1993: pl. 42: 282.283.285.288; 43: 289; Rethemiotakis and Englezou 2010: pl. 63: 193; 70: 211. Compare, for example, Karageorghis and Raptou 2014: pl. 88: 43 (Kouklia, Plakes, Tomb 144); for the Cypriot daggers see also footnotes 189 and 193. — In the literature, it has been suggested that some of the Cretan daggers were imported from Cyprus. See for example Crielaard 1998: 191; 2006: 286; 2012: 148; Kourou 2009: 363 f.; 2016: 54; Karageorghis and Kanta 2014: 158 no. 111; 162 no. 121.

[209] In the case of Athens, Kerameikos, PG Grave 2 (N), Florian Ruppenstein believes that the dirk served purely as a prestige object. See Ruppenstein 2007: 203.

Spears and arrows

As a number of authors have noted, the early iron daggers, with their short blades and rather delicate construction, would not have been very effective on the battlefield, and they probably had a principal function as markers of military or social distinction.[210] According to the grave assemblages, for serious combat the warriors relied on their spears, and this is also clear from the Homeric epics.[211] As suggested by Marco Pacciarelli (see above), at the transition from the Late Bronze Age to the Early Iron Age there was a change in fighting techniques: the traditional bronze cut-and-thrust swords were abandoned, and now spears became of primary importance. With this in mind, it is very interesting that spears were still very often made of bronze, even after iron had been introduced for the manufacture of dirks/daggers and items of jewellery (see for example the grave assemblages in Table 6). Apparently, when it was a matter of life or death, on the battlefield, most warriors still relied on bronze rather than the new metal iron for their most important weapons. In Cyprus, while the earliest iron spearheads date to CG I, they were still heavily outnumbered by bronze examples before the mid-10th century BC.[212] And in mainland Greece, the few spearheads known from Submycenaean and Early Protogeometric graves are all made of bronze.[213] The situation in Crete is less clear. An iron spearhead was found in Knossos, North Cemetery/ Medical Faculty, Tomb 2, but unfortunately from an unreliable context.[214] The tomb from Archanes, Katô Lakkos, with a bronze and an iron spearhead, probably already belongs to the earlier 10th century BC (late Subminoan or SM/EPG transition) (Figure 18).[215]

The weapon set from Kouklia, Plakes, Tomb 144 is particularly interesting.[216] Apart from the iron dagger with an ivory hilt, bronze cheekpieces from a helmet and three phalerae, the offensive weapons seem to display a self-conscious treatment of the two metals, traditional bronze and innovative iron. While one spearhead (length 42 cm) was made of bronze and had an iron ring around the socket terminal, the other (length 23 cm) was of iron and had a bronze socket ring.[217] The arrows again exhibit this symmetrical treatment of the metals: three are of bronze and three of iron.[218] In this grave assemblage, probably dating to the second half of the 11th century BC, the contrast between the old and new metals is clearly being thematized. While the larger and more effective spearhead is of bronze, the iron dagger was probably the most important marker of distinction.

Like the daggers and dirks discussed above, the bronze spearheads found in early tombs containing iron grave goods again indicate close contacts between Cyprus, Crete and mainland Greece. With its facetted socket, the spearhead from Kourion, Kaloriziki, Tomb 40 is related to the examples from Athens, Kerameikos, PG Graves A_2 and B.[219] And the 'bayonet' spearheads from Knossos, North Cemetery/Medical Faculty, Tombs 186 and 201, with incised linear decoration on their sockets and midribs, are probably imports from Cyprus.[220]

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210 See for example: Müller-Karpe 1962: 61; Vonhoff 2013: 205. — For the iron dirk from Athens, Kerameikos, PG Grave 2 (N), see Ruppenstein 2007: 202 f.

211 See Brouwers 2010: 146 f.: The spear is "the main offensive weapon used by both Achaeans and Trojans ... On the battlefield, a sword is used only after a warrior has run out of spears ... Swords are important status objects in the *Iliad*, and many of them are quite ornate."

212 For the earliest iron spears (CG I), see: Kouklia, Plakes, Tomb 144: Karageorghis and Raptou 2014. — Kourion, Kaloriziki, Tomb 39: Benson 1973: 49; 124; pl. 40: K1109.

213 See for example: Avila 1983: cat. no. 114, 880-884; Lemos 2002: 120 ff.; D'Onofrio 2011: 647 ff.; 655 f.; 662 f.

214 The Subminoan date is uncertain. See Coldstream and Catling 1996: 58 f.; fig. 173 (2.f6-9).

215 Orlandos 1978: 61 fig. 70; Sapouna-Sakellaraki 1990: 75 f.; 76 fig. 15.

216 Karageorghis and Raptou 2014.

217 Iron spearheads with bronze rings on the socket terminals are quite common, with the earliest example from Cyprus dating to CG I; the earliest example from the Greek mainland is from Lefkandi in LPG. See Popham et al. 1980: 176 no. 3; pl. 244: a (Toumba, Tomb 14). — Bronze spearheads with iron rings on their socket terminals are much less common. Apart from Kouklia, Plakes, Tomb 144, see: Karageorghis 1983: 54 no. 3; 219 no. 65; fig. 71: 3; 142: 65 (Kouklia, Skales, Tombs 48 and 76).

218 Six arrowheads were also deposited in Tomb 201 of the North Cemetery/Medical Faculty at Knossos; perhaps the number six had a special symbolic significance. See Coldstream and Catling 1996: 194 f.; fig. 163: f2-f6 and f17.

219 See: Matthäus and Schumacher-Matthäus 2015: 54 fig. 43: 29; Avila 1983: 135 no. 882-883; pl. 35: 882.883. — See for example the comments in Snodgrass 1971: 224; 229 f.; Desborough 1972: 311; Vonhoff 2013: 197; 205.

220 See for example the discussion in Vonhoff 2013: 201; 205. — Coldstream and Catling 1996: pl. 163 (Knossos, North Cemetery/ Medical Faculty). — Compare: Karageorghis 1983: fig. 71: 3 (Kouklia, Skales, Tomb 48); Karageorghis and Raptou 2014: pl. 87: 68

Before concluding our discussion, an inhumation burial from the Athenian Kerameikos cemetery (SM Grave 147) raises important questions concerning the early use of iron for weaponry. The buried individual was a child aged 8.5-11.5 years, provided with a lekythos indicating a Transitional SM/EPG or EPG date.[221] The child had fractures on the right femur and on the distal shaft of the left humerus, suggesting perimortem injuries, and an iron arrowhead was lodged in the left shoulder joint.[222] Following the arguments put forward by Florian Ruppenstein, it is difficult to avoid the conclusion that the unfortunate child was wounded by an arrow in a violent incident.[223] The importance of this find is that it demonstrates the actual use of iron, in contrast to the other weapons from burial contexts, which were placed in graves as a conscious choice of "actors creating the material record".[224] It is therefore apparent that iron arrowheads were already in use in central Greece in the second half of the 11th century BC, which is surprising, as most of our evidence from warrior graves suggests that at this time iron was still being treated as a rare and prestigious metal.

Summary

During the second half of the 11th century BC, following the cessation of Mycenaean sword and dirk production, our study of weaponry has revealed three regional groups.

Area 1. In central Greece, Crete, Caria and Cyprus, warrior graves contain iron dirks and daggers together with spears, which were mainly of bronze. From the mid-11th century BC onwards, the weapons' typology shows the existence of a communication network linking these areas together. Within this network, the iron daggers represent a form of weapon which was new in the Aegean and must clearly be related to the earlier appearance of iron daggers in the Levant and Cyprus. The grave inventories in Cyprus and the Aegean are remarkably similar, and it is justified to speak of a *koinè* linking these areas, at least in the field of weaponry (Table 6). The formation of this *koinè* can be explained both by the effects of Cypriot trade and influence on the Aegean, and the mobility of Greek-speakers (the so-called 'Hellenisation' of Cyprus).[225] In the second half of the 11th and the early 10th century BC, Cyprus remained the most important influence in the development of Aegean ironworking, as it had been previously since the appearance of the 'knife horizon'.

Area 2. Bronze dirks (and occasional daggers) are found in Sicily, southern Italy, southern Albania and Aetolia. These are often related to the iron dirks and daggers in region 1, and together form a loosely connected 'post-Naue II/Allerona' network. The weapons indicate relatively intense contacts between the Aegean, western Greece, south Albania, southern Italy and Sicily, and reflect the introduction of new types of warfare around the mid-11th century BC. These contacts can be explained by the existence of long-range maritime routes crossing the Straits of Otranto and Messina, and presumably thereafter heading towards the western Mediterranean.

Area 3. In Macedonia, Boeotia and Epirus bronze swords were still being produced during the second half of the 11th century BC. In several cases (Vergina, Vranezi, Aghios Panteleimon) the swords apparently belong to the early stages of Iron Age tumulus cemeteries. There is no evidence for the use of iron swords in the Aegean before the 1st millennium BC.

Comparing these three regions, there are important differences in the occurrence of iron. Whereas in the first region, iron was used for a wider range of artefacts, including knives, rings, pins, fibulae, dirks,

(Kouklia, Plakes, Tomb 144). — These high-quality spearheads all measure between 37 cm and 42 cm in length.

[221] Ruppenstein 2007: 35 f.; Beil. 17; pl. 40; Lemos 2002: 123.

[222] Lagia 2007: 277: "Based on this evidence we can presume a serious injury of the musculature and peripheral pathway of the arm."

[223] The argument put forward by Anna Maria D'Onofrio (2011: 648) is less convincing; she doubts that the arrow was the cause of death, and suggests that the child was buried with "simple bowman's grave-goods".

[224] See above for the critical comments by Ian Morris concerning the problematic nature of burial evidence.

[225] For Cypriot influence, see Desborough 1972: 54 f.; 82 f.; 340 f.; Ruppenstein 2009: 329. — For the 'Hellenisation' of Cyprus, see for example: Georgiou 2015; 2017: 220-222; Iacovou 2008; 2012; Leriou 2011.

daggers and arrowheads, iron remained extremely rare in the other two areas, with the only exceptions being occasional knives.[226]

Study of the warrior graves alone could give the impression that iron was used as a precious material, used mainly for prestigious weapons and knives. However, the numerous iron pins in graves in central Greece indicate that iron was valued and used by a larger segment of society, and not confined to a restricted élite. Because the archaeological record is dominated by a few specific grave furnishings (e.g. daggers and pins), it is clear that we only have a very distorted view of the true use of iron at this time. This is also indicated by the child buried in SM grave 147 in the Kerameikos cemetery, which shows that iron arrowheads were already used at the time of the SM/EPG transition, earlier than might have been expected from studying the warrior graves in isolation.

4.4 The 10th century BC

The 10th century BC saw a massive increase in the use of iron for a more diverse spectrum of weapons, tools and jewellery. At the same time, iron use spread to new areas, including western and northern Greece. These changes can only be explained by the accelerated transfer of the technology of iron smelting and smithing, now making it difficult for élites to exercise tight control of production, circulation and consumption. For these reasons, evidence for iron use is much more plentiful than in previous centuries, and no attempt will be made here to provide a systematic survey. A few examples for the increase in iron use and the production of new categories of artefacts will be discussed, but the main focus will be on swords and axes, because they provide important information for understanding the northward spread of iron in the Balkan Peninsula.

The earliest well-documented example for this transformation in iron use comes from the MPG burial of a man and a woman in the monumental building in the Toumba cemetery at Lefkandi, perhaps dating to the second quarter of the 10th century BC.[227] The cremated remains of the man were found in a Cypriot bronze amphoroid crater, and he was provided with a sword, a spearhead and a razor, all made of iron. A long iron knife with an ivory hilt and bronze rivets was found next to the female inhumation, which was associated with four iron pins with bone and gold foil heads, along with a rich array of gold, electrum, faience and rock crystal jewellery. Furthermore, the four horses buried close by were provided with two iron bits. The iron horse bits are a striking example for the diversification of iron usage, but the exclusive use of iron for the warrior's implements and weapons is no less important.[228] Tomb 44 from the Marmaro cemetery at Ialysos in Rhodes, dating to the LPG period, is another example for this reliance on the new metal: the cremated man was provided with a dirk, a dagger, a spearhead, a spear ferrule, a long knife, a 'sickle' and an *obelos*, all made of iron.[229]

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[226] See for example the knives from Kouvaras and Thasos. The knives from Kakavijë and Patos, in Albania, will be discussed in Chapter 8.1. — A few other iron objects from western Greece have occasionally been claimed to belong to the 12th or 11th centuries BC (for Malthi, see Waldbaum 1978: 31; Zimmermann 2001: 112; 118; Palermo 2018; for Ephyrus, see Sherratt 1994a: 92; Zimmermann 2001: 115; Palermo 2018; for Pogoni, see Palermo 2018). — In the case of Malthi, the settlement was abandoned in LH IIIA1, and the iron finds could be Byzantine or Medieval (see Worsham et al. 2018: 23 f.), the iron fragments from Tholos 2 are not from reliable contexts (see Hope Simpson 2014: 66 f.). The author is grateful to Rebecca Worsham (Smith College, Massachusetts) for advice on this question. — It is impossible to assign a date to the iron sickles from Tumulus Γ at Ephyrus/Mesopotamos in Epirus, as they lack an archaeological context (see Papadopoulos and Papadopoulou 2020: 104 cat. no. A27-A30). — According to information kindly provided by Christos Kleitsas (Ioannina), who is preparing the finds for publication, the iron knives and spearheads from Tumulus B at Pogoni in Epirus cannot be dated before the 10th century BC, and he confirms that there is no evidence for iron in Epirus before the 10th century BC.

[227] Popham et al. 1993: 17 ff.; Lemos 2002: 143 ff.; Kosma 2012.

[228] Note also the S-shaped iron rod from the monumental building at Lefkandi, which might have functioned as part of a latch or a locking device. See Popham et al. 1993: 27; 71 f.; pl. 34: 4.

[229] Laurenzi 1936: 161 ff.; 165 fig. 152; D'Acunto 2017: 442. — For a later example for this increased role of iron, see Athens, Agora Grave 13, dating to EG I, with a sword, two spears, a trunnion axe, two knives, two arrowheads(?) and two horse bits, all of iron. See Papadopoulos and Smithson 2017: 104 ff.

As we learned in Chapter 3.3, iron spits (*obeloi*) were introduced in the second half of the 11th century BC in Cyprus; they were also used in Crete during the 10th century BC.[230] There is another interesting example for the early use of iron roasting spits, from the important cemetery at Stamna (Aetolia), from a built apsidal cist grave excavated in 1994.[231] The primary burial, a contracted inhumation, was provided with an amphoriskos, a kantharos, a bronze spearhead, two golden hair spirals, bronze and iron rings, and no less than 85 fragments of iron *obeloi*. A secondary cremation burial in the cist grave was associated with an iron dirk, a bronze spearhead and a bronze phalera. As the Stamna cemetery has not yet been published systematically, the precise date of these burials is still uncertain, although a position in the 10th century BC is very likely. It is interesting to note that at this time in Stamna, spearheads were still being made of bronze, while the dirks and short swords were of iron (the single bronze exception has been mentioned above), recalling the practice common in many early weapon graves (see Table 6). As the iron short swords, dirks and daggers from Stamna have rather close parallels in Crete,[232] it is possible that the knowledge of iron, and perhaps the technology of iron production, were transferred to Aetolia in the context of Cretan sea-borne trade.

As they are so frequently provided as grave furnishings, spearheads are of considerable interest for the question of the introduction of iron. As noted above, the transition from bronze to iron occurred relatively late in the case of spears, compared with knives and dirks. Anthony Snodgrass suggested that this might be explained by the fact that the sockets of spearheads were more easily made from cast bronze than forged iron.[233] But an alternative explanation seems more attractive: at this early stage in the introduction of iron, bronze was still preferred for spears, being the warriors' most important weapon, as Homer's accounts of combat in the *Iliad* suggest, whereas iron was used for dirks and daggers.[234] This suggests that warriors mainly relied on bronze in a life-or-death situation, while iron was preferred for the daggers and dirks, which were primarily prestige objects, and not necessarily very effective as weapons.

However, by the second half of the 10th century BC, iron had almost completely replaced bronze in the production of spearheads in both Cyprus and the Aegean.[235] In the Aegean area, iron was gradually adopted for the production of spearheads during the first half of the 10th century BC, but the small number of spearheads (both bronze and iron) known from MPG contexts on the mainland, and the imprecise chronology in Crete around the Subminoan/EPG transition, makes it impossible to trace the transition to iron spearheads in detail.[236] In Cyprus, there are indications that the transition to iron spearheads was more abrupt than gradual. The great majority of spearheads in Cyprus during CG I were made of bronze: in the cemetery of Kouklia, Skales, for example, all eight of the spearheads in CG I graves are of bronze.[237] As mentioned above, the situation is completely different in CG II-III, when almost all the spearheads are of iron. The increased use of iron during the second half of the 10th and the first half of the 9th century BC is also evident in the case of arrowheads.[238]

230 For the iron spits from Fortetsa, Tombs VI and XI, dating to Cretan EPG, see for example Karageorghis 1974b: 171 f.; Hoffman 1997: 104 ff.; 141 ff.; Karageorghis and Kanta 2014: 122 cat. no. 62.

231 For the cemetery at Stamna, see above, footnote 186. — For the built cist tomb (Tomb 7/1994), see Christakopoulou 2001; 2018: 4 ff.; 20 table 2. — For a possible early chronological position, see Kolonas et al. 2017: 533 note 3.

232 See for example the dagger from Knossos, Agios Ioannis, Grave VIII, assigned by John Boardman to the Cretan Early or Middle Protogeometric period: Boardman 1960: 141 fig. 9: 16; pl. 39.

233 Snodgrass 1971: 224.

234 See also the discussion of spears in Chapter 4.3.

235 In Kouklia, Skales, for example, only one spearhead in CG II-III is made of bronze (from Tomb 86, dated to CG III). See Karageorghis 1983: 307 no. 71; fig. 180: 71. — For LPG Attica, Euboea, East Locris, Skyros and Thessaly, see Catling and Catling 1980: 254 ff.; Lemos 2002: 120 ff. — For EPG Crete, see for example Knossos, North Cemetery/Medical Faculty: Snodgrass 1996: 580 ff.

236 In Athens, two iron spearheads are known from MPG graves, another example was associated with the man buried in the monumental building in the Toumba cemetery at Lefkandi. — See Lemos 2002: 120 ff. (Athens, Kerameikos, PG Graves 17 and 34); for the Lefkandi grave, see above.

237 Kouklia, Skales, Tombs 43, 48, 49, 51, 58 and 89. See Karageorghis 1983.

238 For example Lefkandi, Toumba, Tomb 26 with 14 iron arrowheads (LPG), and Toumba, Tomb 79 with 28 iron arrowheads (SPG II). — See: Popham et al. 1980: 183 no. 19; pl. 244: G; Popham and Lemos 1996: pl. 78; 128; 148; table 1.

Swords

Earlier in this chapter, it was noted that bronze sword production had apparently ceased in most areas of Greece by the mid-11th century BC, and evidence for later production and use of swords in the 'Naue II' tradition is only found in Macedonia, Epirus and Boeotia. Considering the similarity between the latest bronze swords from Macedonia and the iron examples of the Protogeometric period (particularly the fish-tail terminal of the hilt and the pair of rivets on the hilt shoulders), it is difficult to avoid the conclusion that there was an unbroken tradition of sword production in this region.[239] The question when the transition to iron in the production of swords took place is important for a number of reasons. Firstly, if the warrior chose to use an iron sword, then he obviously had a considerable degree of trust in the new metal. This is a crucial consideration when, in combat, the sword (rather than the spear) was the warrior's primary weapon. Secondly, there are reasons to suspect that iron swords were first made in Greece in Macedonia, and that the iron swords in the 'Naue II' tradition which appear further south in Thessaly, Euboea and Attica represent the adoption of a 'northern' style of weaponry and combat. And finally, the question of the start of production of iron swords is important for an understanding of the swords in areas further to the north, particularly in Bulgaria.

The theory of the 'northern' origin of iron swords requires a rapid transition to iron metallurgy in Macedonia, considering that iron artefacts are unknown there in the archaeological record before the 10th century BC. Writing in the early 1970s, Anthony Snodgrass and Vincent Desborough already suggested that the large quantity and the early date of the iron weapons at Vergina make it unlikely that the technology was introduced from central Greece,[240] but at present it is unclear how this rapid and effective transfer of technology to Macedonia took place, and which partners were involved; Ionia, with the iron smiths' workshop at Phocaea, is a potential candidate.

Vergina, even 50 years after publication, still remains our most important evidence for the start of iron production in northern Greece. However, it is unfortunate that the chronology of the early stages of the cemetery is not better understood. According to the conventional chronological consensus, the transition from bronze to iron swords at Vergina must have taken place at some point during the first half of the 10th century BC, and possibly shortly after ca. 1000 BC. As mentioned in Chapter 4.3, the bronze sword from Tumulus C, Grave Δ can be assigned to the start of use of the cemetery ("phase II"); phase IIIA-IIIC followed in the 10th and 9th centuries; and phase IVA started sometime in the first half of the 8th century BC.[241] All the iron flange-hilted swords in the so-called 'Naue II' tradition, of which at least 18 were found in the cemetery, are assigned to phases IIIA and IIIB.[242] The sword was definitely the principal weapon of the men buried at Vergina, and they seem to have been made of iron since the first half of the 10th century BC.[243]

As explained above, swords had fallen out of use in most parts of the Aegean by the end of the 2nd millennium BC. Instead, since the mid-11th and continuing through the 10th and 9th centuries BC, iron dirks and daggers – in combination with spears – were widely used in most of Greece and the East

[239] See for example the bronze swords from Elati and Vergina; see footnotes 164 and 167.
[240] Snodgrass 1971: 253 ff.; Desborough 1972: 219 f.
[241] Bräuning and Kilian-Dirlmeier 2013: 148; 150. — For important comments on the chronology of Vergina, see Hochstetter 1984: 302-307; Pabst 2012: 44-53; 2016.
[242] For the typology and chronology of the Vergina swords, see Kilian 1975: 67 ff.; Rhomiopoulou and Kilian-Dirlmeier 1989: 132 ff.; Kilian-Dirlmeier 1993: 113 ff.; 124 ff. — The iron sword from Tumulus X, Grave II, previously assigned to phase II, has been assigned to phase IIIA in the recent monograph by Andrea Bräuning and Imma Kilian-Dirlmeier (2013: 141; see also Beilage 6 and 7). — The central grave (Grave 1) in Malamas Tumulus Γ, with an iron sword, was previously assigned to Phase IIIC, but in the more recent publication seems to be assigned to phase IIIB (Rhomiopoulou and Kilian-Dirlmeier 1989: 114 fig. 25: 1; Bräuning and Kilian-Dirlmeier 2013: 140; Beilage 6). — The only sword dating after Vergina, phase IIIB is a sword of Basarabi-Novo Sad type, found in a grave of phase IVA (Tumulus LXVIII, Grave Z); see Bräuning and Kilian-Dirlmeier 2013: 296 fig. 256: 34. See also Chapter 8.6.
[243] See Bräuning and Kilian-Dirlmeier 2013: Beilage 11. — According to Sabine Pabst, after the practice of furnishing swords in graves came to an end, warrior graves (in phase IV) were instead furnished with spearheads (Pabst 2016: 362). Presumably this reflects a change in methods of combat sometime during the 8th century BC.

Mediterranean, for example in the Argolid,[244] Attica,[245] Euboea,[246] Crete,[247] Rhodes,[248] Cyprus,[249] and the Levant.[250] However, in the second half of the 10th century BC (LPG), swords started to be used again, now made of iron. Apart from Macedonia, they are found in cemeteries in Thessaly (Homolion, Krannon, Marmariani), East Locris (Atalanti), Euboea (Lefkandi) and Attica (Athens).[251] Outside Macedonia, the earliest of these swords comes from the famous burial in the monumental building in the Toumba cemetery at Lefkandi, probably dating around the second quarter of the 10th century BC.[252] While swords have not yet been found in Athens in MPG contexts, there is an iron dirk with a characteristic fish-tail pommel terminal from Kerameikos, PG Grave 6, which can be understood as a typological feature influenced by the 'Naue II' tradition, and typical for Macedonian swords.[253] Otherwise, there are surprisingly few well-documented Protogeometric swords from Athens, and it is possible that swords were adopted rather late in Attica compared to areas further to the north.[254] Perhaps even the burial of the Lefkandi sword-bearer under a monumental tumulus can be interpreted as relating to 'northern' practices, considering that in the Early Iron Age tumulus burials with swords are most common in Macedonia, at sites such as Aghios Panteleimon and Vergina.[255]

Unfortunately, there is little other detailed information on the introduction of iron in the northern Aegean.[256] As described above, in the Thasos cemeteries, the first iron knives appear in the 11th century BC (phase IIA). The number of iron knives increased sharply during the 10th and first half of the 9th century BC, and after the mid-9th century BC all the knives at Thasos were made of iron.[257] Presumably, the smelting of iron ores was introduced in these areas during the 10th century, and according to our interpretation of the Vergina cemetery, iron production probably started particularly early in Macedonia.

Axes

In the context of our study of the dissemination of iron metallurgy, the axes are important for understanding the relationship between the Aegean and the Balkan Peninsula. The flat trunnion axes, also known as lugged axes, will be dealt with first before turning to the shaft-hole axes.

Trunnion axes are particularly interesting for the question of the transition from bronze to iron. One of the curious features of these axes is the fact that the geographical distributions of bronze and iron examples are, with few exceptions, mutually exclusive.[258] The bronze trunnion axe was created in the

[244] In the Argolid, many iron daggers and dirks are known from the PG and G cemeteries of Argos, Mycenae, Nauplion and Tiryns, none being over 50 cm in length. See: Lloyd 2014; 2020: 502.
[245] For example Athens, Kerameikos, PG Grave E and PG Grave 6 (both MPG). See: Kilian-Dirlmeier 1993: pl. 44: 316; 46: 326; D'Onofrio 2011: 660.
[246] For example Lefkandi, Toumba, Tombs 39 and 54 (both LPG). See: Popham and Lemos 1996: pl. 43: 35; 61: 34.
[247] Kilian-Dirlmeier 1993: pl. 42: 281-288; 43: 290-293.296-298; 44: 299-309. — See also Eltyna: Rethemiotakis and Englezou 2010: pl. 63: 193; 68: 207; 70: 211.
[248] See for example Ialysos, Marmaro, Tomb 44 (LPG). See: footnote 229.
[249] See for example Kouklia, Skales, Tombs 64 and 76; Amathus, Tombs 964 and 967. — See: Karageorghis 1983: pl. 120: 5; 142: 24; Stefani and Violaris 2018: fig. 6: c; fig. 11: a.b; for Amathus, see also the comments in Macdonald 1992: 44; 46. For Cyprus, see also Vonhoff 2013.
[250] See for example Hama: Riis 1948: 120 fig. 135: B; fig. 136: A.B.
[251] Lemos 2002: 117 ff. — For Atalanti, see also Dakoronia 2006: 498. — For Athens, see also D'Onofrio 2011.
[252] The sword, with a preserved length of 63.3 cm, has not yet been published. I am very grateful to Irene Lemos (Oxford) for information on this important tomb complex.
[253] Kilian-Dirlmeier 1993: 110 cat. no. 316; pl. 44: 316.
[254] There are three iron swords which might date to LPG: Metropolitan Church (from disturbed graves, see Kilian-Dirlmeier 1993: 112 no. 339); Erechthiou, Tomb Γ (three fragments of a sword from an unclear context, see D'Onofrio 2011: 661); Kerameikos, PG Grave 28 (Kilian-Dirlmeier 1993: 106 cat. no. 274; Papadopoulos and Smithson 2017: 375 [assigned to LPG/EG I]).
[255] The Toumba tumulus was originally ca. 4 m high and measured ca. 25 x 50 m. See Coulton 1993: 55 f.
[256] Iron bloomery slag was found during excavations at the Toumba of Vardaroftsa (Axiochori) in Kilkis. A date in the 10th century BC has been suggested by Euphemia Photos, but judging from the poor standard of the excavation, this cannot be regarded as reliable. — A piece of slag from the 'early Mycenaean' layers (settlement 10) at Vardaroftsa did not derive from iron smelting; single piece of bloomery slag was found in the Iron Age layers (settlement 20). — See Davies et al. 1927: 197 f.; Davies 1939: 255; Photos 1987: 25 f.; 28; 42.
[257] In phase IIB1, ca. 20% of the knives are made of iron; in phase IIB2 the proportion rises to ca. 40%; in phase IIB3 all the knives are of iron. — See Koukouli-Chrysanthaki 1992: 433 fig. 116; 582 fig. 153 (Kastri); 583 fig. 154 (Larnaki); fig. IX (combination table).
[258] See Wesse 1990: map 1.

area between Anatolia and the Levant at some time around the late 3rd or early 2nd millennium BC. In the original 'homeland', bronze trunnion axes fell out of use during the 10th century BC. Just at this time, production in iron started in the Aegean and the eastern Balkans; subsequently, iron trunnion axes became popular in the Balkans and Central Europe during the Early Iron Age. As it is unclear exactly how the trunnion axes were used, the reasons for the sudden changes in their popularity are difficult to explain. In principle, they could have been hafted to function either as axes or adzes.

The few iron trunnion axes from central Anatolia have already been mentioned briefly in Chapter 2 (see for example Figure 2: 1). In the following pages, apart from Cyprus and the Aegean, the axes from eastern Bulgaria will also be discussed, as many of them are closely related to the axes known from the Aegean and the East Mediterranean.

Early iron trunnion axes came to light in two graves in Cyprus: Kourion, Kaloriziki, Tomb 39, and Kouklia, Skales, Tomb 76. While the example from the Kourion grave can be assigned to a later stage of CG I, the axe from Skales is less closely dated, as the tomb contained burials of both CG I and II.[259] Many bronze parallels are known for these axes, from Cyprus, the Levant and Anatolia (compare Figure 19: 1.8).[260] It is interesting that in the southern Levant, similar bronze axes were most common in Iron I, but were apparently still being used in the second half of the 10th century BC.[261] Against this background, it seems likely that both in Cyprus and the Levant the transition to iron trunnion axes took place during the 10th century BC. Related iron axes are known from Bulgaria; for example, a piece from Dragoevo (Shumen Oblast) finds a close parallel in a bronze axe from Beth Shean in Israel (compare Figure 19: 2.9).[262] This suggests that iron trunnion axes were already present in Bulgaria during the 10th century BC.

Similar bronze axes, but with more pronounced, sloping shoulders, are known in bronze from the Dodecanese, while iron versions have been found both at Lefkandi in Euboea, dated between LPG and SPG II, and at Sushina (Shumen Oblast) and Omarchevo (Sliven Oblast) in Bulgaria (compare Figure 19: 3.4.10.11).[263]

Bronze axes with vestigial arms are not found in the original 'homeland' of the trunnion axe (Anatolia, the Levant), but were occasionally made in the Aegean since the late Mycenaean or postpalatial period (see for example Figure 19: 5.6).[264] This makes it most likely that the iron axes with vestigial arms were an Aegean development.[265] In the Aegean, these iron axes have rather wide blades relative to their length. In all, five are known, from Troy, Athens and Lefkandi (e.g. Figure 19: 13); when dateable, their contexts

[259] Kourion, Kaloriziki, Tomb 39: Benson 1973: 124 no. K1100; pl. 40 (a photograph is also available on the website of the Museum of Archaeology and Anthropology, Pennsylvania University); for the chronology, see Steel 1996: 297. — Kouklia, Skales, Tomb 76: Karageorghis 1983: 223 no. 131; fig. 142: 131. — A further flat (trunnion?) axe of uncertain typology was found in Skales, Tomb 69 (CG II-III): Karageorghis 1983: 181 no. 51b; fig. 136: 51b. — See also Kouklia, Skales, Tomb 210 (CG I-III): Karageorghis and Raptou 2016: 89 cat. no. 29; pl. 97: 29.
[260] See for example Catling 1964: 87 f.; fig. 8: 11; pl. 6: g-l; Courtois 1984: 18 no. 137; 176 fig. 6: 3; Wesse 1990: pl. 2-4 (type IB); Miron 1992: 30 ff.; pl. 11-14.
[261] Transition Iron I/IIA or Iron IIA. See Miron 1992: 30 ff.; see also Rabinovich et al. 2019: 100.
[262] Dragoevo: Atanasov and Babadzhanov 2008: 52; pl. 3: 24. — Beth Shean: Miron 1992: 34 no. 190; pl. 12: 190.
[263] Lindos, Rhodes: Wesse 1990: 218 no. 380; pl. 22: 380. — Serraglio, Kos: Vitale et al. 2016: 271 fig. 25: e. — Lefkandi, Toumba, Tomb 39 and Pyre 13: Popham et al. 1982: 241; 238 fig. 8; Popham and Lemos 1996: pl. 43: 33; 48: 2. — Sushina: Atanasov and Babadzhanov 2008: 50 no. 7; pl. 1: 7. — Omarchevo: Wesse 1990: 202 cat. no. 174; pl. 23: 174. — Exact parallels for these axes are absent in the East Mediterranean, but some pieces from the southern Levant are rather similar. See for example Miron 1992: 33 f. no. 186; pl. 11: 186 (Hazor); Rabinovich et al. 2019: 100 fig. 8 (Khirbet Qeiyafa).
[264] For early axes with vestigial arms, see for example: Wesse 1990: pl. 22: 374.378.379.383 (Asine [Argolid], Teichos Dymaion [Achaea], Armenochori [Dodecanese], Karphi [Crete]). — For early 'prototypes', see Harmankaya 1995 (Kozman Deresi hoard, near Iğdebağlari on the north-west coast of the Sea of Marmara, ca. 13th century BC). — Wesse 1990: 223 no. 439; pl. 11: 439 (Ordu, south-east coast of the Black Sea, ca. 12th century BC). — For vestigial arms on chisel-like implements, see for example Wesse 1990: 217 f. no. 373; pl. 22: 373 (hoard from Anthedon, Boeotia, ca. 12th century BC).
[265] Note, however, the iron trunnion axe with vestigial arms from Göltepe in the central Taurus mountains. The axe was associated with a blacksmith's forge with the calibrated radiocarbon date 1000-799 BC (2σ). — See Yener 2021: 24 f.; 72 f.; 119; 141 cat. no. M1; fig. 80: M1 (see also the unstratified axe M2).

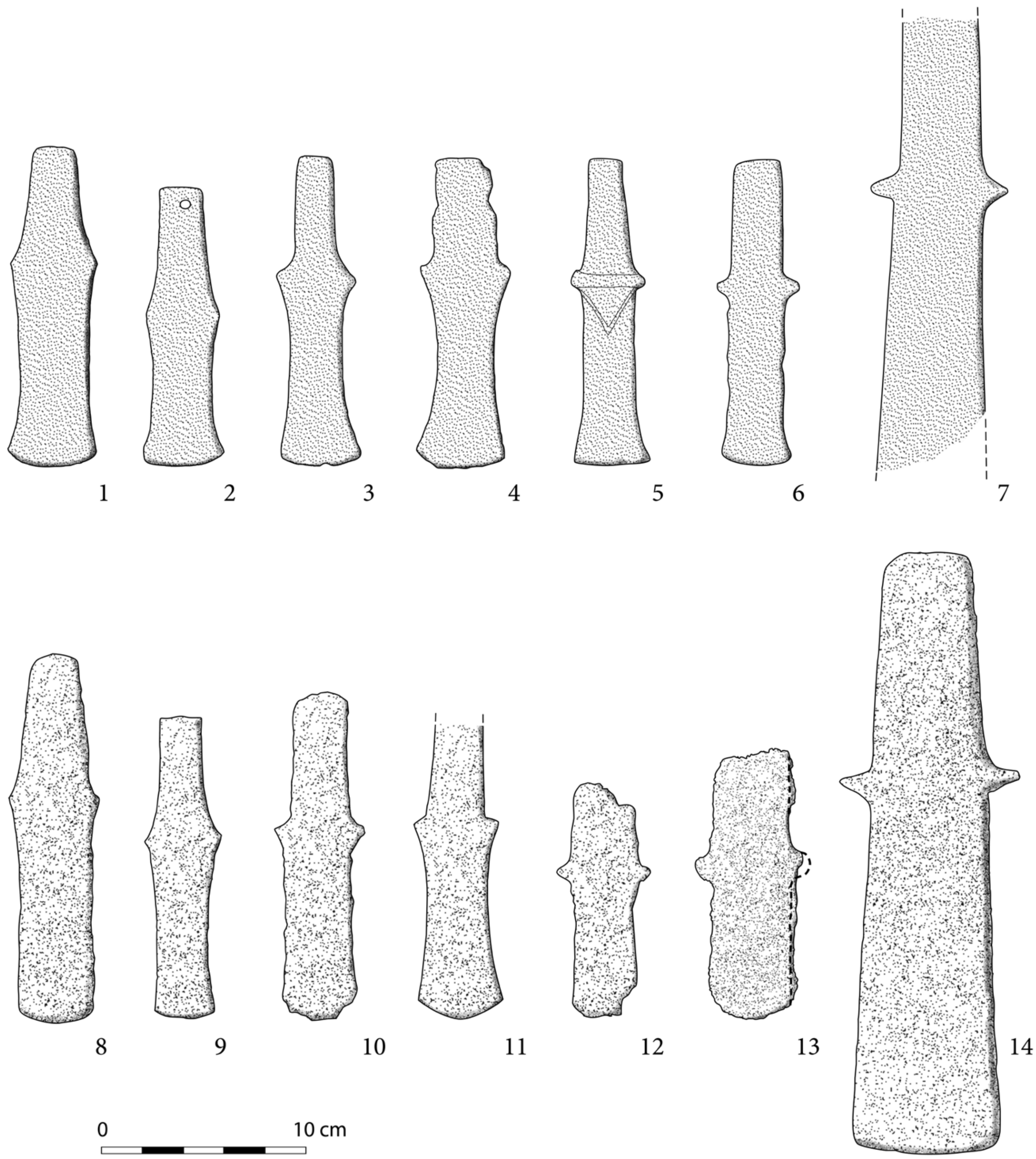

Figure 19. Bronze (1-7) and iron (8-14) trunnion axes: 1 Unprovenanced, Cyprus (after Catling 1964: 87; pl. 6: h). — 2 Beth-Shean, Israel (after Miron 1992: 34 no. 190; pl. 12: 190). — 3 Lindos, Rhodes (after Wesse 1990: 218 no. 380; pl. 22: 380). — 4 Serraglio, Kos (after Vitale et al. 2016: 271 fig. 25: e). — 5 Karphi, Crete (after Wesse 1990: 218 no. 383; pl. 22: 383). — 6 Asine, Argolid (after Wesse 1990: 218 no. 374; pl. 22: 374). — 7 Troy (after Müller-Karpe 1994a: 199; pl. 19: 3). — 8 Kouklia, Skales, Tomb 76 (after Karageorghis 1983: 223 no. 131; fig. 142: 131). — 9 Dragoevo, Shumen Oblast (after Atanasov and Babadzhanov 2008: 52; pl. 3: 24). — 10 Sushina, Shumen Oblast (after Atanasov and Babadzhanov 2008: 50; pl. 1: 7). — 11 Lefkandi, Toumba, Pyre 13 (after Popham et al. 1981: 227; 238 fig. 8: Pyre 13, 2). — 12 Boğazköy, Turkey (after Wesse 1990: 205 no. 207; pl. 27: 207). — 13 Lefkandi, Toumba, Tomb 54 (after Popham and Lemos 1996: pl. 61: 33; 148: e). — 14 Markovo, Shumen Oblast (after Atanasov and Babadzhanov 2008: 49; pl. 1: 1). — Scale 1:3.

range from LPG to EG I.[266] Another axe belonging to this early group was found far to the east at Boğazköy (Figure 19: 12).[267]

Finally, there is an interesting group of narrow, straight-sided trapezoidal trunnion axes, which are often much longer than the axes previously discussed (e.g. Figure 19: 7.14). The only example from the Aegean is a stone mould for bronze axes from Troy.[268] If, as seems likely, this was a one-piece, open mould, then both ends are incomplete and the bronze axes produced in the mould must have been well over 22.4 cm in length. Stone moulds for casting similar axes have been found at Pobit Kamak and Mogilitsa in Bulgaria, and Klinovac in Serbia; the contexts show that this type of axe was already produced during the 13th century BC.[269] Strangely, bronze versions of these axes have never been found. However, iron versions are known from Bulgaria at Markovo and Zhelad (both Shumen Oblast) and near the coast at Obrochishte (Dobrich Oblast).[270] Two more are present in the hoard from Bârlad (jud. Vaslui) in Romania (see Chapters 5.2 and 6.3).[271] Although some of these iron axes measure between 15 cm and 20 cm, most are longer, reaching 29.5 cm in length in the case of an example from Markovo.

In the course of our discussion, it has been possible to identify bronze predecessors for the various forms of early iron trunnion axes in the regions studied. The conversion from bronze to iron probably took place in Cyprus and the Aegean around the mid-10th century BC. Taken together, these types of trunnion axe produced at the time of the bronze/iron transition have an important feature in common (Figure 19). In every case, the 'butt' of the axe (i.e. the part above the trunnions, which originally sat in the wooden haft), comprises at least one-third of the total length of the axe. This was apparently a feature of early iron axes during the second half of the 10th and the first half of the 9th century BC.[272] On later axes, from further north and west in the Balkans, and in Central Europe, the 'butt' is generally much shorter in relation to the total length of the axe. This observation is important, because it indicates that the use of iron axes in eastern Bulgaria already began during this early stage of iron trunnion axe production.

As mentioned above, it is unclear exactly how the trunnion axes were used. Although early iron axes are mainly found in warrior graves, it is not possible simply to interpret them as weapons, as a number of different functions are potentially possible: for example as tools, as sacrificial implements, or even as iron billets ('ingots'). As the blades normally have a symmetrical design, they could theoretically have been hafted either as axes or adzes; the example from Athens, Agora Grave 13, with its asymmetrical outline, is an exception which could hardly have been used as an adze. As the trunnion axes range so widely in size, an interpretation as tools seems much more likely than as weapons. In the case of the axe from Lefkandi, Toumba, Grave 54, for example, when hafted the blade would only have been 7-8 cm long, and could not have been an effective weapon.

Some finds from the central Mediterranean indicate that a further function of trunnion axes deserves consideration. Some of the trunnion axes from the Aegean have close parallels in southern Italy, Sicily

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[266] Late Protogeometric: Athens, Kerameikos, PG Grave 40 (Kübler 1943: 42; pl. 38; Müller-Karpe 1962: 93 fig. 11: 1); Lefkandi, Toumba, Tomb 54 (Popham and Lemos 1996: pl. 61: 33). — Subprotogeometric I: Lefkandi, Palia Perivolia, Tomb 13 (Popham et al. 1980: 147 no. 22; pl. 244: F). — Early Geometric I: Athens, Agora, Tomb 13 (Papadopoulos and Smithson 2017: 116 no. T13-13; 115 fig. 2.63: 13). — "Protogeometric or later": Troy: Becks and Thumm 2001: 421; fig. 482.

[267] Boehmer 1972: 139 no. 1258; pl. 44: 1258 (assigned to phase Büyükkale IIa); Wesse 1990: 205 no. 207; pl. 27: 207. — There is a further possible iron trunnion axe (lacking arms) from the 'House of Bronzes' at Sardis in Lydia: Waldbaum 1983: 48 no. 127; 54; 178 ("probably no later than the late 11th or 10th century BC"); pl. 11: 127; Ramage et al. 2021: 49; pl. 28 (cat. no. 119).

[268] The mould has a preserved length of 22.4 cm. Müller-Karpe 1994a: 199; pl. 19: 3; Wesse 1990: 224 (supposedly layer VIIb2?). Unfortunately, the stratigraphic context of this mould was not recorded during Schliemann's excavations; see Blegen 1958: 144.

[269] See Leschtakow 2019, with further literature.

[270] The axes from Markovo, Obrochishte and Zhelad probably constitute the remnants of hoards, but sadly there is no precise information on their discovery. See Atanasov and Babadzhanov 2008: 49 f. no. 1-8 and 9. — These axes are between 15.7 cm and 29.5 cm long.

[271] Petrescu-Dîmbovița 1958: 61; 53 fig. 4; Wesse 1990: 202 no. 175-176. — The two axes are 22.2 cm and 27.0 cm in length.

[272] There are some further iron trunnion axes which share this, apparently early, feature with the Aegean and Bulgarian axes. — The length of the 'butt' in relation to the total length of the axe amounts to 43% in the case of Leskovac, 'Hisar' (southern Serbia), and 37% in the case of Pećina na Gradini (near Premantura, Istria). — These axes are discussed in more detail in the sections dedicated to the finds from Serbia and Croatia (Chapters 8.1 and 8.4).

and Sardinia. These are the examples with pronounced, sloping shoulders (Figure 19: 3.4), which are closely related to some of the bronze axes of the Scorrano type, which are mainly distributed in Apulia and Basilicata.[273] At Roca Vecchia (Apulia) these axes occur in several different forms: bivalve moulds for axes 7.7 cm and 13.7 cm in length; an open mould for an axe-shaped ingot, 7.5 cm in length; and veritable ingots of the same shape, including one from the well-known 'gold hoard' (hoard 2).[274] Clearly, axe-like objects with quite different functions were being produced and used at Roca Vecchia, including 'axe ingots' or 'axe tokens', as well as proper tools. And a similar function is illustrated by the as-cast trunnion axe 'ingots' in the hoard from Monte Arrubiu in Sardinia, which are typologically closely related.[275] Clearly, ingots were sometimes made in the shape of trunnion axes; the simple, flat shape could easily be cast in a one-piece mould. This raises the possibility that some of the iron trunnion axes were produced as billets, as a way to transport and trade iron as a raw material.

Finally, a brief discussion of shaft-hole axes is necessary. Although only one early iron example is known from the Aegean, from Assiros, near Thessaloniki in central Macedonia, it is important for the early history of iron. The Assiros axe is exceptional in the Protogeometric Aegean because it came from a settlement context, whereas almost all the other early iron artefacts are from burials. The axe makes a decidedly utilitarian impression, and it presumably served as a tool. The Assiros axe is also important because of its close resemblance to another early iron double-axe from Cernat in Transylvania (discussed in Chapter 9.1).

The axe was discovered during excavations by Ken Wardle and his team at Assiros Toumba; it has a rectangular shape (length ca. 18 cm, width ca. 5.5 cm) and a sub-circular shaft-hole (ca. 2.6 x 1.7 cm). The axe came from the 'Great Pit' which, according to Wardle, probably belongs to Assiros phase 3 (roughly corresponding to EPG-MPG), although he does not rule out a position in phase 2 (roughly corresponding to LPG).[276]

Among bronze double-axes, the round shaft-hole is a characteristic feature of Cyprus and Crete, whereas in most parts of the Mycenaean world, the shaft-holes of double-axes were oval in shape.[277] In the case of the Assiros axe, the eye-shape of the shaft-hole was probably caused by the forging process; taking this into account, it seems to correspond to the 'round' rather than the 'oval' tradition of shaft-holes. Mycenaean double-axes have a slender form, and are shaped curving outwards from the shaft-hole, to create longer convex cutting edges.[278] In contrast, like Assiros, the Cypriot and Cretan axes often have a compact, almost rectangular shape.[279] For these reasons, the Assiros axe seems to be related to bronzes from Cyprus and Crete; the closest parallel is in the 'Foundry Hoard' from Enkomi, dating to the 12th century BC.[280] Although the context does not allow a very precise chronology, the Assiros axe does seem to represent reliable evidence for the use of heavy iron tools already in the 10th century BC. Otherwise, the iron double-axes known from the Aegean are later, and belong to other typological variants.[281] Although

[273] For the Scorrano type, see Carancini 1984: 233 ff. — Close parallels for the Aegean axes, for example: Cerveteri, Sorbo cemetery, Grave 283 (Carancini 1984: 234 no. 4483; pl. 172: 4483); Modica, Sicily (Giardino 1995: 23 fig. 10: B6).

[274] Roca Vecchia (prov. Lecce): Guglielmino 2006: moulds 1, 3 and 4; 2011: 60; Maggiulli 2009a: 213; 212 fig. 2: n.18; 2009b: 324 no. 2.15; 321 fig. 5: 2.15. — These finds were associated with LH IIIC Late and Submycenaean pottery, and date to the end of *Bronzo Finale* 2 (around the second quarter of the 11th century BC).

[275] Monte Arrubiu (near Sarroch, Prov. Cagliari): Giardino 1995: 52 fig. 24: 2.3; Ialongo 2010: 338 fig. 9: A; Lo Schiavo 1981: 322 f. fig. 359. — The hoard is assigned to *Bronzo Finale* 3.

[276] Wardle 1987: 320; pl. 51: b; Wardle and Wardle 2007: 473; 455 table 1; Weninger and Jung 2009: 388.

[277] For a general introduction to the Aegean double-axes, see Buchholz 1959; 1983.

[278] For Mycenaean axes, see for example the 20 finds from the tripod grave at Mycenae (late LH IIIC): Onassoglou 1995: 56-58.

[279] For Cypriot axes, see Catling 1964: 88 f.; fig. 9: 1.2 — For Cretan axes, see Evely 1993: 41 f. — For another (unprovenanced) bronze axe of this type, in the Milan museum, see Carancini 1984: 232 no. 4469; pl. 171: 4469.

[280] Catling 1964: 88 f.; fig. 9: 2; Matthäus 1985, pl. 124: 4.6.7.

[281] See for example: Lefkandi, Toumba, Pyre 13 (SPG II): Popham et al. 1982: 227 f.; 242; 238 fig. 8: pyre 13, 1; Popham and Lemos 1996: pl. 48: 1; 128: Pyre 13, 1. — Argos (8th century BC): Courbin 1957: 369 fig. 50-51; 1974: 135. — Various examples from Crete date to the 9th or 8th century BC: Vrokastro, Karakovilia, Chamber Tomb I: Hall 1914: 123 ff.; 138 no. 10; for the pottery from this tomb, see Hayden 2002: 6-12. — Knossos, North Cemetery/Medical Faculty, tombs 219 and 285: Coldstream and Catling 1996: 222 no. 98; 252 no. 58; fig. 178; pl. 291. — Fortetsa, Tomb P: Brock 1957: pl. 172: 1641. — Agios Georgios Papoura: Watrous 1980: 275 no. 23; pl. 29: 23. — Kavousi, Vronda, Building A: Boardman 1971: 6; pl. Δ; Day 2016: 166 f.

the shape of the Assiros axe is related to the Cypriot tradition of axe production, as iron was already produced in Macedonia in large quantities during the 10th century BC (see the comments on Vergina, above), there is no compelling reason to believe that it was an import.

Summary

Our brief review showed that there was a marked advance in iron production in the 10th century BC compared with the situation in the second half of the 11th century BC. A wider range of artefacts was produced, including new types, such as swords, spears, axes, *obeloi* and horse bits. And iron was now used in western and northern Greece, where previously only occasional iron knives were found. Considering the large numbers of iron artefacts in Iron Age cemeteries such as Vergina, Aghios Panteleimon and Stamna, iron was already made in some regions of western and northern Greece during the 10th century BC by smelting local ores. It is presently unclear how this transfer of technology to western and northern Greece took place, as smelting and blacksmithing sites of this early date have still not been discovered and excavated.

The adoption of iron for the production of swords and axes was discussed in detail. According to the present consensus concerning the chronology of the Vergina cemetery, production of iron swords started in the first half of the 10th century BC in Macedonia. If this chronology is accepted as a working hypothesis, then as a consequence it appears that the use of iron swords spread from Macedonia both southwards to central Greece, and northwards to Greek and Bulgarian Thrace.

In the Aegean area, trunnion axes were made of iron during the second half of the 10th century BC, whereas previously only bronze examples are known. According to our typological analysis, iron axes were also already present in Bulgaria during the 10th century BC.

Copper or bronze ingots were sometimes made in the shape of trunnion axes, as examples in the Central Mediterranean demonstrate. Ingots of this kind were also possibly used in the Aegean; for example, the objects produced in the large open mould from Troy (Figure 19: 7) might have been ingots, rather than functioning axes. If this is accepted, then it is quite possible that iron billets were also made in the shape of trunnion axes, and this might explain why some hoards in Bulgaria contain such large numbers of iron trunnion axes.

4.5 Discussion and conclusions

Apart from summarizing the main results of the chapter, in the following pages some important theoretical work on early iron in the Aegean area will be reviewed. As stated at the start of the chapter, the broad outlines of the development of iron use are quite well-known, particularly since the publications of Anthony Snodgrass and Susan Sherratt.

In the Minoan and Mycenaean palatial period, iron is found in Crete and the Peloponnese almost exclusively in the form of signet rings, and almost always in combination with other precious metals. As Sherratt puts it: iron was clearly “an exotic luxury with intrinsic value as a precious metal”.[282] It is most likely that the iron used on these items of jewellery was of meteoritic origin, as the tiny quantities of metal used and the raised levels of nickel suggest.

The few scientific analyses available for artefacts dating after 1200 BC indicate that they were made of smelted metal. During the 12th and the first half of the 11th century BC in the Aegean, almost all the iron objects are either knives or ring jewellery; in Cyprus a wider range of utilitarian iron artefacts has been found in LC IIIA and IIIB contexts, including knives, spatulae, ‘chisels’ and the earliest dagger. The rings from Ialysos must be related to the ‘ring horizon’ in the Near East, and they were presumably imported to Rhodes from the Levant. In the Aegean (central Greece, Cyclades, Crete), knives are the most frequent

[282] Sherratt 1990: 811.

iron finds, and more than half of them have bronze rivets. It is significant that iron knives with bronze rivets likewise predominate in Cyprus during LC IIIA and IIIB. As the earliest iron knives in Cyprus date to the start of the 12th century, whereas the Aegean examples only appear after the mid-12th century BC, and as knives are much more frequent in Cyprus, it is certain that knife production started first in Cyprus. This is remarkable, considering that iron was apparently unknown in the island before the 12th century BC. The technology of iron production must have been transferred to Cyprus from somewhere in the Near East during the Crisis Years.

Susan Sherratt has argued that there was a 'commercial revolution' in Cyprus, and iron knives were one of the new commodities traded by Cypriot seafarers, exported since the second half of the 12th century BC to the Levant and the Aegean. Indeed, Cyprus was probably the sole producer of utilitarian iron implements in the 12th century BC. The important role of Cyprus, and the belief that the early knives with bronze rivets and some iron dirks or daggers were imported to the Aegean from Cyprus, has long been the consensus among scholars.[283]

Clearly, the transfer of technology from the Near East to Cyprus, and then to the Aegean, is a case of diffusionism. This is in stark contrast to the 'gradualist' model, which envisages that the technology of iron production was already widely available in many parts of the Old World during the Bronze Age (see Chapter 2). Both Jane Waldbaum and Joanna Palermo questioned the general consensus of Cypriot priority in the development of iron technology, arguing that production of iron started earlier in the Aegean.[284] It has become clear in the course of this chapter that Waldbaum's and Palermo's conclusions are based on an uncritical treatment of the contexts and chronology of the earliest iron artefacts, and cannot be accepted.[285]

The iron finger rings in graves of the Submycenaean period are a significant development indicating the local production of iron artefacts in central Greece. However, it is unclear whether the metal was obtained from smelting local ores, or whether it was imported as billets from Cyprus or some other source. It is very interesting that almost all the iron artefacts found in the Aegean before the second half of the 11th century BC are either items of ring jewellery or knives. It is not easy to explain why iron use was so tightly circumscribed, with the artefacts appearing in the archaeological record as distinct 'horizons' ('ring horizon', 'knife horizon').[286] This suggests that, at this time, there was no universal consensus on the conceptualization of the new metal. Iron was still polysemous and polyvalent, and the selection of artefacts produced and consumed reflects this state of ambiguity. The very different choices of rings and knives indicate the existence of separate provinces in the "social and spatial process of adopting inventions", in which distinctly different meanings adhered to iron (compare Figure 7).[287]

The choice of either rings or knives indicates that in the early stages of acquaintance with the new metal iron, its conceptualisation differed markedly from region to region. In the case of the Submycenaean finger rings, while most are simple band-shaped rings, the earliest examples, from Tomb 63 in the Athenian Agora, belong to a different type. The bronze rings with iron bezels from this female burial correspond to Mycenaean types of finger rings with shield-shaped bezels, and it seems plausible that the conceptualization of the Submycenaean bimetallic and iron rings was related to that in the Bronze Age. In the case of the bronze rings with iron bezels, while we can conclude that iron was probably still treated

[283] See for example Lorimer 1950: 114-117; Snodgrass 1971: 217 ff.; 229 f.; 248 ff.; Desborough 1972: 78; 308 ff.; 340; Sherratt 1994a: 60 f.; Pickles and Peltenburg 1998: 85 ff.

[284] Waldbaum 1978: 72; 1982: 335-338; Palermo 2018: 128; 140-144; 164; 257 f.

[285] In her catalogue, Palermo (2018: 87) includes 37 iron artefacts in Greece prior to ca. 1200 BC. As many as half of these objects are unreliable or erroneous.

[286] This stage, in which "specific and singular types" of iron artefacts were manufactured has also been recognized by Yahalom-Mack and Eliyahu-Behar (2015: 288 f. "Phase 2 Early").

[287] For the definition of innovation as "the social and spatial process of accepting inventions", see Kristiansen 2005: 152. — It is tempting to speculate that the knife and the ring had special symbolic meanings; for example the piercing/penetrating function of the knife could be linked to phallic symbolism, and the ring could symbolize unity or eternity. It is, perhaps, worth mentioning that in the Aegean during the second half of the 11th century BC iron knives are almost exclusively found in warrior graves.

as a precious metal, we are ignorant concerning the specific symbolic meaning associated with the iron finger rings.

The situation changes in the Aegean (central Greece, Crete, Caria) after the mid-11th century BC, when a wider range of artefacts is encountered, among which the iron pins and various types of iron weapons are most prominent. At this date, the warrior graves exhibit very close relations with Cyprus. To the west and north of central Greece, only occasional knives are found at this time. Presumably this ephemeral 'knife horizon' represents the first acquaintance of these regions with iron.

The 10th century BC saw a further widening of the range of iron products, and at the same time the transfer of the technology of iron production to western and northern Greece. Iron production (extractive metallurgy) seems to have been adopted particularly rapidly in Macedonia, where iron swords were apparently already produced in the first half of the century.

In 1980, Anthony Snodgrass published his well-known 'three-stage' scheme for the adoption of iron-working.[288] The model has been influential, and has frequently been cited and discussed in subsequent publications on the introduction of iron. Without wishing to detract from Snodgrass's valuable contribution, some comments on the weaknesses of the scheme are necessary at this point, if only to explain why the 'three-stage' model is not used in the present study.

Snodgrass summarized the scheme succinctly as follows: "The criterion of working iron distinguishes Stage 1, in which iron is used with greater or lesser frequency for purposes of display and prestige, from Stage 2 in which it is used for practical purposes but as yet less frequently than bronze. The criterion of proportion is used to set off Stage 2 from Stage 3, in which iron has become more frequent than bronze as working metal."[289] According to Snodgrass, the use of utilitarian implements (Stage 2) began in the Aegean around 1200 BC, with the full Iron Age (Stage 3) following at ca. 1050 BC.[290] The transition to Stage 3, in which iron tools and weapons had become as common or more common than bronze examples, took place slightly earlier in Cyprus.[291] Cyprus was therefore the first region of the Ancient World to make the full transition from the Bronze Age to the Iron Age.[292]

In his model, Snodgrass bases his arguments on the differing functions of the iron artefacts. Strangely, he does not emphasize the crucial distinction between meteoritic and smelted iron, and the introduction of extractive metallurgy. The criterion used to define the start of Stage 2, the distinction between iron used for utilitarian rather than ornamental purposes, was not a new idea.[293] In fact, the distinction was already made by Christian Jürgensen Thomsen in the earliest definition of the Bronze and Iron Ages, in which he specified that the Iron Age was marked by the adoption of "cutting weapons and tools" of hardened iron, as opposed to the use of iron for ornaments or jewellery (see Chapter 12.3).[294] In Snodgrass's view, the transition to utilitarian iron is associated with a major technological development, carburization and heat treatment (quenching and tempering), which enabled the production of steel tools and weapons superior to those of bronze.[295] As we have seen, according to the present state of research in Cyprus and the Levant, this theory seems to be unfounded: there is little evidence for intentional carburization and heat treatment in the early stages of ironworking, and it is necessary to seek other reasons for the introduction of the new metal.

288 Snodgrass 1980: 336 f. — For earlier versions of the model, see Snodgrass 1971: 221 f.; 228 ff.
289 Snodgrass 1982: 285 f.
290 See for example Snodgrass 1982: 291 fig. 2.
291 Snodgrass 1980: 341; 346.
292 Snodgrass 1982: 291 f.
293 See for example Lorimer 1950: 113-115 ("useful iron").
294 Thomsen 1836: 59 ("*skjærende Vaaben og Redskaber af Jern*" = 'cutting weapons and implements/tools').
295 Snodgrass 1980: 345 ("the vital breakthrough"). — The same idea is implied by C.J. Thomsen's use of the term 'hardened iron' to define the start of the Iron Age (see Chapter 12.3).

Whereas the criterion of 'working iron' was understood by Snodgrass to be associated with a technological advance (carburization), he regarded the transition to Stage 3, based on the criterion of 'proportion', to be an economic development.[296] However, the moment when iron overtook bronze in the manufacture of utilitarian artefacts is not easy to pinpoint precisely. Jane Waldbaum, for example, suggested later dates for the Eastern Mediterranean; for her, the full Iron Age, when iron was commonly used for both weapons and agricultural tools, was only reached by the end of the 10th century BC.[297] But it is surely more likely that the transition from bronze to iron took place at different times in the case of the different categories of cutting implements (e.g. knives), weapons (e.g. daggers, dirks, spearheads), tools (e.g. axes) and agricultural equipment (e.g. scythes, ploughshares), and so it appears unlikely that a precise and sharp date can be assigned to the start of Stage 3. Ian Morris even questions the principle of utilitarian iron at this time, noting that there is little evidence for iron tools in Greece before the 7th or 6th century BC.[298]

Finally, as Snodgrass stated that the 'three-stage' model is applicable for all Eurasia, it is essentially universalist or evolutionist.[299] The model is therefore unable to accommodate idiosyncratic regional variations, which are a crucial feature of the archaeological record.[300] As we have seen, the 'three-stage' model fits best to the Aegean, while Cyprus lacks a Stage 1, and the developments in the Near East can hardly be understood as following a coherent evolutionary development.

While previous interpretations of the introduction of iron were based on technological and/or economic principles, in 1989 Ian Morris presented an interpretation of the introduction of iron involving the symbolic value of the metal and its role at a time of social transformation. Like Snodgrass, he discussed the conspicuous prevalence of iron objects in central Greek graves in the period 1050/1025-950 BC, but developed a model which was in direct contradiction to Snodgrass's 'bronze shortage' theory (described in the introduction to Chapter 3).[301]

Morris questioned the assumption that the iron objects known from the archaeological record represent a reliable reflection of the importance of iron in Greek everyday life, noting that our information derives exclusively from tomb furnishings. Strictly speaking, the occurrence of iron grave goods provides us primarily with information about developments in burial customs ("the choices of actors creating the material record") and not directly about the production and practical use of iron or bronze. Morris argues that, initially, iron was used for the manufacture of prestige goods, and only later gradually attained a wider role in economic activity. According to this view, iron objects were deposited in graves to emphasize the status of the deceased at a time when the new metal was still a scarce commodity. Iron was a prestige good, "monopolized by elites and circulated as gifts among them. ... Iron moved around in a very restricted sphere of exchange, divorced from everyday activity, but it was that sphere which had the greatest influence on the creation of the archaeological record."[302]

Furthermore, Morris believes that by controlling iron and making it the symbol of membership of the élite in formal burial, a ritual gap was created between the élite and the rest of the population.[303] The use of iron in this way was a conscious act by the élite, drawing a line between themselves and the past; if bronze symbolized the past, iron defined the new élite order. Furthermore, this use of iron "symbolically

[296] Snodgrass 1980: 368.
[297] Waldbaum 1980: 86 f.; 90.
[298] Morris 1989: 514: "Iron reigned supreme as a prestige good and on the battlefield, but metals were apparently little used otherwise – until ca. 700 or even later most tasks were probably carried out with stone, bone or wood." — Morris 2000: 218: "There is little evidence for iron tools in Greece before the sixth century, and we should not think of the Dark Ages as an 'Iron Age' in the functional sense."
[299] Snodgrass 1980: 336 (applicable for all Eurasia). See also Snodgrass 1982: 291 fig. 2 ('three stage' model applied to the Aegean, Egypt, Mesopotamia, the Caucasus, Iran and China).
[300] For 'historical particularism' as opposed to 'universalism' and 'evolutionism', see Harris 1968: 250-289.
[301] Morris 1989; Morris 2000: 208-218.
[302] Morris 1989: 513; 515.
[303] Morris 1989: 507.

cut its users off from the east ... iron came to stand as a symbol of the new, narrower horizons of the modern world."[304]

Considering that Snodgrass's 'bronze shortage' model has fallen out of favour, Morris's interpretation of the adoption of iron at the beginning of the Protogeometric period represents a constructive and, in many ways, convincing alternative. And his comments on the danger of relying exclusively on burial evidence is a necessary warning which certainly deserves to be heeded. As we have already remarked, it does not seem to be the case that iron implements were technologically superior (harder, sharper) compared with bronzes; other reasons must be sought for the adoption of iron, and so the question of the conceptualization of iron, as discussed by Morris, becomes of central importance. In view of the large number of graves with iron objects (e.g. pins), in my opinion Morris exaggerates the exclusivity of iron during the Early and Middle Protogeometric period, and it is rather uncertain whether access to the metal could have been controlled so strictly. Morris argues convincingly that in the Aegean, at a time of social transformation, demonstratively opting for the new metal iron would have signalled a break with the Bronze Age past. However, Morris' suggestion that this "symbolically cut its users off from the east", fails to convince. The prestige of the new metal was surely associated with its Cypriot suppliers, with iron being just one of a series of innovations which the impoverished élites of the Aegean could access through contacts via the East Mediterranean maritime network. Indeed, this is exactly the scenario described by Jan Paul Crielaard in his compelling discussion of long-distance exchange and communications during the 11th and 10th centuries BC.[305] Crielaard shows how the emergent aristocracies in Greece and other parts of the Mediterranean sought to emulate the culture of the Cypriot élites, and how not only goods, but also ideas and information passed through the interlocking regional exchange networks traversing the Mediterranean (for further discussion, see Chapter 12.3).

It remains to discuss the uneasy relationship between the introduction of iron and the concept of the Early Iron Age (see also Chapter 12.3). As Anthony Snodgrass noted, "The concept of an 'Iron Age' is one of the least analysed in European prehistory, though as an expression it is constantly on the lips of every prehistorian in Europe" (the statement is just as true for the Near East as it is for Europe).[306] This is a curious paradox: if the term 'Iron Age' is so indispensable, why are attempts to define its significance so rare, and why is its meaning so difficult to understand? Analysis of the usage of the term 'Early Iron Age' in Aegean archaeology leads to some interesting conclusions (see Chapter 12.3).

Since the 1990s, the term 'Dark Age' for the period between the last Mycenaean palaces and the rise of the *polis* has gradually fallen out of use, most often being replaced by the less pejorative 'Early Iron Age'.[307] In the more familiar usage, scholars equate the beginning of the Early Iron Age with the transition to the Protogeometric period around the middle of the 11th century BC.[308] However, other authors use the term for the whole period between the downfall of Mycenaean civilisation ca. 1200 BC and the beginning of the Archaic period ca. 750/700 BC.[309] We therefore have two dates at our disposition for the start of the Early Iron Age. The innovation of utilitarian iron around 1200 BC has been regarded by some authors as an effect of, or a 'reaction' to the political and economic upheavals at the end of the Bronze Age.[310] This contrasts with the 'active' social use of the new technology around the middle of the 11th century BC, when, according to Morris, iron was mobilized as a symbol of the new social order.[311]

[304] Morris 2000: 218.
[305] Crielaard 1998.
[306] Snodgrass 1989: 22.
[307] For a discussion of this terminology, see Kotsonas 2016; Murray 2018b.
[308] See for example Lorimer 1950: 115 (transition from Submycenaean to Protogeometric). — Dickinson 2006: 77 (Postpalatial, followed after ca. 1050 BC by the Early Iron Age). — Lemos 2010: 87 (LH IIIC the last stage of the Late Bronze Age, Early Iron Age beginning with Protogeometric, Submycenaean as a short transitional stage).
[309] See for example Morris 2004: 257; Papadopoulos 2014: 181; 185; Murray 2018b: 17; 44; Kotsonas 2016: 240 note 10.
[310] Snodgrass 1971: 239 (a symptom rather a than cause of the political upheaval at the end of the Bronze Age); Morris 1989: 503 ("The motor for change is located in the eclipse of the Bronze Age kingdoms").
[311] On the 'active' role of society in assigning value to iron, see also Waldbaum 1978: 11: "In order for a material to lend its name to an 'age' it is not necessary for the material in question to be the sole one in use for utilitarian objects – tools and weapons – but only that it be the material of preference."

In recent scholarship, there is another motivation behind the use of the term 'Early Iron Age' (see Chapter 12.3). As Antonis Kotsonas explains, by using the term 'Early Iron Age' as opposed to the term 'Dark Age', Aegean archaeologists embrace a "more cosmopolitan, Mediterranean outlook for the discipline". The term, with its pan-Mediterranean scope, is favoured because "this was the period when the region was first conceptualized as a unity, and the time its inhabitants started sailing from one end of it to the other. In spatial as in temporal respects, the term 'Early Iron Age' is in full agreement with current conceptions of the period ..."[312] The same idea is reflected in the recently published book by Tamar Hodos, significantly entitled *The Archaeology of the Mediterranean Iron Age. A Globalising World ca. 1100-600 BCE*. Discussing her use of the term 'Iron Age', she argues that it "serves appropriately as a broadly generalising indicator of shared or similar, related practices during a common temporal horizon across a large geographic distance. In other words, Iron Age serves as a global-level socio-chronological contextualiser."[313] Furthermore, she notes that the concept of an 'Iron Age' is relative, in that it reflects changes from previous 'Bronze Age' traditions. So today, there is a new connotation to the Early Iron Age, as a distinct field of study, focusing on "globally shared practices" in the Mediterranean, which are distinct from those of the Bronze Age.[314] Ian Morris refers to this new research approach as 'Mediterraneanization', which emphasizes "the connectedness of the Mediterranean basin and the fluidity of the movement of people, goods and ideas".[315] Clearly, the new conceptualization of the Mediterranean 'Early Iron Age' depends on the existence of adequate techniques for seafaring on the high seas; the requisite developments in sails, rigging and navigation were all available at the end of the 2nd millennium BC, as Cyprian Broodbank has shown in his admirable *Making of the Middle Sea*.[316]

In our discussion of theoretical models in Chapters 3 and 4, we have encountered many stimulating and useful ideas, particularly in the publications by Susan Sherratt, Ian Morris, Jan Paul Crielaard, Antonis Kotsonas and Cyprian Broodbank. The main propositions are briefly summarized below (and see Chapter 12.3):

- After the Crisis Years, Cyprus was at the forefront in developing decentralized, entrepreneurial forms of maritime trade, free from centralised political control.
- The iron knives found in the Levant and the Aegean since the second half of the 12th century BC were imported from Cyprus; they represent an early example of the new decentralized, sub-élite seaborne trading practices.
- In the period following the Crisis Years, use of new sailing and navigation technologies made it possible to sail from one end of the Mediterranean to the other; for the first time, the Mediterranean was conceived of as a unit.
- The term 'Early Iron Age' is sometimes used in a special, pan-Mediterranean sense, to designate the period characterized by the process of 'Mediterraneanization', which resulted in increased connectedness and fluidity in the Mediterranean basin. In this sense, the 'Early Iron Age' represents a turning point and the prelude to the 1st millennium BC.
- In the context of the pan-Mediterranean 'Early Iron Age' Cyprus has an important structural position as intermediary between the Near East and regions elsewhere in the Mediterranean. The Cypriot élites were widely emulated throughout the Mediterranean.
- The conceptualization of the metal iron in the Mediterranean basin seems to have been markedly different from the Near East. In the Aegean and East Mediterranean, iron could be used to symbolise the new 'Early Iron Age' social order.

[312] Kotsonas 2016: 262. These ideas are developed further in Chapter 12.3.
[313] Hodos 2020: 48.
[314] Hodos 2020: 46; 48; Kotsonas 2016: 263.
[315] Morris 2003: 50. — For the concept of 'Mediterraneanization', see also Chapter 12.3.
[316] Broodbank 2013: 464 ff.; 473 (the "sea-shrinking eastern sail technology").

Chapter 5
The eastern Balkan Peninsula

This chapter will concentrate on the area of south-east Europe between the Lower Danube and the northern Aegean. The analysis concentrates on the earliest iron artefacts found in Bulgaria; relevant finds from Dobrudja (Romania) are also treated briefly. Unfortunately, Turkish Thrace and the Greek regions of Eastern Macedonia and Thrace cannot be analysed in detail as the present state of research does not allow a meaningful account of the earliest use of iron.

5.1 Knobbed, fluted and stamped pottery

In recent research on southern Thrace, four stages are recognized in the chronological development from the end of the Late Bronze Age to the start of the Early Iron Age.[1]

1. In the first phase, pottery is mainly undecorated and incised ornamentation is uncommon; the first examples of fluted decoration appear in this phase ('Horizon of Fluted Ware I', according to Elena Bozhinova).
2. In the second phase, pottery with fluted and knobbed decoration, often with a polished surface, becomes predominant; at this time, stamped ornamentation already appears occasionally, mainly comprising concentric circles, sometimes joined by tangents, and impressed pseudo-cord motifs ('Horizon of Fluted Ware II'). This 'lustrous' pottery with fluted decoration shows that the Eastern Balkans were strongly influenced by the Carpatho-Danubian region, while at the same time there was a reduction of contact with the Aegean.[2] As Carola Metzner-Nebelsick showed, the popularity of the polished and fluted pottery of 'Gáva' type, which even reached as far as Troy, demonstrates the influential role of the north-eastern Carpathian Basin in large parts of eastern Europe at this time.[3]
3. The 'true' Iron Age begins in the third phase (beginning ca. 950 BC, according to Bozhinova), in which stamped decoration is predominant on pottery, mainly composed of concentric circles connected by tangents, S-stamps, and impressed pseudo-cord ('Pshenichevo I'). In the Bulgarian research tradition, the start of the Early Iron Age was traditionally equated with the onset of the pottery with fluted decoration. The 'true Iron Age', i.e. the introduction and use of iron, starts in the Pshenichevo phase. According to Bozhinova, there is a reversal of the cultural orientation in Thrace at this time, and Aegean (rather than Carpatho-Danubian) influence becomes dominant.[4] The pottery of the third phase is comparable with contemporary stamp-decorated wares around the Iron Gates (Insula Banului/Ostrov) and in Dobrudja (Babadag).
4. Pottery with rich stamped decoration continues in the fourth phase ('Pshenichevo II'), which is contemporary with the Basarabi phenomenon along the Lower Danube.

In an important article, Georgi Nekhrizov and Julia Tzvetkova have described this development in greater detail, based on the stratigraphy in the settlements of Ada Tepe and Gluhite Kamani in the eastern Rhodopes.[5] According to multiple radiocarbon dates, the first phase, with undecorated pottery, can be assigned to the 12th century BC. Unfortunately, the transition to the classic 'Pshenichevo' stamped pottery is less securely dated. On the basis of a single radiocarbon date, Nekhrizov and Tzvetkova suggest

[1] Bozhinova 2012; see also Nekhrizov and Tzvetkova 2018: 17-19.
[2] Bozhinova 2012: 54; 62.
[3] Metzner-Nebelsick 2012a: whereas the earlier Gáva pottery (Gáva I/Br D-Ha A1) was concentrated around the upper Tisza, the later pottery (Gáva II/Ha A2-B1) reached a vast area, including Troy (level VIIb2).
[4] See Bozhinova 2012: 61 f. — For the marked increase in contact between the eastern Balkans and the Aegean beginning in the second half of the 10th century BC (Late Protogeometric), see the discussion of bronze drinking vessels and fibulae in Pare 2015; and see the discussion in Chapter 12.3-4.
[5] Nekhrizov and Tzvetkova 2018.

that the third phase, with typical 'Pshenichevo' decoration with S-stamps, began around 900 BC at Gluhite Kamani.[6]

As can be surmised from the above summary, the transition from fluted to stamped pottery decoration is important for our understanding of the developments – both in settlement and funerary archaeology – at the transition from the Bronze Age to the Iron Age. Precisely this question, the spread of stamped pottery, has been analysed in a recent study by Sorin-Cristian Ailincăi.[7] He has drawn attention to major problems in the internal chronology of the Babadag settlement, and showed that the traditional tripartite scheme (Babadag I, II, III) is flawed.[8] He concludes that it is impossible to distinguish between the pottery of the Babadag I and II phases, both having incised and stamped decoration, and both phases together should be assigned approximately to the 10th/9th century BC. At Babadag, pottery with stamped decoration is already found in the earliest occupation levels, which can be reliably dated to sometime in the 10th century BC.[9] Owing to these current problems in understanding the chronology of Babadag pottery, it is presently impossible to date the earliest iron finds in Dobrudja precisely.[10]

Ailincăi explains that in the area between the Iron Gates and the middle Dnister, a series of cultural groups emerged during the 10th century BC using pottery with stamped decoration.[11] The decorated pottery of these groups is in turn related to the stamped pottery further south in Bulgaria. Indeed, these kinds of stamped decoration started earlier in the Thracian Plain than further north. This indicates that the cultural groups in the areas to the south and south-east of the Carpathian Mountains experienced a cultural reorientation at the start of the Iron Age: whereas their pottery had previously belonged to the 'Gáva complex', it now reflects influence from the Pshenichevo culture of southern Thrace.[12] As in most of these areas the first iron objects appear in the archaeological record at the same time as stamped decoration on pottery, it seems likely that knowledge of iron arrived from southern Bulgaria along with the new kind of pottery decoration.[13] The formation of this cultural *koinè* culminated in the richly decorated pottery of the 'Basarabi phenomenon', which is mainly distributed in the regions reaching from Syrmia, the Banat and south-west Transylvania in the west, along the lower Danube, to southern Moldavia and the middle Dnister in the east.[14]

It is clear that the cultural reorientation described above, with a 'Bronze Age' stage with fluted wares, succeeded by an 'Iron Age' stage with stamp-decorated pottery, offers an important hypothetical framework for the following discussion of the earliest evidence for iron usage. An important aspect of this model is the idea that the expansion of the 'Gáva' complex of fluted and knobbed wares reflects the influential role of the bronze-producing regions of the north-eastern Carpathian Basin; the subsequent formation of the Stamped Pottery *koinè* could, in part, reflect the prestige of cultures which had mastered the technology of iron production.

The cessation of bronze hoard deposition is obviously highly relevant in the context of this cultural reorientation. In Bulgaria north of the Stara Planina, the practice of depositing bronze hoards came to an end sometime around the end of the 2nd and the beginning of the 1st millennium BC. As the latest hoards

6 Nekhrizov and Tzvetkova 2018: 34; see also 37 table 6.

7 Ailincăi 2020.

8 In the traditional scheme, developed by Sebastian Morintz, the Babadag I phase was characterised by incised (rather than stamped) decoration. See Ailincăi 2013a: 148; 2016: 223 ff.

9 This statement is based on three radiocarbon dates from the earliest occupation level at Babadag. See Ailincăi 2020: 457; 463 f.

10 A total of 23 iron finds are known from contexts of the Babadag culture from five sites in Dobrudja: several knives, a trunnion axe, a trunnion hammer, several sickles and awls, two fibulae, a fish-hook, a ring and three indeterminate fragments. See Jugănaru 2005: 69-72; Ailincăi 2013a: 91; 2013b: 243 fig. 17; 2016: 212. — Furthermore, iron slags and remains of an iron-smelting furnace have been discovered in sites of the Babadag culture at Babadag (jud. Tulcea), Galiţa (jud. Constanţa) and Hârşova (jud. Constanţa). See Boroffka 1991: 7; László 1977: 53 ff.; Ailincăi 2016: 212.

11 Ailincăi 2020; see also Pare 1998: 411 fig. 48; Metzner-Nebelsick 2010a: 142.

12 Sorin-Cristian Ailincăi (2020: 464) summarises the situation as follows: "As a result, an immense area between the Rhodopi Mountains, Middle Dniestr and along the Danube, from the Iron Gates to the river's mouth, belongs to the same cultural complex".

13 See Ailincăi 2020: 455.

14 See Ailincăi 2020: 460; 464.

mainly contain only socketed axes, it is difficult to date them precisely. Berhard Hänsel believed that the latest hoards can be assigned to Ha A2-B1, whereas Tanya Hristova came to the conclusion that they date to the 11th century BC.[15] Two important Romanian hoards can be assigned to hoard phase IV: in Dobrudja, the hoard from Sâmbăta Noua I (jud. Constanţa) contains socketed axes and sickles; and in Muntenia, the hoard from Dridu (jud. Ialomiţa) contains spearheads and a range of tools (socketed axes, sickles, chisels, awls) and other artefacts made of bronze.[16] The cessation of bronze hoard deposition around 1000 BC or in the first half of the 10th century BC, appears to correspond with the cultural reorientation at the time of the establishment of the Stamped Pottery complex.

Interesting as this model for the Bronze/Iron transition may be, it should be treated with due caution. The fashion of stamped ornamentation on pottery may have spread gradually over a considerable span of time, and there were doubtless important differences in the development of pottery production in the various regional cultural groups in this vast area.

5.2 Selected early iron artefacts

The present state of research makes it difficult to reach reliable conclusions on the introduction of iron in Bulgaria. Unfortunately, hardly any early iron artefacts are associated with significant pottery from reliable archaeological contexts. On the other hand, large numbers of relevant iron artefacts come from plundered graves or unsystematic excavations. For this reason, the discussion will concentrate on the typological study of certain classes of artefacts, particularly trunnion axes, fibulae and swords. Despite these difficulties, there is a general consensus in the specialist literature that the use of iron began in the 10th century BC, for example in publications by Maria Chichikova, Elena Bozhinova, Totko Stoyanov and Borislav Borislavov; Goranka Toncheva suggested a slightly earlier date for the introduction of iron, in the second half of the 11th century BC.[17]

Iron trunnion axes have already been discussed in Chapter 4. Unfortunately, the Bulgarian examples are all either stray finds or they derive from hoards consisting exclusively of these implements.[18] As explained in Chapter 4, some of the Bulgarian axes are similar to the oldest iron axes in the Aegean and the East Mediterranean (e.g. Dragoevo and Sushina, Figure 19: 9.10). Taken together, the early iron trunnion axes from Bulgaria, together with the examples from Leskovac, Hisar (Serbia), Cernat (Transylvania), Bârlad (Moldavia), and perhaps Nedilyska (Galicia), are comparable with the axes from the Late Protogeometric and Early Geometric Aegean, indicating the usage of large utilitarian iron implements in the eastern Balkans and neighbouring regions from the second half of the 10th or the first half of the 9th century BC onwards.[19]

The fact that the early trunnion axes have mainly been found in eastern Bulgaria makes it likely that the impetus for their production derived from Aegean seafarers active along the Black Sea coast. Comparable early axes have not been found in western and north-western Bulgaria, where the earliest finds, from Krivodol (Vratsa Oblast), are considerably later.[20] The surprisingly large number of iron trunnion axes from Bulgaria requires comment. For example, in Shumen Museum alone there are 25 iron trunnion axes from at least nine locations.[21] Considering that copper or bronze ingots were sometimes cast in the shape of trunnion axes during the 11th and 10th centuries BC in the central Mediterranean (see Chapter 4.4),

[15] Hänsel 1976: 41 ff. with fig. 3; Hristova 2018: 161 ff. (Esernitsa horizon). — Note that bronze hoards are almost completely absent in the area to the south of the Balkan Mountains (Stara Planina) during the Bronze Age.
[16] Petrescu-Dîmboviţa 1978: 147 f.; pl. 252: B; 253; 254: A. — Enăchiuc 1995.
[17] Čičikova 1978: 187-190; Tončeva 1980: 55; Bozhinova 2008: 47; Stoyanov and Borislavov 2018: 289 ff.
[18] The examples from Ada Tepe and Svilengrad do not come from closed archaeological contexts.
[19] An even earlier date for iron trunnion axes has occasionally been proposed, on the basis of the hoard of Bârlad (jud. Vaslui), from the area of the Cozia culture in Moldavia. Indeed, bronze axes related to those from Bârlad were already made around the 12th century BC, as shown by the stone moulds from Pobit Kamak and Mogilitsa. However, in my opinion the Bârlad hoard cannot be closely dated (see Chapter 6). — See Leschtakow 2019, with further references.
[20] Nikolov 1970.
[21] Atanasov and Babadzhanov 2008.

it is worth considering whether some of the iron examples could have served as billets of raw material. Indeed, during the early stages of iron use, iron could even have been imported to eastern Bulgaria in the shape of axe-shaped billets.

Fibulae have played an important role in previous discussions. According to Totko Stoyanov and Borislav Borislavov, a series of fibulae from southern and north-eastern Thrace belong among the earliest securely dated iron artefacts.[22] These are two-looped fibulae with a triangular outline and three beads on the bow; more than 20 examples are known, mainly from Bulgaria, but also from Dobrudja and Greek Thrace, and an isolated outlier has been found in Bosnia (Figure 21, and see List 5.1). Totko Stoyanov discussed in detail these iron fibulae and their bronze forerunners.[23] He explained that a typological development can be reconstructed, reaching from the earliest bronze examples of the 11th century to the latest iron fibulae of the 9th or 8th century BC. While the earliest bronze precursors, which lack the typical triple beads on the bow, have a simple wire shank between the 'knee' and the 'foot' (Figure 20: 1-2), on the later bronze and iron fibulae the foot became flattened, first narrow and spatulate (Figure 20: 4-6), and eventually enlarged and occurring in a variety of shapes (Figure 20: 7-9). This development is of considerable importance, because the same tendency is seen among fibulae in the Aegean: Submycenaean arched fibulae have a simple wire shank above the foot, whereas during the Early and Middle Protogeometric phases the foot typically becomes spatulate.[24] This suggests that the bronze and iron two-looped fibulae with narrow spatulate foot from Bulgaria should also date around the second half of the 11th and the first half of the 10th century BC; if so, it seems plausible that the iron versions appeared later than the bronze fibulae, perhaps being introduced during the first half of the 10th century BC.[25] This early date is reinforced by a radiocarbon date from Stambolovo, Tumulus II, Grave 2, containing an iron fibula with bronze inlays (Figure 20: 6), which indicates a position in the 10th century BC.[26]

The five tumuli from Sboryanovo have been studied in an important monograph by Toto Stoyanov.[27] Two iron fibulae and two iron knives come from burials which can be assigned to the earlier stage in the use of the cemetery, before the introduction of pottery with rich stamped decoration (Figure 22).[28] The fluted ornamentation of the pottery and the shapes of some of the kantharoi are similar to the fluted and knobbed handmade lustrous ware of Troy VIIb2, once again suggesting an early date for these iron artefacts, perhaps around the end of the 2nd or the start of the 1st millennium BC.[29] Apparently, the iron knife from the settlement of Sava-Tsonevo came from a context with similar pottery, leading Goranka Toncheva to suggest a date in the second half of the 11th century BC.[30]

[22] Stoyanov and Borislavov 2018: 296.

[23] Stoyanov 1997: 74 ff.

[24] For the earlier fibulae in Bulgaria, see Gergova 1987: cat. no. 101, 102, 106. — The fibula from Hama, Syria (Figure 20: 1) comes from a grave belonging to Period 1 of the cemetery (see Chapter 2.3). — A similar construction, but on one-looped fibulae, is seen on numerous Submycenaean examples from Lefkandi and Athens (Kerameikos) (for example Müller-Karpe 1962: 87 fig. 5: 12). For examples from Caria, see Özer 2020: 230 fig. 2; compare 232 fig. 3. See also Kourion, Kaloriziki, Grave 40 (Matthäus and Schumacher-Matthäus 2015: 48 fig. 37).

[25] For the bronze fibulae with spatulate foot, see Gergova 1987: 37 cat. no. 102, 104, 105, 106. — Iron examples are known from Sboryanovo, Stambolovo and Kossynthos; for Kamen Rid, see Gergova 1986: 22 fig. 10: b.c.

[26] The sample from Grave 2, taken from human bone, gave a 2σ date of 1052-898 BC. The radiocarbon dates from Tumulus II suggest a date in the 10th century BC for all four pithos graves. See Nekhrizov and Tzvetkova 2018: 35 table 5. — The pottery from the four pithos graves is assigned by Nekhrizov and Tzvetkova (2020: 36; 37 table 6) to 'Early Iron Age I', characterised by pottery with fluted, rather than stamped decoration. Unfortunately, the pottery has not yet been published comprehensively.

[27] Stoyanov 1997.

[28] Stoyanov 1997: 83 (early phase): Tumulus III, Grave 3; Tumulus IV, Grave 3/4; Tumulus V, Grave 1; pottery with stamped decoration was not found in these three tumuli. — Because of their arrangement close beside each other, it is very likely that the four inhumations in Tumulus V ('Graves 1-4') were interred within a short span of time. See Stoyanov 1997: 44 Plan 5. — For the (early) phase with knobbed and fluted pottery at Sboryanovo, preceding the introduction of pottery with stamped decoration, see Ailincăi 2016: 22 f.; 2020: 460.

[29] Troy VIIb2 is currently dated to ca. 1150-1050/1000 BC, see Aslan 2020. A somewhat earlier date for the end of VIIb2 is suggested by Pieniążek et al. 2020: 69 fig. 26.

[30] Tončeva 1980: 55; 51 pl. 19: 1. The knife came from the hearth of 'Building no. 1'; the associated pottery of 'Gáva' style had fluted and 'turban' decoration and knobs. See Tončeva 1980: 32; 35; 40 ff.; 50 ff.

On many of the iron triangular two-looped fibulae, the foot has not been preserved, making them difficult to date. However, several examples come from contexts with richly decorated pottery of classic Babadag or Pshenichevo type, suggesting that later variants of the triangular fibulae continued to be worn in the second half of the 10th or 9th century BC.[31] According to Stoyanov, the bronze fibulae with large, shield-shaped foot from Sboryanovo, Tumulus II, Grave 5 (Figure 20: 8) belong to the later stage of the cemetery's use.[32]

Stoyanov's argument that the earliest iron fibulae and knives from Sboryanovo date around 1000 BC, or the first half of the 10th century BC, is convincing. Indeed, it is hardly surprising that iron was introduced to southern and eastern Bulgaria at this time, considering the proximity of evidence for the production and use of iron in the Aegean, notably the blacksmiths' forges from Phocaea, which probably date around the middle of the 11th century BC, and the early evidence for iron at Thasos.[33] As we have seen, our discussion of the two-looped fibulae revealed the existence of contacts with the Aegean, and even with the East Mediterranean (Hama), during the 11th century BC (see Figure 20: 1). As some of these early fibulae come from the eastern regions of Bulgaria, not far from the Black Sea coast, it is likely that these contacts reflect maritime exchange relations with the Submycenaean and Protogeometric Aegean.

Iron swords have always played an important role in discussion of the transition from bronze to iron in Bulgaria. The swords have been compared to examples from Protogeometric Greece, and the earliest are thought to date to the 10th century BC.[34] The swords normally have a leaf-shaped blade, with the centre of gravity located towards the tip. The most characteristic feature is the flanged hilt tang terminating in a fish-tail, but the distribution of the rivets – typically one or two

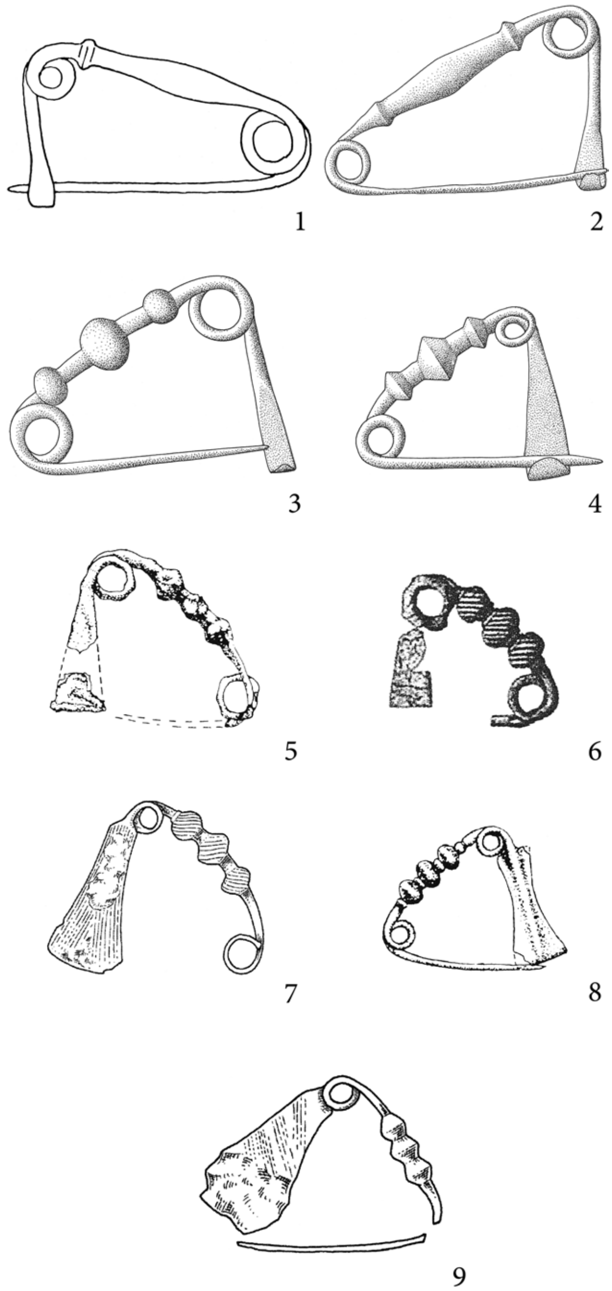

Figure 20. Examples of triangular two-looped fibulae. — 1 Hama, Syria, Grave G IV 325 (after Riis 1948: 132 fig. 167: B). — 2 Nova Zagora vicinity (after Gergova 1987: pl. 8: 101). — 3 Suvorovo, Varna Oblast (after Gergova 1987: pl. 8: 106). — 4 Sava, Varna Oblast (after Gergova 1987: pl. 8: 104). — 5 Sboryanovo, Razgrad Oblast, Tumulus V, Grave 1 (after Stoyanov 1997: pl. 18: 127). — 6 Stambolovo, Haskovo Oblast, Tumulus 2, Grave 2 (after Nekhrizov 2009: 267 fig. 1: 3). — 7 Kamen Rid, Razgrad Oblast (after Teržan 2009: 204 fig. 13: 3). — 8 Sboryanovo, Haskovo Oblast, Tumulus II, Grave 5 (after Stoyanov 1997: pl. 18: 129). — 9 Yagodina, Smolyan Oblast, Tumulus 1 (after Teržan 2009: 204 fig. 13: 4). — 1-4.8 bronze; 6 bronze and iron; 5.7.9 iron. — 1-6.8 scale 1:2; 7.9 not to scale.

31 Kašuba 2006: 224 ff.

32 Note that pottery sherds with stamped decoration were found above Graves 4 and 5 in Tumulus II, perhaps representing the remains of a ritual deposition associated with the funeral rites. See Stoyanov 1997: 26 f.; pl. 11: 78.79-81.93.

33 As explained in Chapter 4, a few iron knives were found at Thasos in contexts of the 11th century BC, their use increased steadily during the 10th century BC, and iron had completely replaced bronze for knives by the mid-9th century BC.

34 See for example Čičikova 1978: 187 ff.; Tončeva 1980: 49 f.; Shalganova and Gotzev 1995: 338; Bozhinova 2008: 47 f.; Valentinova 2010: 140 ff.

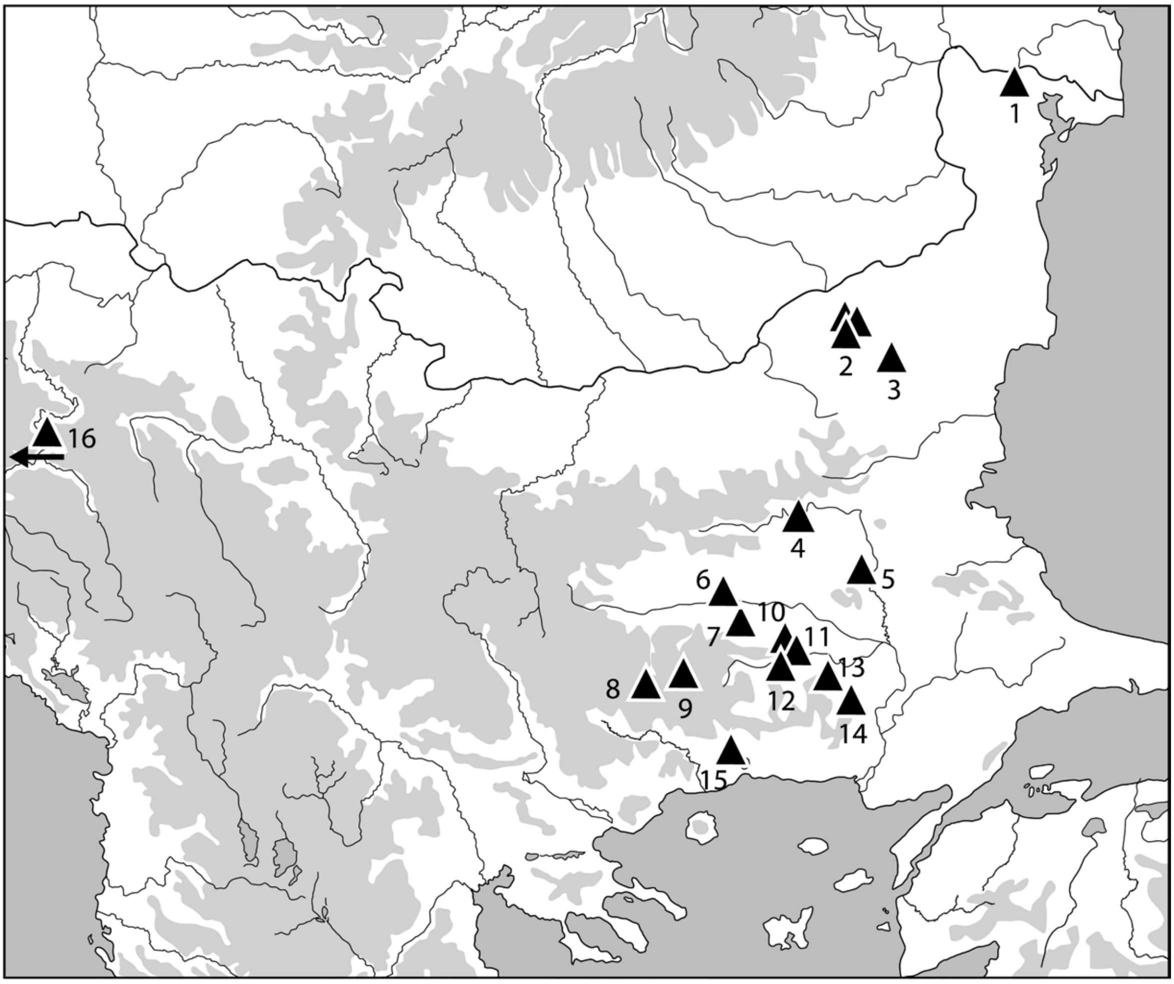

Figure 21. Distribution map of iron triangular two-looped fibulae with three beads on the bow (see List 5.1). — 1 Revărsarea. — 2 Kamen Rid, Lyulyakov Grad, Sboryanovo. — 3 Lisi vrah. — 4 Nova Zagora vicinity. — 5 Hlyabovo. — 6 Gradina. — 7 Angel Voivoda. — 8 Yagodina. — 9 Progled. — 10 Stambolovo. — 11 Pchelari. — 12 Dolna kula. — 13 Zhelezino. — 14 Roussa, Dikella. — 15 Kossynthos. — 16 Debelo brdo.

on the hilt and one on each shoulder – is also a regularly occurring feature. However, the swords are sometimes badly preserved, lacking elements significant for a typological classification (for a representative sample, see Figure 23). When information is available on the find circumstances, most of the swords seem to have come from tumulus burials, and sometimes they were associated with other iron artefacts.[35] At present, 18 of these iron flange-hilted swords are known from Bulgaria; similar swords have also been discovered in Greece and the Republic of North Macedonia (Figure 24; see List 5.2).

The iron swords are particularly interesting, partly because they are evidently closely related typologically to the latest Bulgarian bronze flange-hilted swords.[36] For this reason, a precise analysis of the development of these swords should provide important information on the transition from bronze to iron in the production of weaponry. The latest Bulgarian bronze swords are rather similar to the last bronze swords in Greece, for example the weapons from Macedonia with a pair of rivets on the shoulders and the hilt terminating in a fish-tail from Aghios Panteleimon, Elati and Vergina. As explained in

[35] Swords from tumulus graves: e.g. Borino, Novo Selo, Popovo, Topchii, Troyan. — Swords associated with iron spears: e.g. Borino, Novo Selo, Topchii.

[36] For the latest bronze swords in Bulgaria, see for example: Pchela, near Elhovo (Yambol Oblast): Alexandrov et al. 2018: 520 cat. no. 363; Odarne (Pleven Oblast): Gergov 1981; Vasil Levski (Targovishte Oblast): Kilian-Dirlmeier 1993: 96 cat. no. 235; pl. 35: 235; and an unprovenanced example: Shalganova 2011.

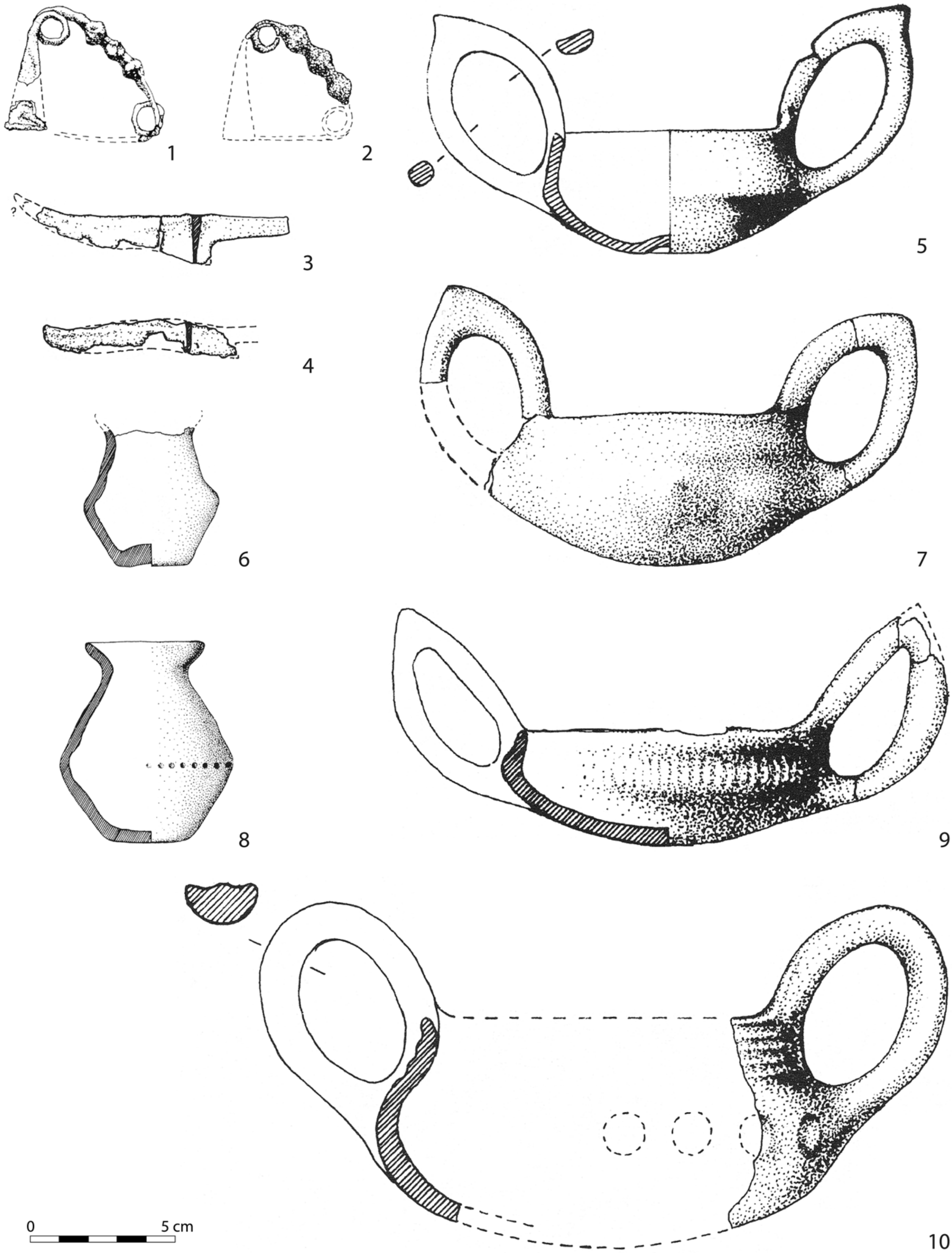

Figure 22. Iron and pottery artefacts from the earlier stage in the use of the cemetery at Sboryanovo, Razgrad Oblast (drawings taken from Stoyanov 1997). — Scale 1:2.

Chapter 4, production of bronze swords seems to have ceased in Macedonia ca. 1000 BC. But the Bulgarian swords also have significant parallels among bronze swords from the western Balkan Peninsula and the Carpathia Basin, which are somewhat later in date, some dating to the second half of the 10th century BC (Ha B2).[37] This suggests that bronze sword production continued longer in Bulgaria than in northern Greece, perhaps lasting until the mid- or second half of the 10th century BC.

A particularly interesting sword fragment was discovered, together with some other metal fittings and a pottery kantharos, in a tumulus at Devetaki in the Lovech region (Figure 25).[38] The hilt closely resembles the weapons from Vasil Levski and Haskovo – the former in bronze, the latter in iron (for Haskovo, see Figure 23: 7). Clearly, the sword from Devetaki was made at the time, when bronze was being supplanted by iron for sword production. However, the Devetaki sword is very unusual as the hilt and blade were made separately – the hilt having originally been cast onto the blade (*Überfangguss*). Although it is not certain, it is most likely that the blade of the sword was of iron, as in the case of the bimetallic dirks from Tanis in Egypt and Torre Galli in Calabria (see Figures 17 and 57), and several Gündlingen swords from France and Belgium.[39] The two bronze, band-shaped fittings from the tumulus at Devetaki may have been rivetted onto the hilt and the blade – to reinforce the cast-on join (Figure 25: 1-3). The fact that the rivets surviving on the hilt and on the two fittings are made of iron speaks for the suggested bimetallic construction of the sword. Maya Valentinova noted that the kantharos from Devetaki is related to some kantharoi from Troy (VIIb2) and Sboryanovo.[40] But whereas the latter kantharoi have handles with an angular shape, the handles on the Devetaki example are more rounded, suggesting a later chronological position. Valentinova notes a closer parallel for the Devetaki kantharos from Troyan, Turlata, Tumulus 4, which contained an iron sword.[41]

Although the date of the Devetaki sword cannot be determined precisely, the parallels for the finds suggest that the transition from bronze to iron in sword production was taking place in northern Bulgaria around the second half of the 10th century BC. However, this would not exclude the possibility that iron swords were manufactured earlier in southern Bulgaria and in Greek Eastern Macedonia and Thrace. As the swords and associated grave furnishings from Amphipolis, Drama and Kossynthos have not yet been published, this remains an open question.

The Bulgarian iron flange-hilted swords are similar to those in the Late Protogeometric and Early Geometric Aegean, although the blades of the Aegean examples are normally parallel-sided, rather than leaf-shaped.[42] The example from Lefkandi, Toumba, Pyre 8 is important as it closely resembles the sword from Haskovo (Figure 23: 7). As the Lefkandi sword has features which are otherwise untypical for the Aegean, including the pronounced mid-rib and the leaf-shaped blade found on Bulgarian swords, it must either have been imported to Euboea, or it demonstrates influence from the Bulgarian sword tradition. As the Lefkandi weapon comes from a tomb dating to Subprotogeometric I-II, this demonstrates that iron swords were already manufactured in the Thracian Plain during the first half of the 9th century BC. Furthermore, the close relationship between the iron sword from Haskovo, the bronze sword-hilt from Devetaki, and the bronze sword from Vasil Levski, supports the proposal that the transition from bronze to iron sword production took place in Bulgaria in the second half of the 10th century BC.

[37] See the swords from Trilj, Dalmatia (Harding 1995: 58 cat. no. 195A; pl. 24: 195A). — Vojskova, Bosnia (Harding 1995: 57 cat. no. 195; pl. 23: 195). — Celldömölk, Hoard II, Transdanubia (Kemenczei 1988: 69 cat. no. 370; pl. 41: 370; Mozsolics 2000: pl. 17: 3). — Hida, Transylvania (Bader 1991: 112 cat. no. 274; pl. 27: 274).

[38] See Valentinova 2010; Stoyanov and Borislavov 2018: 291 fig. 4; Alexandrov et al. 2018: 554 cat. no. 593.

[39] The bronze hilt from Devetaki has a notch-like cavity in the lower end to accommodate the sword blade. — For the swords from France and Belgium, see Vuaillat 1987: 21 fig. 5; Warmenbol 2009: 381 f. fig. 6: 1.

[40] Valentinova 2010: 140 (kantharos Type A.107 at Troy, Stoyanov's Type II at Sboryanovo).

[41] The kantharos from Troyan has pseudo-cord impressions around the widest part of the vessel. See Valentinova 2010: 145 fig. 1: B. — A kantharos with similar handles, and with impressed decoration, was found in a pit together with an iron two-looped fibula at Revărsarea, Dealul Tichileşti. See Ailincăi 2013a: pl. 6: 16.

[42] See, for example, the swords from Athens and Lefkandi: Kilian-Dirlmeier 1993: pl. 41: 278; 42: 280; 45: 317.318.320.321. — Note that the iron sword from Kouklia, Skales, Grave 277 also has a leaf-shaped blade, similar to some of the Bulgarian weapons. Unfortunately, the context is not closely dateable (ca. 900-750 BC). See Karageorghis and Raptou 2019: 333 no. 44; 358 fig. 15: 44; 363 fig. 20: 44.

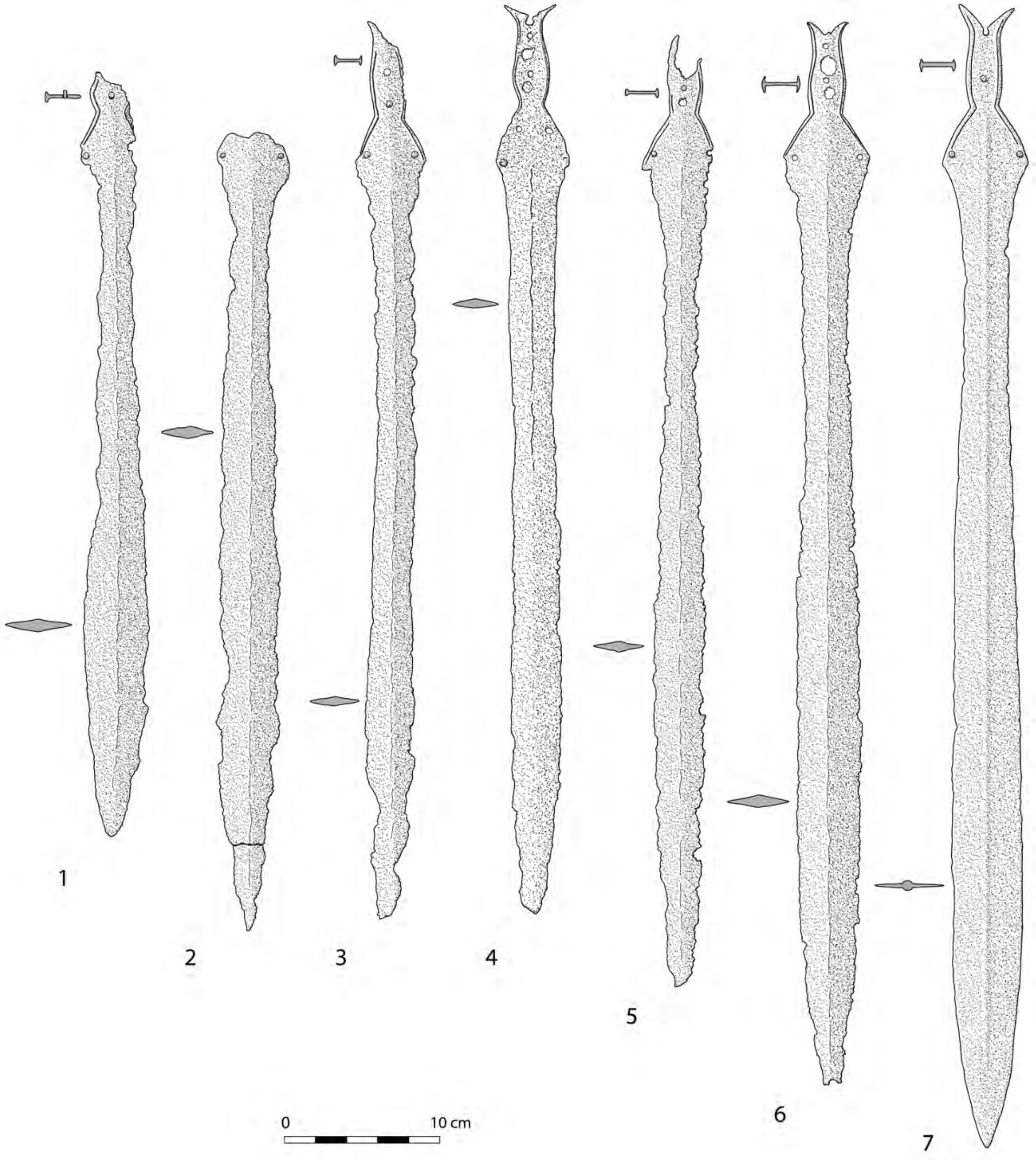

Figure 23. Iron flange-hilted swords from Bulgaria. — 1.3 Palamartsa. — 2 Troyan. — 4 Topchii. — 5 Hlevene. — 6 Aleksandrovo. — 7 Haskovo district. — Scale 1:4.

The iron flange-hilted swords from the Mušja jama at Škocjan in Slovenia, and from Brno-Obřany, Grave 169 in Moravia (Figure 52: 1), are very similar to Bulgarian examples and were presumably imported.[43] The latter sword was found in a grave context dated to Ha B3, which is further evidence for the production of swords in Bulgaria during the 9th century BC. In the case of a further iron sword from Slobozia, on the lower Dnister, the state of preservation makes it impossible to decide if it is more closely related

[43] For Brno-Obřany, see Stegmann-Rajtár 1993: 37 ff.; pl. 2: 1. — Škocjan, Mušja jama: Teržan et al. 2016: 689 pl. 14: 3; for a close parallel from Bulgaria, see Torbov 2018: 6 cat. no. 2; 2020: 9; pl. 1: 1.

to Bulgarian or Aegean weapons.[44] The Slobozia grave has been assigned to the second half of the 9th century BC.[45]

Although iron swords were clearly used in Bulgaria during the 9th century BC, it is less easy to ascertain when the production of these weapons ceased. It is quite likely that the typical Bulgarian flange-hilted weapons already fell out of use during the 8th century BC, at a time when more 'developed' swords and dirks of Basarabi-Novi Sad type, and related variants, are attested in the Balkans (see Chapter 8.6).[46]

As Lyuben Leshtakov remarked, the iron flange-hilted swords represent a continuation of older, Late Bronze Age, traditions of weaponry.[47] A spearhead from Devin (Smolyan Oblast) is a further example for the translation of a traditional 'Urnfield' type into iron: the blade of the spearhead has incised lines imitating the ribbed decoration found on Late Bronze Age spearheads.[48] Unfortunately, the Devin spearhead is an isolated find.

5.3 Discussion and conclusions

Despite the unfavourable state of research in the eastern Balkan Peninsula, and the general lack of published contexts with early iron artefacts, some important conclusions can nevertheless be drawn.

Although it is impossible to say when the first iron objects were introduced in Bulgaria, local iron production had evidently begun before or around 1000 BC, as the analysis of the triangular two-looped fibulae indicates. A few iron knives are also known from approximately this time, from Sboryanovo and Sava-Tsonevo. This result confirms the existing academic consensus in Bulgaria on the date of the introduction of iron. Most likely, the first iron objects, and eventually the technology of iron smelting, reached Bulgaria from the northern Aegean and the Black Sea coast, as Totko Stoyanov and Borislav Borislavov conclude.[49]

Large utilitarian iron objects were probably introduced later. As described in Chapter 4.4, the early iron trunnion axes from Bulgaria have parallels in the Aegean and the East Mediterranean dating to the second half of the 10th and the first half of the 9th century BC. It seems plausible that the earliest iron trunnion axes in Bulgaria were already introduced during the second half of the 10th century BC, corresponding to the horizon of trunnion axes from Serbia (Leskovac), Transylvania (Cernat), Moldavia (Bârlad) and Galicia (Nedilyska).

As our discussion demonstrates, the transition from bronze to iron in the manufacture of swords probably took place in the second half of the 10th century BC. The Bulgarian swords are similar to examples of the 10th century BC in Macedonia (Vergina) and central Greece (especially Athens and Lefkandi). The manufacture of iron swords is a clear indication that large quantities of iron were already produced at this time in the eastern Balkan Peninsula, doubtless by smelting locally occurring ores.

The earliest iron objects are found in southern, eastern and northern central Bulgaria (see, for example, Figures 21 and 24). Comparably early finds are not known from north-west Bulgaria, where iron was evidently introduced later, probably sometime during the 9th century BC.[50] Considering our knowledge of early iron in surrounding areas (particularly from Phocaea, Vergina, Thasos and the North Pontic steppe), it is hardly surprising that the new metal was introduced in the eastern Balkan Peninsula around

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[44] Slobozia (Republic of Moldova), Tumulus 3, Grave 3: Yarovoy et al. 2002: 301 fig. 9: 1; Kashuba 2013: 251 fig. 11: 5; Kashuba and Kulkova 2021: 108 fig. 2.9: 1.

[45] Kashuba 2013: 249; Kašuba et al. 2019: 195; Kashuba and Kulkova 2021: 144 f. cat. no. 175.

[46] There are two iron dirks and one iron sword in Bulgarian private collections, which probably represent a late development of the typical flange-hilted type. — See Thraker 2004: 103 cat. no. 152; Torbov 2018: 4 cat. no. 1618; 9 cat. no. 5; Kabakchieva 2000: 33 cat. no. 18.

[47] Leshtakov 2011: 40.

[48] For Devin, see Leshtakov 2011: 37 fig. 5: 7. For bronze spearheads of this type, see Pabst 2013b: 160-162; Teržan et al. 2016: 66-70; 67 fig. 18.

[49] Stoyanov and Borislavov 2018: 297.

[50] Stoyanov and Borislavov 2018: 297.

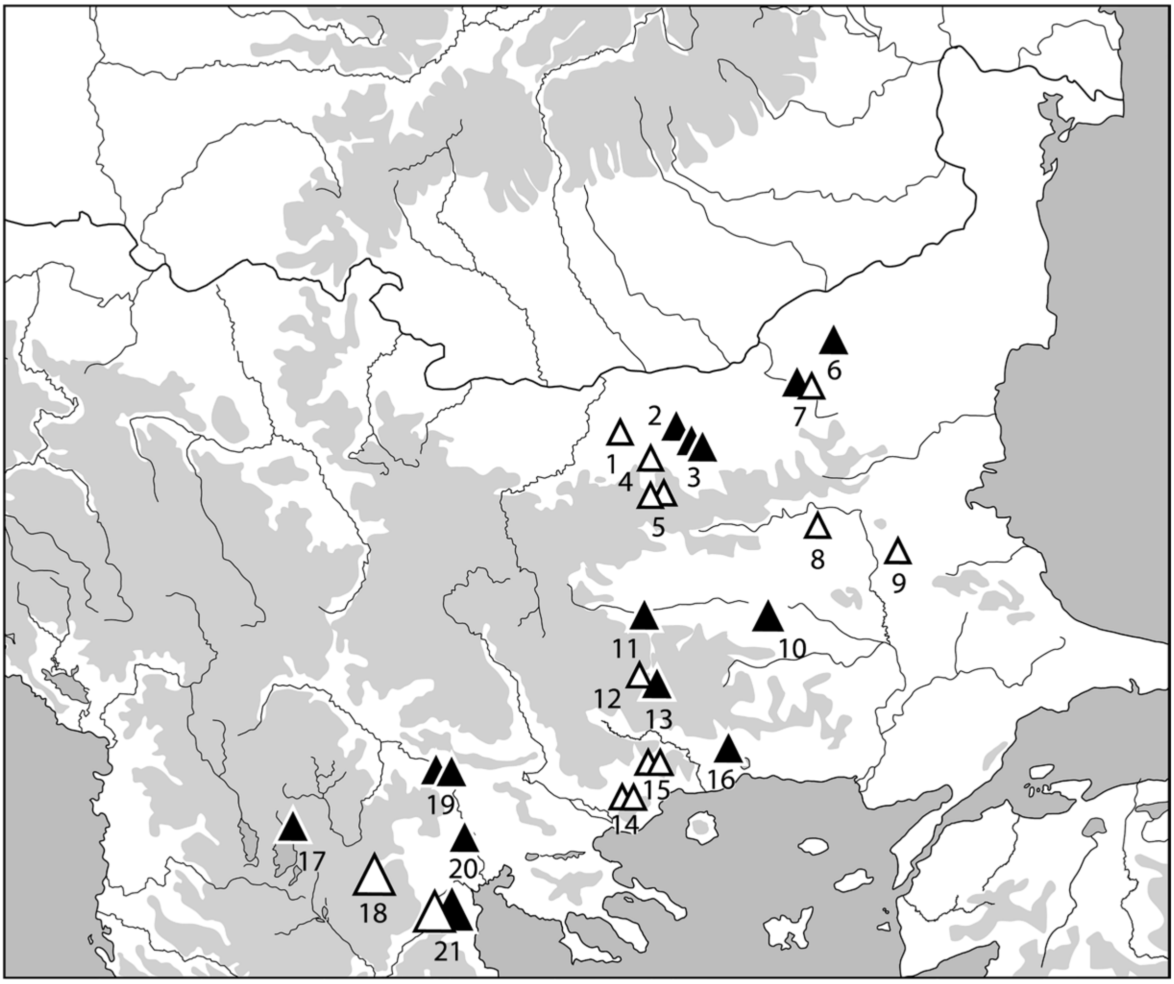

Figure 24. Distribution map of iron flange-hilted swords in the eastern Balkan Peninsula (see List 5.2); examples with a hilt terminating in a fish-tail are marked with black triangles, sites with multiple examples are marked with a large symbol. — 1 Barkach. — 2 Aleksandrovo. — 3 Gorsko Slivovo. — 4 Hlevene. — 5 Troyan. — 6 Topchii. — 7 Palamartsa. — 8 Omarchevo. — 9 Popovo. — 10 Haskovo district. — 11 Novo Selo. — 12 Borino. — 13 Trigrad. — 14 Amphipolis. — 15 Drama. — 16 Kossynthos. — 17 Visoi, Beranci. — 18 Aghios Panteleimon. — 19 Milci, Gevgelija. — 20 Agrosykia. — 21 Vergina.

the second half of the 11th or ca. 1000 BC. Unfortunately, it is not possible to be more precise about the process of the introduction of the new metal. It is uncertain if iron was initially imported (in the form of finished artefacts, or as raw material), and when bloomery smelting began.

It is worth emphasizing once again the extreme shortage of significant excavated and published contexts with metalwork at the time of the transition from bronze to iron (11th-9th century BC). This obviously makes it very difficult to understand the introduction of iron metallurgy in more detail. Nevertheless, interesting hypotheses have been developed which appear convincing.

As explained above, in recent research, the technological change from bronze to iron in the eastern Balkan Peninsula has been linked to a wide-reaching cultural reorientation. In the Late Bronze Age, the popularity of fluted and knobbed pottery reflects the influential role of the north-eastern Carpathian Basin.[51] The latter region, where the 'Gáva' complex originated, was pre-eminent in the production of bronze, which was used for making prestige goods, and as a 'currency' in transactions between people

[51] For an impressive example of the fluted pottery complex, see the comparison of the pottery between the Banat and the Dnister on Pare 1998: 409 fig. 47.

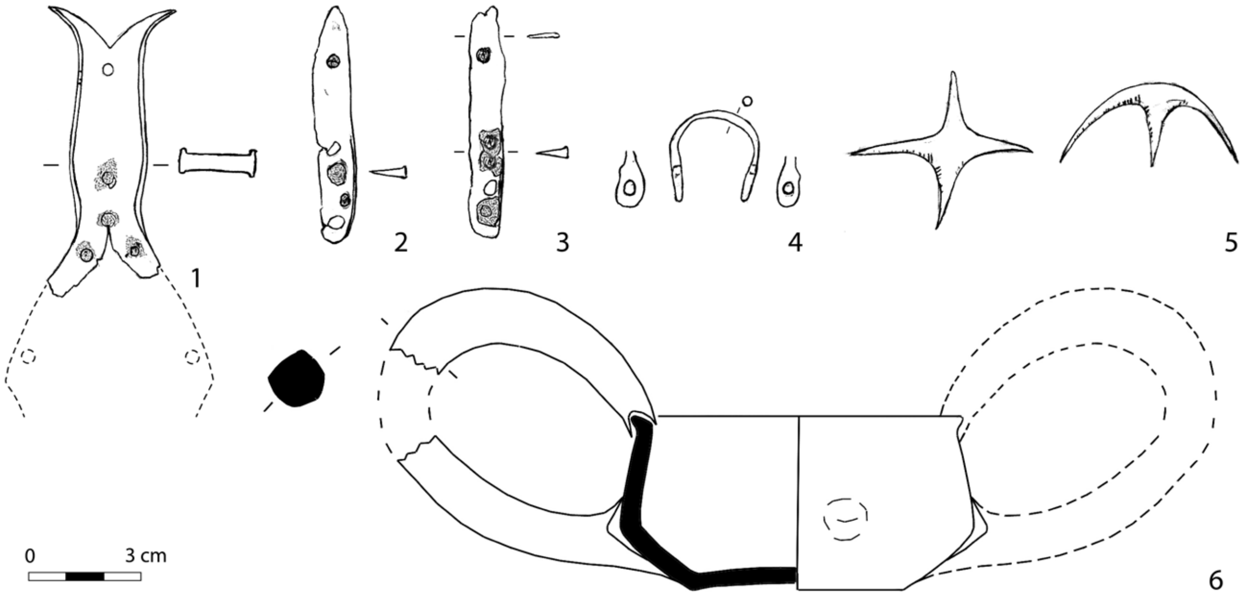

Figure 25. Finds from a tumulus at Devetaki, Lovech Oblast. — 1-3 bronze and iron; 4-5 bronze; 6 pottery. - After Valentinova 2010. — Scale 1:2.

and as offerings to the gods in religious rituals. The formation of the Stamped Pottery complex between the Thracian Plain, the Iron Gates and Moldavia represents a reversal of cultural orientation. In the Stamped Pottery *koinè* of iron-producing cultures, influence from the Protogeometric and Geometric Aegean became increasingly important (see Chapter 12.3-4). This transformation in cultural geography reached its peak in the formation of the Basarabi complex between the Banat, the Lower Danube and Moldavia in the 8th century BC.

The suggested linkage between this cultural reorientation and the technological change at the Bronze/Iron transition makes it possible to add a third change which happened at approximately the same time. The cessation of bronze hoarding ca. 1000 BC in the area north of the Stara Planina implies that a reconceptualization of bronze took place, whereby bronzes were no longer deemed suitable as offerings to the gods. Naturally, the question follows whether this depreciation of bronze was caused by the introduction of the new metal, iron. As a comparison, consider how in most parts of Greece bronze sword and dirk production apparently ended in LH IIIC, at a time when iron was still a rare commodity, which again suggests a reconceptualization associated with the growing prestige of iron. Of course, the question of the cessation of bronze hoarding is not only pertinent to Bulgaria: it is a phenomenon which can be observed in much of central and western Europe during the early 1st millennium BC, and will be revisited in Chapters 8 and 9 (see Figure 55).[52]

The distribution maps of iron fibulae and swords (Figures 21 and 24), even though the individual artefacts have a wide chronological range between the 10th and 9th/8th century BC, provide an impression of the 'Thracian' province of innovation in iron metallurgy. According to the arguments of Sorin-Cristian Ailincăi and other scholars, the Thracian Plain played a prominent role in the formation of a vast cultural complex in the eastern Balkan Peninsula. The emergence of innovative iron-using cultures transformed the cultural geography of south-east Europe, culminating in the formation of the Basarabi complex, which was of crucial importance for the further dissemination of iron metallurgy towards the north and west. The influence of 'Thracian' iron metallurgy is demonstrated by the swords of Bulgarian type

[52] For a distribution map of hoards in the Early Iron Age (Ha C), see Westhausen 2019: 284 fig. 4.

from Slovenia (Škocjan), Moravia (Brno-Obřany, Figure 52: 1), and possibly Moldavia (Slobozia).[53] The widespread popularity of the two-looped arched fibulae in the Balkans, which were popular after the triangular two-looped fibulae, can also be understood as a reflection of the influential role of Thrace at the Bronze/Iron transition.[54]

[53] See Chapters 6, 8 and 9.
[54] See the classic study by Stane Gabrovec 1970.

List 5.1. Iron triangular two-looped fibulae with three beads on the bow (Figure 21).

Romania

Revărsarea (jud. Tulcea), Dealul Tichileşti: Jugănaru et al. 2004: 137 fig. 1: 7.

Bulgaria

Angel Voivoda (Haskovo Oblast): information kindly provided by Stanislav Iliev (Haskovo) and Georgi Nekhrizov (Sofia).
Dolna kula (Kardzhali Oblast): information kindly provided by Georgi Nekhrizov (Sofia).
Gradina (Plovdiv Oblast): information kindly provided by Elena Bozhinova (Plovdiv); see Bozhinova 2008: 48 note 39.
Hlyabovo (Haskovo Oblast), Dolmen 2: Gergova 1987: 38 cat. no. 108-109; pl. 8: 108.109.
Kamen Rid (Malak Porovets, Razgrad Oblast): Gergova 1986: 22 fig. 10: a.b; Stoyanov 1997: 74 cat. no. 8; 73 fig. 1: 8.
Lisi vrah (Shumen Oblast): Atanasov 2002: 47 fig. 2: 26.
Lyulyakov Grad (Razgrad Oblast): Stoyanov 1997: 75.
Nova Zagora vicinity: Gergova 1987: 38 cat. no. 110; pl. 8: 110.
Pchelari (Haskovo Oblast): Nehrizov 1994: 8 fig. 5.
Progled (Smolyan Oblast): Gergova 1987: 38 cat. no. 107; pl. 8: 107; Damyanov 2002: 145 fig. 18; Stoyanov and Borislavov 2018: 292 fig. 5.
Sboryanovo (Razgrad Oblast): Stoyanov 1997: pl. 18: 127.128.
Stambolovo (Haskovo Oblast), tumulus II, Grave 2: Nehrizov 2009: 267 fig. 1: 3.
Yagodina (Smolyan Oblast): Kisyov 1988: 26 fig. 11.
Zhelezino (Haskovo Oblast): Nehrizov and Mikov 2002: 77.

Greece

Kossynthos (Western Thrace), Pithos Grave 2: Triandaphyllos and Kallintzi 1998: 18 fig. 6.
Roussa, Dikella (Thrace): Triandaphyllos 1980: 155 fig. 13: 6.

Bosnia

Debelo brdo (near Sarajevo): Fiala 1896: 63 fig. 176.

List 5.2. Iron flange-hilted swords in the eastern Balkan Peninsula (Figure 24).

Bulgaria

Aleksandrovo (Lovech Oblast): L. 68.5 cm (Mus. Lovech, inv. no. OF.247); Kalchevska et al. 2017: 378 fig. 2; Alexandrov et al. 2018: 552 cat. no. 589.
Barkach (Pleven Oblast): Lazarova 1987: 11; pl. 1: 1.
Borino (Smolyan Oblast), Tumulus 1: Kisyov 1991: 2 fig. 2.
Gorsko Slivovo (Lovech Oblast): two examples, information kindly supplied by Maya Dimitrova (Regionalen Istoricheski Muzey, Lovech).
Haskovo district: L. 73.9 cm (Mus. Haskovo, inv. no. A.4586); Petrov 2006; Alexandrov et al. 2018: 552 cat. no. 588.
Hlevene (Lovech Oblast): L. 61.6 cm (Mus. Lovech, inv. no. NSF.169); Valentinova 2006; Kalchevska et al. 2017: 378 fig. 3; Alexandrov et al. 2018: 552 cat. no. 590.
Novo Selo (Plovdiv Oblast): Kisyov 2004: 12; pl. 3: 1; Konova 2020: 156 fig. 2: 1.
Omarchevo (Sliven Oblast): Detev 1960: 356 fig. 18.
Palamartsa (Targovishte Oblast): two examples, L. 49.3 cm and L. 58.4 cm (Mus. Popovo).
Popovo (Yambol Oblast): Popov 1929: 289 fig. 156.
Topchii (Razgrad Oblast): L. 58.7 cm (Mus. Razgrad, inv. no. P3.200); Chlenove 1930: 12 fig. 4a.
Trigrad (Smolyan Oblast): Delchev et al. 2005: 17 fig. 2.31.
Troyan (Lovech Oblast), Turlata, Tumulus 4: L. 51.6 cm (Mus. Troyan, inv. no. AMI.62); a second iron sword was found at a distance of 250 m from Tumulus 4; Totevski 1991: 4-5; Valentinova 2010: 145 fig. 1: v (kantharos from Tumulus 4); Hristov 2019: 50 cat. no. 22.
Unprovenanced (private collection), two examples: Torbov 2018: 6 cat. no. 2; 7 cat. no. 3; 8 cat. no. 4; Torbov 2020: 9; pl. 1: 1.

Greece

Agrosykia (Central Macedonia), Grave Γ: Chrysostomou et al. 2007: 260 fig. III.10: 1; 277 fig. III.A: 2.
Amphipolis (Eastern Macedonia), Kastas Tumulus, two examples: Chalazonitis 2017: 289-292.
Drama (Eastern Macedonia), Tumulus C, two examples: Chalazonitis 2017: 294-296.
Kossynthos (Western Thrace), Grave 1: Triandaphyllos and Kallintzi 1998: 17 fig. 2.
For Aghios Panteleimon (nine examples) and Vergina (at least 18 examples), see Chapter 4.4.

Republic of North Macedonia

Milci (Gevgelija Municipality), Graves 7 and 56: Georgiev 1984: 68 fig. 6: D; Mitrevski 1991: 152 pl. 1: 2.
Visoi, Beranci (Bitola Municipality), Tumulus I, Grave III: Kilian 1975: pl. 60: 8; Papazovska 2018: 94 fig. 2; 96; 97 fig. 5.

Chapter 6
The area north of the Black Sea

The area to the east of the Carpathian Mountain range and north of the Black Sea is the next case-study for the spread of iron metallurgy.[1] The subject of early iron was first treated comprehensively by Boris Grakov in 1958, and Boris Shramko subsequently published a number of important studies.[2] In his monograph on the north-western Caucausus region, Vladimir Erlikh also reviewed the relevant iron finds north of the Black Sea.[3] Important regional studies have been published by Sergiy Pankov on the introduction of iron in Ukraine, and by Maya Kashuba on the region between the Carpathians and the Dnister.[4] The subject was also discussed in my article on early iron in southern Europe, published in 2017.[5] However, since then a major study has appeared by Maya Kashuba et al. which offers a much better foundation for an evaluation of the question.[6]

The earliest iron artefacts appear in the Early Bronze Age Yamnaya (Pit Grave) culture, and date to ca. 2850-2600 BC. The grave from Boldyrevo, with a bimetallic (copper and iron) axe/chisel, an iron awl, an iron disc and fragments of a possible dagger is most important.[7] Scientific analyses were able to demonstrate that the bimetallic axe/chisel and the awl were made of meteoritic iron. Another bimetallic object with an iron point has been found in a grave from Tamar-Utkul', but in this case the iron has not yet been analysed.[8] Both of these graves are located in the steppe in the south of Orenburg Oblast, close to the border with Kazakhstan. In the Catacomb culture (ca. 2500-2200 BC), a dagger blade was found in a grave from Bichkin-Buluk in Kalmykia.[9] In this case, analysis revealed a nickel content of 3.65%, suggesting that this artefact was also made of meteoritic iron. The 'dagger' with a copper tang from Gerasimovka (Belgorod Oblast), dated to the Middle Bronze Age, has been the object of much discussion; however, it now seems uncertain whether the blade of the 'dagger' was made of metallic iron.[10]

In summary, according to the latest research, iron artefacts were extremely rare during the Early and Middle Bronze Age: following the critical revision by Kashuba et al., iron was only contained in three grave finds from the steppe between Kalmykia and Orenburg. These exceptional finds show that meteoritic iron was known in the Yamnaya and Catacomb cultures, and in the case of Boldyrevo the iron artefacts come from an elaborate 'élite' grave and seem to have been highly valued. This recalls the situation in the Near East, where rare artefacts made from meteoritic iron are found in high-status graves of the later 4th and mid-3rd millennium BC, for example from El-Gerzeh (Egypt), Ur (southern Mesopotamia) and Alaca Höyük (central Anatolia).[11]

The new study by Kashuba et al. has also helped clarify the question of iron finds in the Late Bronze Age. Iron objects have been reported from the Srubnaya (Timber Grave), Sabatinovka and Trzciniec-Komarov cultures. The unclear chronology of these contexts represents a major problem: the cultures existed for much of the Late Bronze Age, from the 19th/18th to the 13th century BC, and in some cases continued

[1] The author is grateful to Nikolaus Boroffka (Berlin), Yakov Gershkovych (Kyiv) and Maya Kashuba (Saint Petersburg) for their generous help during the preparation of this chapter.
[2] Grakov 1958. — See, for example, Shramko 1981. — See also the study by Jozef Bátora (2005) on the iron finds of the 3rd and 2nd millennia BC in eastern Europe.
[3] Erlikh 2007: 14 ff.
[4] Pankov 2014. — Kashuba 2013.
[5] Pare 2017.
[6] Kašuba et al. 2019; the study is accompanied by a comprehensive and systematic database: see Kashuba and Kulkova 2021: 118-145.
[7] Kašuba et al. 2019: 164-168; Kashuba and Kulkova 2021: 118 f. cat. no. 1-6.
[8] Kashuba and Kulkova 2021: 118 f. cat. no. 8.
[9] Kašuba et al. 2019: 168-173; Kashuba and Kulkova 2021: 120 f. cat. no. 13.
[10] Kašuba et al. 2019: 168-173; Kashuba and Kulkova 2021: 120 f. cat. no. 14.
[11] See Chapter 2.2.

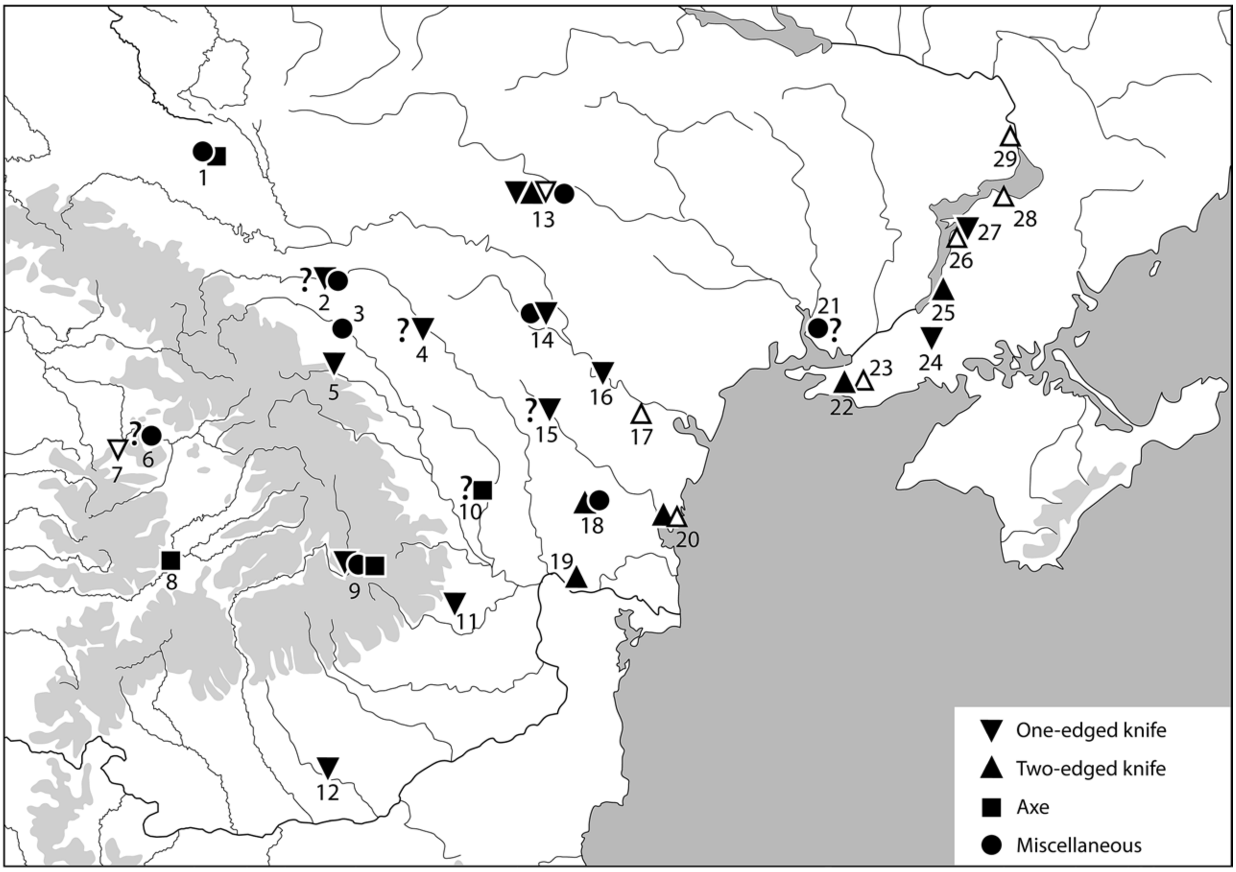

Figure 26. Distribution map of iron finds dating to the 11th-10th century BC from Romania, the Republic of Moldova and Ukraine. Bimetallic knives are marked with an empty triangle. — 1 Nedilyska. — 2 Mahala. — 3 Lozna. — 4 Truşeşti. — 5 Grăniceşti. — 6 Câţcău. — 7 Hida. — 8 Teleac. — 9 Cernat. — 10 Bârlad. — 11 Cândeşti. — 12 Meri. — 13 Hordiivka. — 14 Saharna. — 15 Hansca. — 16 Pohrebea. — 17 Hadjillar. — 18 Cazaclia. — 19 Budurzhel. — 20 Kochkuvate. — 21 Mikolaiv. — 22 Obloi. — 23 Zburivka. — 24 Brylivka. — 25 Kairy. — 26 Mala Lepetykha. — 27 Pervomaivka. — 28 Zapovitne. — 29 Mala Khortytsia.

into the 12th/11th century BC.[12] The other major problem is that many of the iron objects come from settlement excavations and lack a documented context.

In all, 12 iron awls and three iron knives have been reported from Late Bronze Age sites. Kashuba et al. believe that they represent initial experiments by blacksmiths, manufacturing small objects with simple shapes, probably towards the end of the Late Bronze Age.[13] However, in the case of the Srubnaya culture this seems very doubtful. The finds (six awls and two knives) come from settlements in Voronezh Oblast, where early iron finds are unknown in the subsequent 'Transitional' period (ca. 1050-800 BC). This makes the 'experimental phase' in the late Srubnaya culture unconvincing, because it evidently did not lead to the establishment of a local tradition of iron production.[14] Two awls have been reported from a settlement and a grave of the Sabatinovka culture, and four further awls or pins have been found in graves of the Trzciniec-Komarov culture. Some of the latter graves apparently date to the 12th or 11th century BC.[15]

[12] Kašuba et al. 2019: 173 ff.
[13] Kašuba et al. 2019: 196; 198.
[14] Kašuba et al. 2019: 199 f. — In previous discussions of early iron, a stone cist grave from Bryanka (Luhansk Oblast), with an iron knife, has often been assigned to the Srubnaya culture. However, it seems that the context is uncertain as there is no precise documentation about the excavation. See Kašuba et al. 2019: 175.
[15] Kašuba et al. 2019: 178.

The supposed iron finds from the settlements of the Late Bronze Age should be treated with great caution, indeed scepticism. Most of the artefacts are awls or similar 'implements' which could be later intrusions, i.e. ancient, medieval or modern nails. As our discussion will show, iron artefacts from well-dated and reliable contexts are first encountered in the 11th century BC. Although the possibility cannot be excluded that craftsmen occasionally succeeded in manufacturing iron awls during the Late Bronze Age, before the 11th century BC, at present the evidence is not compelling.

The early iron finds of the Final Bronze Age will now be reviewed. The most important sites are shown on a map (Figure 26) and references are provided in List 6.1.

6.1 The Bilozerka culture

During the Final Bronze Age, the Pontic steppe was occupied by the Bilozerka culture, reaching westwards as far as the southern part of the Republic of Moldova, the Budzhak, and the mouth of the Danube.[16] In recent research publications, the Bilozerka culture is normally assigned to the time-span between ca. 1200 and ca. 900 BC, and the contexts with iron objects apparently belong to the later stage of the culture (mid-11th to 10th century BC).[17] The following iron finds have been found in graves and settlements: five two-edged knives; six bimetallic two-edged knives; three one-edged knives; one fibula; and one awl (see List 6.1).[18] With their short lengths and rounded points, the tanged two-edged blades (e.g. Figure 27: 1-5) are interpreted as cutting implements (knives) rather than stabbing weapons (daggers).[19] In the Bilozerka culture it was customary to use two-edged rather than one-edged cutting implements.

The great majority of iron artefacts were found in graves; only two objects come from settlements (at Mala Khortytsia and Mikolaiv, 'Diky Sad').[20] Taken together, iron was found in 12.5% of all Bilozerka graves containing metal grave furnishings.[21] The proportion of iron compared to bronze is greater in the case of knives: ca. 20% of all the knives known from settlements and graves are made of iron. The special status of knives is also demonstrated by the analysis of the metal finds of the Bilozerka culture by N.I. Nikitenko. Nikitenko provides a very useful survey of all the various artefacts (tools, weapons, jewellery, etc.) which have been recorded from settlements, cemeteries and hoards of the Bilozerka culture.[22] It transpires that while bronze was used for the full range of tools, implements, weapons and ornaments, iron was used almost exclusively to manufacture one-edged and two-edged knives. And the proportion of iron to bronze is even larger in the case of knives found in graves: of the 37 knives found in Bilozerka burials, no less than 14 were made of iron, i.e. 35% of the total number.[23] There was clearly a preference for providing iron knives as grave furnishings.

Only three one-edged iron knives are presently known from the Bilozerka culture, and they are regarded either as evidence of influence from the Carpatho-Danubian region, or even as imports.[24] This interpretation fits well with the majority opinion among Ukrainian and Russian scholars, that the iron technology of the Bilozerka culture was derived from the Carpatho-Danubian zone, and specifically

[16] For an introduction to the Bilozerka culture, see Vančugov 1996.

[17] For radiocarbon dates from the cemeteries of the Bilozerka culture at Zapovitne und Kochkuvate, see Ignaczak and Ślusarska-Michalik 2003; Otroshchenko 2003. — A wooden bowl from Hadjillar, Tumulus 1, Grave 3 (also containing a bimetallic two-edged knife) has yielded a 2-sigma ^{14}C-date of 1375-1131 BC; note that this date is probably subject to the old wood-effect. See Kashuba 2021: 370.

[18] See also Kashuba and Kulkova 2021: 122 ff. cat. no. 30-41: 138 ff. cat. no. 144-147.

[19] Nikitenko 1998: 44; Dergačev 2002: 129 f. — Bochkarev and Kashuba (2018: 67) refer to the two-edged knives as "commonplace table knives".

[20] Metallographic analysis of the awl from 'Dikiy Sad' revealed traces of martensite, showing that the iron had been subjected to thermal treatment (quenching). This might possibly indicate that the awl is a later intrusion, and does not belong to the Bilozerka settlement. See Kasuba et al. 2019: 188 note 194.

[21] Nikitenko 1998; Erlikh 2007: 21.

[22] Nikitenko 1998: 43 table 2.

[23] Bochkarev and Kashuba 2018: 67. — Bochkarev and Kashuba (2018: 68) also suggest that the whetstones found in late Bilozerka burials are a sign of the importance of the new metal.

[24] From Brylivka, Pervomaivka and Pohrebea. — See for example Nikitenko 1998: 41; Dergačev 2002: 179; Erlikh 2007: 19.

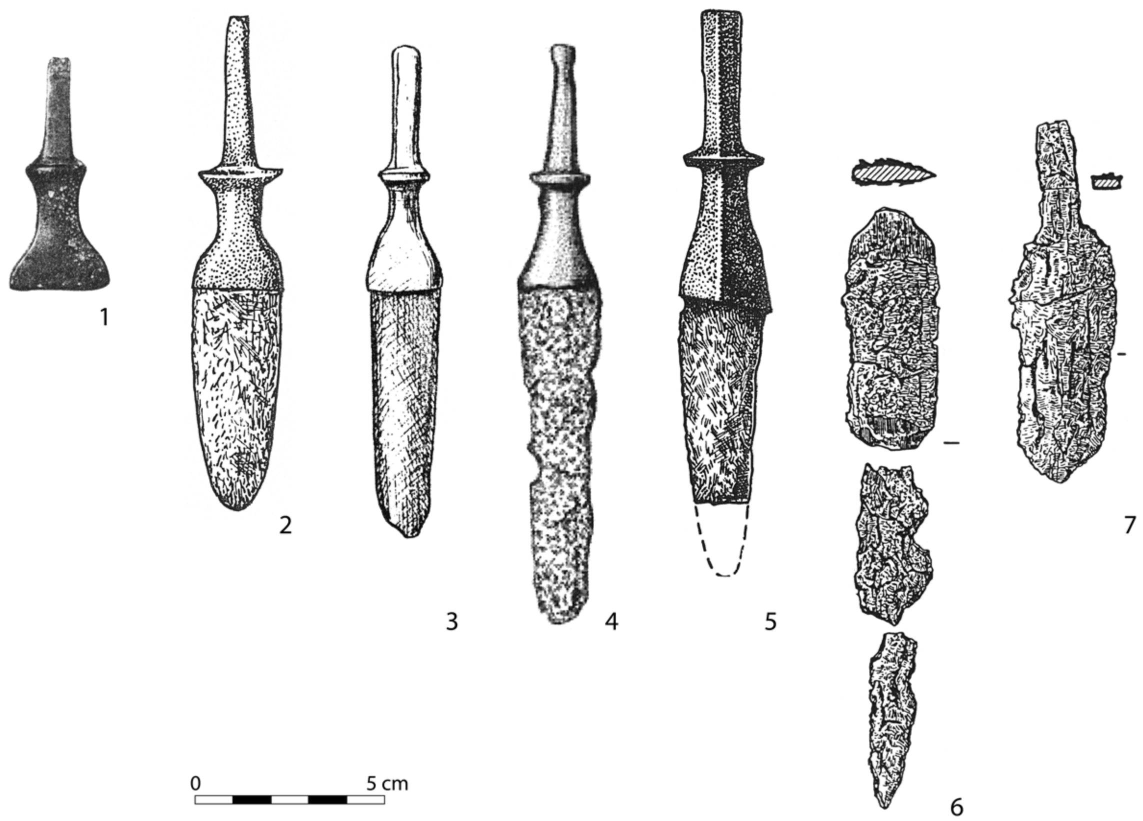

Figure 27. Bimetallic (1-5) and iron (6-7) two-edged knives from the area north of the Black Sea. — 1 Zburivka, Kherson Oblast (after Otchet 1903: 155 fig. 310). — 2 Zapovitne, Zaporizhzhia Oblast (after Bidzilya et al. 1983: fig. 4: 2). — 3 Kochkuvate, Odessa Oblast (after Vanchugov et al. 1992: 26 fig. 8: 6). — 4 Hadjillar, Ştefan vodă raion (after Agulnikov 2008: 42 fig. 3: 2). — 5 Mala Lepetykha, Zaporizhzhia Oblast (after Bidzilya et al. 1983: fig. 4: 1). — 6-7 Hordiivka, Vinnytsia Oblast, Tumulus 32 and 37 (after Berezanskaya and Klochko 1998: pl. 61: 3; 73: 2). — Scale 1:2.

Transylvania.[25] However, this theory does not appear convincing, considering that iron artefacts were still very rare in the regions west of the Carpathian Mountains before the mid-10th century BC (see Figure 26, and Chapter 9.1).[26]

In an alternative theory, a crisis in the bronze supply supposedly led to the autochthonous development of iron metallurgy in the Bilozerka culture.[27] According to this idea, the crisis in the bronze supply is indicated by the general decline in the number of bronze artefacts in the later part of the Bilozerka culture, and the fact that the practice of bronze hoarding almost completely ceased in the late Bilozerka phase (Bochkarev's Metalwork Stage VII).[28] The crisis, and the consequent necessity to procure an alternative metal, supposedly led to the development of a discrete 'East European' tradition of iron metallurgy. As we have seen, there is no compelling evidence for experimentation with iron production before the 11th century BC. This means that the technology of iron smelting would have to have been

[25] See for example Erlikh 2007: 19; 24; Kashuba 2013: 236; 252; Kashuba 2021: 373; Bochkarev and Kashuba 2018: 73 ("... iron appeared in the Danube-Carpathian region 1–1.5 centuries earlier than in the Northern Black Sea region. These data as well as many others allow us to assert that the skills of iron production in the Northern Black Sea region were inspired by a Danube-Carpathian influence.").

[26] This weakness of the 'Carpatho-Danubian' theory is acknowledged in Kašuba et al. 2019: 200.

[27] Nikitenko 1998; Erlikh 2007: 20; 24; Kashuba 2021: 371.

[28] Nikitenko 1998: 38; Bochkarev and Kashuba 2018: 59.

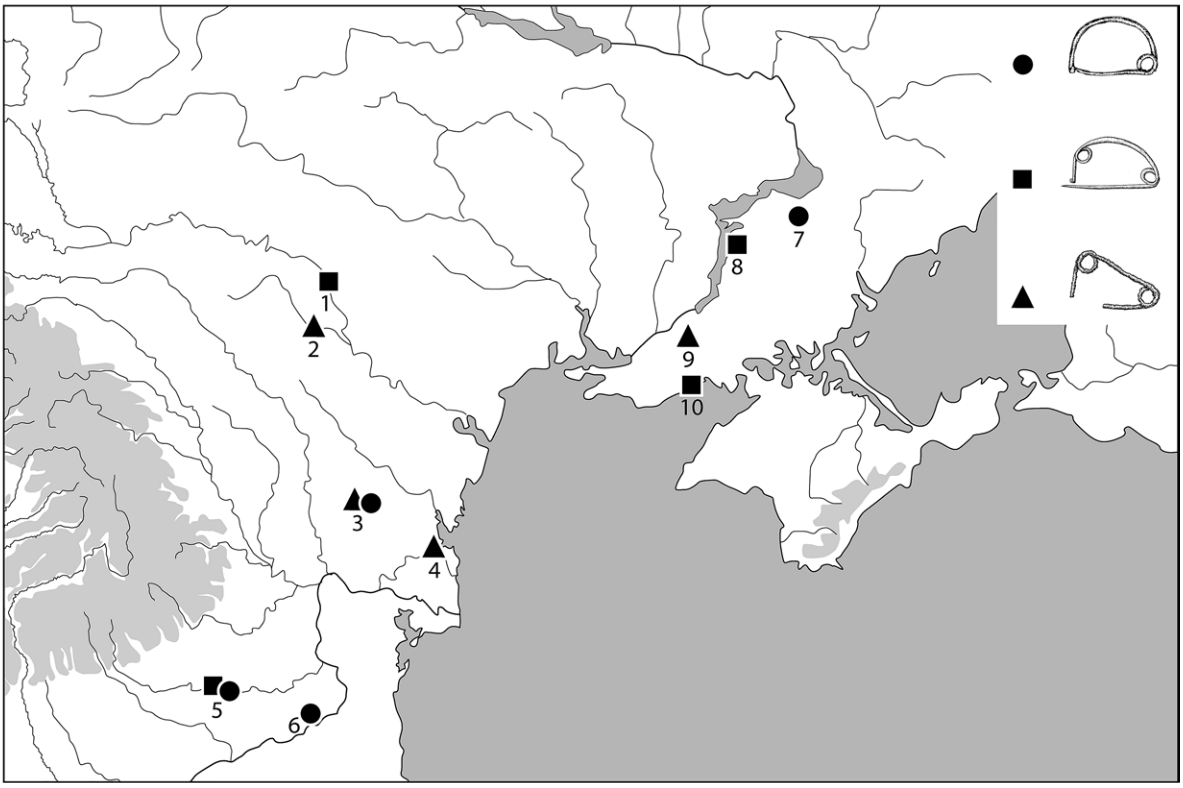

Figure 28. The earliest fibulae in the area north-west of the Black Sea. — 1 Saharna. — 2 Lucaşeuca. — 3 Cazaclia. — 4 Strumok. — 5 Dridu. — 6 Coslogeni. — 7 Zapovitne. — 8 Pervomaivka. — 9 Lukyanivka. — 10 Shyroke.

spontaneously invented, around the mid-11th century BC, in order to manufacture iron substitutes for the bronze artefacts which were no longer available. This scenario does not seem plausible.

Another explanation appears to be more likely: iron was introduced in the context of contacts along the coast, linking the North Pontic steppe to the lower Danube, eastern Bulgaria and – ultimately – the Aegean. In this case, the importance of bronze would have declined just at the time when iron was introduced. According to this scenario, the 'depreciation' in the value of bronze, and the decline in the number of bronze objects deposited in graves and hoards, could have been caused by the introduction of the new metal.

Iron was probably introduced at approximately the same time – around the second half of the 11th century BC – in the Bilozerka culture, in Dobrudja and in eastern and southern Bulgaria. For this reason, it is likely that knowledge of the new metal was transmitted to Ukraine, during the 11th century BC, by seafarers travelling and trading along the western and northern Black Sea coastlines. Indeed, there is some further evidence for innovations reaching the North Pontic steppe at this time, including the introduction of the first fibulae, and the beginning of the so-called 'Bilozerka School' of glass production.

The earliest fibulae in the Bilozerka culture have been discussed in an important study by Maya Kashuba.[29] The three early fibula variants show that the regions north-west of the Black Sea were part of a communication network linked to the Lower Danube, eastern Thrace and ultimately the Mediterranean (Figure 28).[30] Kashuba distinguished between two variants of the two-looped fibulae. The older variant,

[29] Kašuba 2008.

[30] For the fibulae shown on the distribution map, see: Saharna, Tumulus 3, Grave 1 and Tumulus 4, Grave 1: Kašuba 2008: 201 fig. 9: 14.20. — Lucaşeuca: Kašuba 2008: 202 fig. 10: 1. — Cazaclia, Grave 1: Kašuba 2008: 197 fig. 5: 9. — Cazaclia, Grave 14: Kašuba 2008:

with steep and straight bow, is very similar to comparable fibulae from central and northern Italy and from the region around the Iron Gates.[31] According to these parallels, the examples from graves of the Bilozerka culture at Cazaclia, Lukyanivka and Strumok should be assigned to the 11th century BC, corresponding to *Bronzo Finale* 2 in north Italy.[32] The second fibula variant, found at Pervomaivka and Shyroke, has a curved and less steeply sloping bow, and is considered to be a local development, probably dating to the 10th century BC. The case of the triangular two-looped fibulae shows how new fashions were quickly transmitted. As explained in Chapter 5.2, these fibulae became extremely popular in eastern and southern Bulgaria, and an example even reached Hama in Syria (Figure 20: 1). While the simple arched fibulae from near the mouth of the Danube at Coslogeni and Dridu are closely similar to Aegean Submycenaean and Early Protogeometric examples, the arched fibulae of the Bilozerka culture from Cazaclia and Zapovitne are local derivations.[33]

Anatoly Ostroverkhov drew attention to the numerous small blue glass beads found in graves of the Bilozerka culture.[34] It is significant that they were made using a 'mixed-alkali' recipe (so-called LMHK glass), which was used for the large-scale production of glass at Frattesina in northern Italy.[35] Beads made using the same recipe were found in graves from Elateia (Phocis) and Thasos, which may have been imported from northern Italy. Although it is presently uncertain whether the glass beads of the Bilozerka culture were imported, or whether the glass was made locally in Ukraine using the new LMHK recipe, either way, the beads show the existence of trade linking the North Pontic steppe, the Lower Danube and the Aegean. As explained in Chapter 4.3, iron artefacts have been discovered in contexts of the 11th century BC both at Elateia and at Thasos, and this obviously suggests that knowledge of iron reached the Bilozerka culture in the context of the same exchange relationships which brought the 'mixed-alkali' glass technology to the North Pontic steppe.

It is certain that iron artefacts were manufactured in the Bilozerka culture. This is shown by the iron two-edged knives (particularly the bimetallic examples), which imitate the typical local bronze two-edged knife varieties.[36] However, it is impossible to be certain whether they were made from 'raw' material which was imported in the form of billets, or from iron smelted from local ores north of the Black Sea. As no traces of smelting (furnaces or slag) have yet been discovered, it is impossible to say when a true transfer of technology took place.

6.2 The Hordiivka cemetery

The cemetery of Hordiivka (Vinnytsia Oblast) is especially important for the question of the introduction of iron in the area north of the Black Sea.[37] The cemetery is generally assigned to the Belogrudovka culture of the forest steppe, but in many respects it is exceptional. The inhumation burials were housed in rectangular wooden chambers and covered by large tumuli. The best preserved, Tumulus 41, survives with a diameter of 50-55 m, and a height of 5 m. Unfortunately, the excavators found that many of the tumuli had been plundered, including all the graves containing iron objects. Nevertheless, Hordiivka is renowned for the large quantity of elaborate grave furnishings, particularly of gold and amber.[38]

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198 fig. 6: 2. — Strumok: Kašuba 2008: 200 fig. 8: 8. — Dridu: Enăchiuc 1995: 302 fig. 7: 7.8. — Coslogeni: Neagu and Basarab Nanu 1986: 127 fig. 24. — Lukyanivka: Kašuba 2008: 195 fig. 2: 7. — Zapovitne/Sovchoz Stepnoe: Kašuba 2008: 197 fig. 5: 2. — Shyroke: Kašuba 2008: 195 fig. 3: 5. — Pervomaivka: Kašuba 2008: 196 fig. 4: 2.

31 See Kašuba 2008: 195 fig. 2: 2; 198 fig. 6: 2; 200 fig. 8: 8. — For the Iron Gates region see, for example, Vasić 1999: pl. 2: 19 (Korbovo).

32 The north Italian phase *Bronzo Finale* 2 dates to ca. 1060-1035/1010 BC. See Pare 2008b.

33 The introduction of the arched fibula with unthickened bow to Transcaucasia around the mid-11th century BC is discussed in Chapter 7.1.

34 Ostroverkhov 2002: 408 fig. 15; see also Kaiser and Kashuba 2016.

35 See for example Venclová et al. 2011: 568 fig. 1.

36 The Novo-Aleksandrovka, Vasil'evka, und Kardashinka knife variants; see Dergačev 2002: 128 ff.

37 For the Hordiivka cemetery, see Berezanskaya and Klochko 1998; Klochko 2011. See also Kašuba et al. 2019: 178 f.; Kashuba and Kulkova 2021: 124 f. cat. no. 42-47.

38 No less than 1,500 amber beads were found in the Hordiivka cemetery. — An impression of the splendour of the grave furnishings is provided by the colour photographs in Klochko 2011: 161 ff. ('Photoalbum').

Iron finds were discovered in five graves at Hordiivka: the handle of a large knife in Tumulus 5, Grave 1; a tanged two-edged knife and an awl from Tumulus 32, Grave 2; a one-edged knife fragment with a decorated gold cuff from Tumulus 35; a tanged two-edged knife from Tumulus 37; and a bimetallic one-edged knife from Tumulus 38.[39] According to the chronological study of the cemetery by Carola Metzner-Nebelsick, the graves from Tumulus 5 and 38 belong in the 11th century BC, the other three graves (Tumulus 32, 35 and 37) are assigned to the 10th, or perhaps the early 9th century BC.[40]

As mentioned above, the Hordiivka cemetery has an exceptionally large collection of amber beads. Among them, the beads of the Tiryns and Allumiere types from Tumulus 31 and 38 deserve to be highlighted, as beads of this type are otherwise known mainly from the central Mediterranean (Sardinia, northern Italy, north-eastern Adriatic Sea), but also from the Peloponnese, the Aegean, and even the Levantine coast.[41] Furthermore, some of the other amber beads from Tumulus 31 and 38 have parallels in Romania.[42] The huge quantity of amber beads at Hordiivka can surely be explained by its location close to the right bank of the Southern Bug river. The importance of this river (Greek: Hypanis) as a trading route is indicated by the foundation by Miletus of a major colony, Oblia, at the mouth of the river. Hordiivka must have had a crucial role in the amber trade. The amber presumably came from the Baltic Sea, following a route along the Western Bug, and then crossed the watershed to reach the Southern Bug.

It can hardly be a coincidence that beads of 'mixed-alkali' (LMHK) glass have frequently been found at sites with amber beads of Tiryns/Allumiere type, for example at Frattesina, Hauterive-Champréveyres, Elateia, and Thasos. This correlation between the amber beads and 'mixed-alkali' glass is highly significant, and must be an expression of trading contacts within the Central and East Mediterranean, and also passing along the Sava and Lower Danube rivers and reaching the northern coastline of the Black Sea. Indeed, Hordiivka evidently played an important role in this exchange network. The small blue glass beads found in Tumulus 35 and 37 were doubtless imported from the Bilozerka culture; although they have not yet been analysed, they were probably made with the 'mixed-alkali' recipe typical for the 'Bilozerka school' of glass production.[43] The glass beads from Hordiivka were used on necklaces (comprising gold beads, gold spiral tubes, biconical and barrel-shaped amber beads, simple beads of blue glass), which have exact counterparts in graves of the Bilozerka culture.[44] Perhaps it is significant that the three graves with blue glass beads from Hordiivka all contain iron artefacts.

For the question of the introduction of iron in the area north of the Black Sea, the bimetallic one-edged knife from Tumulus 38 is the single most interesting artefact from the Hordiivka cemetery (Figure 29: 2). The knife is 19 cm long and has a one-edged iron blade which curves downwards towards the tip. The bronze handle has four rivets and tapers slightly towards the discoidal pommel; before reaching the pommel, the handle has a circular thickening. The knife is closely related to two bimetallic knives from Thasos (Kentria, Tomb 5B; Tsiganadika, Tomb 18B), which were discussed in Chapter 4.2 (Figure 29: 1). The connection between Thasos and Hordiivka, already indicated by the amber beads of Allumiere type and the beads of 'mixed-alkali' glass, is confirmed by the bimetallic knives.

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39 Berezanskaya and Klochko 1998: pl. 7: 11; 61: 3.6; 69: 1; 73: 2; 80: 1.

40 See Metzner-Nebelsick 2005a. — For the Radiocarbon dates from the cemetery of Hordiivka, see Ślusarska-Michalik 2003; Kašuba et al. 2019: 179.

41 The geographically closest examples come from Dridu (Allumiere type), Thasos (Allumiere type) and Elateia (Tiryns type). — For a distribution map, see Pare 2008b: 94 fig. 5.13; Bellintani 2013: 787 fig. 46.1. — For the chronology of the amber beads of the Allumiere type, see Weninger and Jung 2009: 390.

42 Boroffka 2001. — For similar beads made of gold from the hoard of Hinova (jud. Mehedinţi), located a short distance below the Iron Gates, see Davidescu 1981.

43 Small blue glass beads: Berezanskaya and Klochko 1998: pl. 69: 4; 72: 6; Klochko 2011: 59.

44 Hordiivka, Tumulus 5, Grave 1, Tumulus 35 and Tumulus 37. — These jewellery elements are sometimes found in graves with early fibulae or early iron objects. With iron grave furnishings: Brylivka, Grave 47 (Evdokimov 1999: 101 fig. 2: 5.7.15.16); Pervomaivka, Tumulus 5, Grave 3 (Evdokimov 1987: 110 fig. 2: 4.6.7); Pohrebea, Tumulus 3, Grave 1 (Agulnikov and Ketraru 1992: 137 fig. 2: 3.7; Nicic 2008: 205 fig. 61: 5-8); Cazaclia, Grave 55 (Agulnikov 1996: 107 fig. 19: 3.4). With fibulae: Cazaclia, Graves 1, 14 and 55; Lukyanivka; Shyroke, Cherson Oblast; Shyroke/Alkaliya, Odessa Oblast; Zapovitne/Sovchoz Stepnoe, Tumulus 3, Grave 1; see Kašuba 2008. Among the finds from Tumulus 7, Grave 1 from Strumok there is a bronze two-looped fibula and a gold bead similar to examples from Hordiivka, Tumulus 5, Grave 1; see Berezanskaya and Klochko 1998: pl. 7: 12; Kašuba 2008: 200 fig. 8: 7.

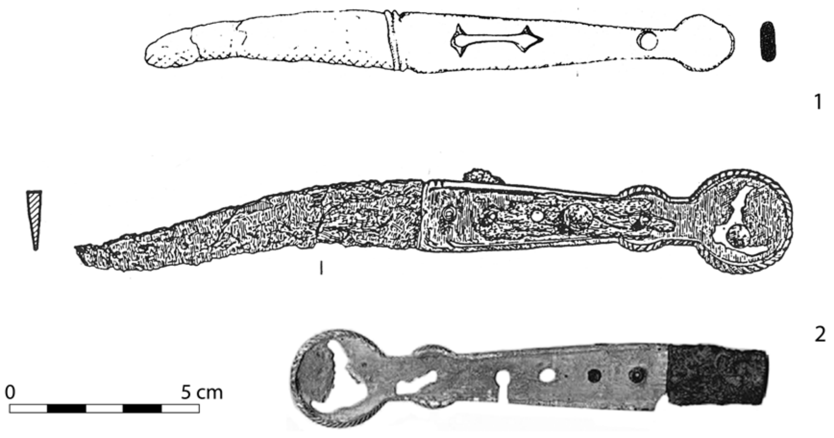

Figure 29. Bimetallic knives from Thasos (1) and Hordiivka (2). — 1 after Koukouli-Chrysanthaki 1992: pl. 109: 55. — 2 after Berezanskaya and Klochko 1998: pl. 80: 1; Klochko 2011: 179 pl. 19. — Scale 1:2.

In my opinion, it seems most plausible that these bimetallic knives, with their distinctive handles, represent imitations of large and prestigious iron knives with discoidal or ring-shaped pommels which were in circulation, presumably in the context of élite exchange, during the 11th century BC. Examples are mainly known from Cyprus and the Levant, often provided with an ivory handle (see, for example, Figure 41: 1). The knife from the rich grave at Kouvaras (Acarnania) is another prominent representative. And the large iron knife with discoidal pommel from Grave 75 at Patos (Albania) also probably belongs to this horizon of prestigious early knives (Figure 41: 2).[45] With its tapering shape and large rivets, the fragmentary knife handle from Hordiivka, Tumulus 5, resembles the bronze handle of the bimetallic knife from Tumulus 38, and probably represents the remains of a large one-edged iron knife.[46] With its bimetallic construction, the knife from Kouvaras is a particularly interesting parallel for the knife from Hordiivka, Tumulus 38.

According to the chronology published by Carola Metzner-Nebelsick, these knives from Tumulus 5 and 38 are the earliest iron artefacts from the Hordiivka cemetery, belonging to her Phase 2 (11th century BC). The fact that the bimetallic example from Tumulus 38 has a one-edged blade underlines its 'foreign' character in the North Pontic context, where two-edged cutting implements were customary during the Final Bronze Age. It is surely significant that the earliest iron artefacts from Hordiivka – the knives from Tumulus 5 and 38 – were both 'foreign' types. This strongly suggests that these knives represent the initial stage in iron use, when the first iron artefacts were imported and not manufactured locally.

Considering the close relationship between the bimetallic knives from Hordiivka and Thasos, it is most likely that the new metal reached the area of the Bilozerka and Belogrudovka cultures via exchange along the northern and western coastline of the Black Sea, and ultimately connecting with partners in the northern Aegean. Our discussion of the fibulae and the glass and amber beads revealed several links in this chain of exchange, indicated by the arched and two-looped fibulae (Dridu), the amber beads of Tiryns and Allumiere type (Dridu, Thasos, Elateia) and the blue beads of 'mixed-alkali' glass (Thasos, Elateia). It is worth emphasizing a further similarity between the cemeteries of Hordiivka and Thasos: in both cases, iron first appears in the form of bimetallic knives, perhaps at some time around the mid-11th century BC. And at Thasos, as in Hordiivka and in the Bilozerka culture, in graves of the 11th/10th century iron is found predominantly in the form of knives.

6.3 Cultures between the Dnister and the Carpathians

The cultural geography of the area between the Dnister and the Carpathian Mountains is complex, and specialists recognise a number of regional cultural groups which are of fundamental importance for an understanding of the chronological development, especially of the pottery. The early iron artefacts are registered in List 6.1.

[45] The iron knife blades from Enkomi and Tiryns illustrated in Figure 14 might also be fragments of such high-status knives.
[46] Note that the fragmentary knife handle from Tumulus 5 was found in the fill of the shaft dug when Grave 1 was plundered.

The iron finds of the Saharna (or Cozia-Saharna) culture have been discussed by Maya Kashuba in a number of recent publications.[47] Apparently, iron finds securely dated before the 9th century BC have only been discovered in the cemeteries from the eponymous site of Saharna, located on the middle Dnister in the Republic of Moldova, comprising two iron knives and two iron fibulae.[48] As noted above, the chronology of the earliest fibulae in the area north of the Black Sea has been discussed in an important study by Maya Kashuba.[49] The two-looped iron fibulae from Saharna belong to the variant with a curved and less steeply sloping bow, and probably date to around the 10th century BC.

Kashuba notes that bronze objects are surprisingly uncommon during the 10th and 9th centuries in the area of the Cozia-Saharna culture, whereas iron objects are regularly found in settlements and cemeteries. This decline in the importance of bronze should presumably be linked to the similar decline in the frequency of bronze artefacts which has been detected – possibly slightly earlier – in the late Bilozerka culture.[50]

Apart from the cemetery at Saharna, in the area between the Dnister and the Carpathians early iron finds have mainly been reported from settlements.[51] For Romanian Moldavia, the monographs dealing with the Late Bronze Age by Oleg Levițki and Attila László are particularly important for the cultural and chronological interpretation of the settlement contexts and the associated pottery.[52]

Two iron knives were found in the settlement of the Holercani-Hansca culture at Hansca, 'La Matcă' in the Republic of Moldova.[53] Iron knives are known from settlements of the Gáva-Holihrady culture at Grăniceşti and Mahala in Bukovina. As for the Corlateni-Chişinău culture, excavations at Truşeşti discovered an iron knife; an iron tongue-shaped billet was found at Lozna; and some iron fragments came to light further south at Cândeşti in Muntenia. At Cândeşti, the excavators also found an iron knife in a context assigned to the Tămăoani-Babadag I culture.

Compared to burials, the chronology of the early iron finds from settlements is much more difficult to assess, and it is necessary to rely on the opinions of archaeologists with specialist knowledge of the regional pottery traditions. According to Attila László, the iron fragments from Cândeşti and the knife from Grăniceşti could belong to the phase Ha A, and the knives from Hansca, 'La Matcă' should also be earlier than the 10th century BC, if they truly belong to the Holercani-Hansca phase of the settlement stratigraphy. The knives from Cândeşti and Truşeşti more likely belong to Ha B.[54] A date corresponding to Ha B is also likely for the iron finds from Mahala; they were found in the uppermost level of the settlement (Mahala IV), which probably lasted until the end of Ha B (Ha B2/3).[55] Owing to the uncertain chronology, several iron artefacts have a question mark on the distribution map (Figure 26).

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[47] See Kashuba 2013; Kašuba et al. 2019: 191 ff.; Kashuba 2021.

[48] Some other early iron finds from the Saharna cemeteries (two knives and one fibula) cannot be dated so precisely, and Kashuba suggests a position for them in the 10th or 9th century BC. See Kashuba and Kulkova 2021: 142 f. cat. no. 162, 164, 165. — The iron finds from the following settlements are less precisely dated, and have been assigned to the time-span between the late 11th and the mid-8th century BC: Mateuți, 'La Başnea'; Saharna Mare, 'Dealul Mănăstirii'; Țahnăuţi. See Kashuba and Kulkova 2021: 140 f. cat. no. 150-154; 142 f. cat. no. 166-171.

[49] Kašuba 2008; see also Kashuba 2013: 243 ff.

[50] Kašuba et al. 2019: 194; Kashuba 2021: 371.

[51] The iron objects from Corni and Volovăţ in the northern part of Romanian Moldavia were previously assigned to Ha A, but in my opinion without justification. See for example Boroffka 1991: 9 no. 13; 13 no. 43; László 1994: 150 f.; 207 f. — In the case of the iron knife blade in a bronze sword hilt from Corni (jud. Suceava) it is uncertain when the bronze sword hilt was re-used, this could even have taken place in the recent past. See Bader 1991: 138 f. — The iron knife from Volovăţ (jud. Suceava), tumulus 2, was found together with a bronze pin-head of the later Hallstatt period. See Ignat 1978: 110 ff. fig. 3: v; 13: 5.

[52] Levițki 1994a; László 1994. — See also the fundamental studies on the introduction of iron in Romania by Attila László, Adriana Stoia and Nikolaus Boroffka: László 1977; Stoia 1989; Boroffka 1991. — For a distribution map of early iron finds, see Kashuba 2021: pl. 16. — The author is very grateful to Prof. Attila László (Iaşi) for his generous assistance concerning the early iron finds from the Republic of Moldova and Romanian Moldavia.

[53] Note, however, that doubts have recently been expressed concerning the contexts of the knives from Hansca, 'La Matcă'. — See Kašuba et al. 2019: 181 note 138.

[54] László 1994: 150 f.; 207 f.

[55] For an introduction to the chronology of the later Gáva-Holihrady culture, see László 2013.

Although difficult to date precisely, these settlements once again reinforce the impression that knives are most frequent among the earliest iron artefacts, as also encountered in the Bilozerka culture and at Hordiivka. In these cultures between the Dnister and the Carpathians, one-edged varieties were used, and as many as seven examples could date to the 11th/10th century BC. The small knife from Tumulus 2 at Meri, in eastern Wallachia, can also probably be added to our list of early iron knives.[56] A date in Ha A is generally accepted for the typical fluted pottery from the tumulus.

The tongue-shaped billet from the settlement of the Corlateni-Chişinău culture at Lozna deserves special mention; as it has a good parallel in Transylvania, from Cernat, it will be discussed again in Chapter 9.1. Although the Lozna example cannot be precisely dated, it could well be contemporary with the find from Cernat. As iron was evidently exchanged as a raw material in the form of such billets, iron artefacts were clearly being manufactured at this time both in Transylvania and Moldavia. And as the shape of these iron billets is identical to the traditional tongue-shaped ingots of bronze or copper used in this region during the Later Bronze Age, the billets were certainly not imported from a distant source, and were presumably made from iron smelted somewhere in eastern Romania.

Hoards with early iron artefacts have been found in Moldavia (Bârlad) and in Galicia (Nedilyska). At Bârlad, in the area of the Cozia (or Cozia-Saharna) culture, two large iron trunnion axes (22.2 cm and 27.0 cm in length) came to light, which were probably deposited together with a bronze 'posamenterie' fibula and a bronze socketed axe.[57] As explained in Chapters 4.4 and 5.2, the specific type of iron trunnion axe found in the Bârlad hoard is also known from eastern Bulgaria, and it is likely that the examples from Bârlad were imported (compare Figure 19: 14).[58] The hoard is difficult to date, but considering the general similarity to trunnion axes from Late Protogeometric and Early Geometric Greece, a position for the Moldavian examples in the second half of the 10th or first half of the 9th century BC seems plausible.[59]

The hoard of Nedilyska was discovered much further to the north, near the upper Dnister, in the area of the Gáva-Holihrady culture.[60] Alongside numerous bronze objects, the hoard contains three fragments from two iron bracelets, an iron anvil and a flat iron axe. Although the 'arms' of the axe are almost completely lost to corrosion, a reconstruction similar to the trunnion axe from Leskovac, 'Hisar' in Serbia seems quite likely (Figure 44: 2).[61] The chronology of the hoard has often been discussed: while most authors prefer a date in Ha B1, in my opinion some of the objects indicate a slightly later date, probably in the mid- or second half of the 10th century BC (Ha B2).[62] If the interpretation as a small 'pyramidal' anvil is accepted, the iron example from Nedilyska is another indication – along with Cernat (Transylvania) – that blacksmiths were already active around the second half of the 10th century BC.[63] As mentioned above, the iron billet from the Lozna settlement points in the same direction. The Nedilyska hoard contains a large number of bronze artefacts, some of which were in a fragmentary condition (scrap), including socketed

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56 Nikolaus Boroffka (1991: 10 no. 24) dates the grave from Meri to Ha A; see also Lazăr 2018: 12. — However, in the specialist literature doubts have been raised concerning both the early date of the grave, and whether the iron knife originally belonged among the grave furnishings. See Schuster and Negru 2008: 48 (with references to further literature); see also Motzoi-Chicideanu 2001: 215 note 47.

57 The iron trunnion axes were found a short distance from the bronze objects of the 'hoard'; see Dietrich 2021: 656 cat. no. 2603 ("Nachuntersuchungen ergaben, dass zwei eiserne Ärmchenbeile nicht direkt bei den Bronzen lagen, was eine gleichzeitige Vergrabung jedoch nicht unbedingt ausschließt").

58 A further iron trunnion axe, belonging to a later type, forms part of a hoard found in 1955 in the defended settlement of the Chernoles culture at Subotiv (Cherkasy Oblast); it is dated to the end of the 9th century BC. — See Gershkovych 2016: 374 fig. E8: 2.

59 For different views on the chronological position of the Bârlad hoard, see for example: László 1977: 73; Bader 1983: 51; Wesse 1990: 144; Kemenczei 2005: 75 f. (socketed axe variants B and C).

60 In the literature, the hoard from Nedilyska (formerly Niedzieliska) is sometimes regarded as belonging to the Vysotska culture. See, for example, Kašuba et al. 2019: 187 f. — For Nedilyska, see also Kashuba and Kulkova 2021: 126 f. cat. no. 52-55.

61 For a discussion of the axe from Leskovac, 'Hisar', see Chapter 8. — While the Nedilyska axe is 10.5 cm long, the Serbian example has a length of 16.3 cm.

62 For the chronology of the Nedilyska hoard, see Müller-Karpe 1959: 139; von Brunn 1968: 56; Pare 1998: 364 note 129; 381 note 216; Metzner-Nebelsick 2002: 73; Tarbay 2018: 323; 335 no. 9.

63 For a study of Bronze Age anvils, including the example from Nedilyska, see Armbruster et al. 2019: 149 no. 114; 151 fig. 7: 9; 153 (pyramidal anvil/sub-class 1b).

axes, a socketed chisel, two knives, a razor, a fibula, and various ornaments. The bronze vessels in the hoard are of fine quality, and include a Jenišovice cup, a Hajdúböszörmény situla and remains of two basins with cross-shaped handle attachments.[64] These artefacts show that the community which deposited the hoard took part in élite feasting rituals, and was involved in long-distance exchange relations. Perhaps this is an indication that early iron production in this region was controlled by local élites.[65]

6.4 The Chernoles and Bondarikha cultures of the forest steppe

The Chernoles and Bondarikha cultures are important regional groups of the Ukrainian forest steppe. The early iron finds from these cultures cannot be dated precisely, and they are generally assigned approximately to the 10th/9th century BC; in the case of the Bondarikha culture some of the contexts could even be later.[66] For this reason, the iron finds from these cultures have not been included on the distribution map (Figure 26). In some cases, the quality of the excavation documentation is poor, making an interpretation of the contexts of the iron artefacts problematical. Nevertheless, it is worth drawing attention to the spectrum of finds from both cultures. Five settlements of the late Chernoles culture have produced 12 one-edged knives, one awl and one pin with a rolled head. In the case of the Bondarikha culture, four one-edged knives, one awl and one small chisel/burin were found during the excavation of five settlement sites. The interesting feature of these finds is that knives again dominate the find spectrum, with 16 examples, compared with the small number of other artefacts (one pin, two awls, one chisel/burin).

Two hoards containing iron artefacts are known from the final phase of the Chernoles settlement at Subotiv (Cherkasy Oblast), which, according to radiocarbon, dates to the end of the 9th century BC.[67] The iron objects from the hoards – a bimetallic sword and a trunnion axe – are quite different from the normal range of iron artefacts found in settlement excavations.[68]

6.5 Discussion and conclusions

As we have seen, a few very early iron artefacts dating to the 3rd millennium BC have been found in three burials of the Yamnaya and Catacomb cultures. It is most likely that the iron is of meteoritic origin, like the iron objects in the 'royal tombs' from Alaca Höyük in Anatolia, which are of similar date. Otherwise, there is no compelling evidence for the use of iron in the area north of the Black Sea before the 11th century BC. A number of small iron artefacts, mainly 'awls', have been found in sites of the Srubnaya, Sabatinovka and Trzciniec-Komarov cultures, but these could be intrusions of much later date. There is no reliable evidence for experimentation with iron production before the end of the 2nd millennium BC, which speaks against the idea of a gradual and autochthonous development of iron metallurgy in the region.

As iron finds are as yet unknown in Transylvania before the mid-10th century BC, there is no reason to believe that the technology of ironworking reached the area north of the Black Sea from the Carpathian Basin. Instead, it is most plausible that knowledge of iron spread from the Aegean via the eastern Balkan Peninsula. This is indicated most clearly by the bimetallic knife from the cemetery of Hordiivka, which

[64] Note that remains of iron rust were found in the Jenišovice-type cup, presumably stemming from the iron artefacts contained in the hoard.

[65] The early iron finds of the Vysotska culture will not be treated in detail, as they cannot be dated with any precision. The earliest iron artefacts apparently date to the late Vysotska culture (ca. 10th-8th century BC). Three knives and one pin are known from three settlement excavations; and four knives, one pin and one button were discovered in five late Vysotska graves. See Kašuba et al. 2019: 184-187; Kashuba and Kulkova 2021: 132 f. cat. no. 96-105.

[66] Iron finds of the Chernoles culture: Kašuba et al. 2019: 33 f.; Kashuba and Kulkova 2021: 128-131 cat. no. 76-80 and 82-92. — Iron finds of the Bondarikha culture: Shramko and Buinov 2012; Kašuba et al. 2019: 181 f.; Kashuba and Kulkova 2021: 126-129 cat. no. 60-64 and 68-71. — The iron knife fragment from the settlement at Lyubivka (Kharkiv Oblast) is apparently especially early, and should date to the 10th century BC; perhaps it is significant that the Lyubivka settlement is located further south than the other Bondarikha sites.

[67] See Kločko et al. 1998.

[68] Bimetallic sword (from hoard 1) and iron trunnion axe (from hoard 4): Gershkovych 2016: 368 fig. E2: 1; 374 fig. E8: 2.

is related to examples from the north Aegean island of Thasos (Figure 29). Around the mid-11th century BC, prestigious iron knives were in circulation, probably as high-status gifts. The exchange network evidently reached as far as Kouvaras (Acarnania) in the west and Hordiivka in the east. The existence of this network of long-distance exchange relationships is also indicated by other finds, including amber and glass beads and fibulae.

In the earliest stages of iron use, it is quite likely that iron billets or iron artefacts, such as one-edge knives, were imported to the area north of the Black Sea. However, certain fibulae and the two-edged knives, which belong to typological variants characteristic for the area north of the Black Sea, show that iron objects were already manufactured locally in the Saharna and Bilozerka cultures by ca. 1000 BC, which appears to be similar to the situation in Thrace. In the area between the Dnister and the Carpathian Mountains it is difficult to date the settlement contexts of the earliest iron artefacts. However, judging from the hoards from Cernat (Transylvania) and Nedilyska (Galicia), blacksmiths were active there by the mid-10th century BC. Iron seems to have been introduced to the regions east of the Dnipro relatively late: in these regions, reliably dated iron finds first appear in the 9th century BC.[69]

It is worth summarizing the spectrum of early iron finds discussed above from the cemeteries and settlements in the area between the Carpathians and the Dnipro (Figure 26). In all, 13 iron or bimetallic two-edged knives and 10 one-edged knives are securely dated before the 9th century BC; in the case of six further examples, the chronology of the settlement contexts is less reliable. Taken together, at least 23 and possibly as many as 29 knives count among the earliest iron artefacts. Jewellery is much less common, comprising three fibulae, and one ring. The spectrum of iron finds from the late Chernoles and Bondarikha cultures, from ten settlements in the forest steppe probably dating to the 10th/9th century BC, is surprisingly similar, comprising 16 one-edged knives, two awls, one chisel/burin and one pin.

From this summary of the published iron finds, it would be easy to draw the conclusion that the blacksmiths in the area north of the Black Sea were mainly occupied with producing knives, and only occasionally made other artefacts – such as items of jewellery and small implements such as awls. However, the archaeological sources must be treated critically. Note that the spectrum of iron artefacts is completely different in the case of the hoards (Bârlad, Cozia culture; Nedilyska, Gáva-Holihrady culture; Subotiv, Chernoles culture): four axes, one bimetallic sword, one small anvil and two bracelets. It must be significant that there is absolutely no overlap between the find spectrum of the hoards and the spectrum from the graves and settlement contexts. The obvious conclusion is that the three archaeological sources (graves, settlements, hoards) each provide only a partial insight into the usage of iron.

In the case of the Bilozerka culture, it is certainly true that the grave furnishings only represent a very restricted selection of metalwork. The large cemetery of Shyroke (Kherson Oblast), which has recently been published, is a good example: the graves only contain a small number of metal objects, mainly simple items of jewellery, which can hardly be a true reflection of the metalwork which was available and in use.[70] Even in the Chernogorovka culture, the grave furnishings still include a very restricted selection of iron artefacts during the 9th century BC: mainly knives, some daggers, and one awl.[71] The rich grave from Slobozia, in the Republic of Moldova, which probably dates to the second half of the 9th century BC, is exceptional, with its iron flange-hilted sword probably imported from Greece or Bulgaria, and two conical iron ornaments.[72]

The obvious conclusion to be drawn from this brief summary is that the metallic grave furnishings do not provide a realistic reflection of the true spectrum of iron artefacts in circulation between the 11th

[69] Kašuba et al. 2019: 180. — For a discussion of this question, and for the early iron objects in the Volga/Kama region (Maklasheevka culture), see Chapter 7.2.
[70] See Leskov et al. 2019.
[71] Makhortykh 2008: 110 ff.
[72] See Kašuba et al. 2019: 194 f.; Kashuba and Kulkova 2021: cat. no. 118-134 and cat. no. 172-177. — Apart from Slobozia, the database includes 21 further graves of the Chernogarovka culture dating approximately to the 9th century BC, containing: 12 iron knives, 6 or 7 iron daggers and one iron awl.

and 9th centuries BC. As we have seen, the hoards offer an important alternative source of information, providing further evidence that iron was used in the production of utilitarian implements by the second half of the 10th century BC.

While the hoards give the impression that iron already played an important role, other evidence indicates that bronze was still widely used for utilitarian implements during the 9th century BC. For example, in graves of the Chernogorovka culture, roughly half of the knives were made of bronze.[73] A hoard found very recently in the southern part of Kherson Oblast provides another tantalizing insight into the role of bronze and iron at the time of the transition from the Bilozerka to the Chernogorovka culture. The hoard contained the handle of a bimetallic dagger or sword of Golovyatino-Leibnitz type, together with a spearhead, two socketed axes and a socketed gouge all made of bronze.[74] In this case, the contents suggest two alternative interpretations. Considering that bimetallic daggers/swords of Golovyatino type are normally dated to the 9th or 8th century BC, the hoard could indicate that in the Lower Dnipro region, bronze was still being used as the main metal for tools and weapons after 900 BC. Alternatively, it is conceivable that bimetallic weapons of Golovyatino type were already manufactured during the 10th century BC, either locally or perhaps in the area north-west of the Caucasus.

Unfortunately, we must conclude that it is difficult to provide a more detailed reconstruction of the replacement of bronze by iron in the production of tools and weapons between the Carpathians and the Dnipro. Nevertheless, we do know that iron artefacts were manufactured locally in the area north of the Black Sea by ca. 1000 BC. And the numerous iron knives from settlements in Moldavia and in the Ukrainian forest steppe (late Chernoles and Bondarikha cultures) surely indicate that iron implements were widely available for use in daily life by the 9th century BC, if not earlier.

Iron was introduced to the Bilozerka culture at a time of radical change in the North Pontic steppe. The number of permanent settlements decreased during the 12th, 11th and 10th centuries; and there was evidently a change from a sedentary to a mobile lifestyle, as a prelude to the equestrian nomadism of the pre-Scythian period.[75] This fundamental transformation had far-reaching repercussions, and will be discussed more fully in Chapter 7.2.

[73] According to Olga Dubovskaya (1994: 25 fig. 5), 54% of the knives from crouched burials of the Chernogorovka around the Lower Dnipro and in west Ukraine are made of bronze. — According to Sergey Makhortykh (2008: 118 ff.), 42% of the knives in graves of the Chernogorovka culture in the Republic of Moldova and Ukraine are made of bronze.

[74] Klochko 2022. — Note that the place-name 'Golovyatino' is today correctly transcribed as Holoviatyne (Cherkasy Oblast). — For ca. 10 newly found bimetallic daggers/swords of Golovyatino-Leibnitz type from Ukraine, see Klochko 2020.

[75] See, for example, Machortyh and Ievlev 1992: 112-114; Metzner-Nebelsick 2003: 402 f.; 2005a: 311. — For the almost complete absence of late Bilozerka settlements, see Pieniążek 2012: 184; 186; map 8. — For climatic change during the 12th-9th century BC, see Kulkova et al. 2022.

List 6.1 Iron finds dating to the 11th-10th century BC from Romania, the Republic of Moldova and Ukraine (Figure 26).

Romania

Bârlad, jud. Vaslui, hoard: two iron trunnion axes. Petrescu-Dîmboviţa 1958: 61; 53 fig. 4; Wesse 1990: 202 no. 175-176.
Cândeşti, jud. Vrancea, settlement: iron knife and iron fragments. László 1994: 150 f.
Grăniceşti, jud. Suceava, settlement: iron knife. László 1994: 150 f.; 230 fig. 10: 1-2.
Lozna, jud. Botoşani, settlement: iron tongue-shaped billet. Teodor and Şadurschi 1981: fig. 10: 4.
Meri, jud. Teleorman, Tumulus 2: iron knife. Moscalu 1976: 80 fig. 3: 4.
Truşeşti, jud. Botoşani, settlement: iron knife. László 1994: 150 f.; 207 f.; 284 fig. 64: 9; Leviţki 1994a: 226 fig. 49: 14; 235 fig. 58: 26.
The iron finds from Transylvania shown on Figure 26 (Câţcău, Cernat, Hida and Teleac) are treated in Chapter 9.1 (and see List 9.1).

Republic of Moldova

Cazaclia, Ceadîr-Lunga raion, Grave 54: point of an iron two-edged knife. Agulnikov 1996: 106 fig. 18: 7; Kashuba and Kulkova 2021: cat. no. 146.
Cazaclia, Ceadîr-Lunga raion, Grave 55: iron fibula. Agulnikov 1996: 107 fig. 19: 4; Kashuba and Kulkova 2021: cat. no. 147.
Hadjillar, Ştefan vodă raion, Tumulus 1, Grave 3: bimetallic two-edged knife. Agulnikov 2008: 42 fig. 3: 2; Kashuba and Kulkova 2021: cat. no. 145.
Hansca, Ialoveni raion, 'La Matcă', settlement: two iron knives. Leviţki 1994b: 229; Kashuba 2000: 330; Kashuba and Kulkova 2021: cat. no. 148-149.
Pohrebea, Dubăsari raion, Tumulus 3, Grave 1: iron one-edged knife. Agulnikov and Ketraru 1992: 137 fig. 2: 6; Nicic 2008: 205 fig. 61: 9; Kashuba and Kulkova 2021: cat. no. 144.
Saharna, Rezina raion, Cemetery I, Tumulus 3, Grave 1: iron fibula, knife and (?)pin. Kašuba et al. 2019: 191 ff.; Kashuba and Kulkova 2021: cat. no. 155-158.
Saharna, Rezina raion, Cemetery I, Tumulus 4, Grave 1: iron fibula and knife blade. Kašuba et al. 2019: 191 ff.; Kashuba and Kulkova 2021: cat. no. 159-160.

Ukraine

Brylivka, Kherson Oblast, Grave 47: iron one-edged knife. Evdokimov 1999: 101 fig. 2: 5.7.15.16; Kashuba and Kulkova 2021: cat. no. 41.
Budurzhel (Plavni), Odessa Oblast, Tumulus 14, Grave 4: iron two-edged knife. Toshchev 1992: 28; 21 fig. 3: 3; Kashuba and Kulkova 2021: cat. no. 37.
Hordiivka, Vinnytsia Oblast, Tumulus 5, Grave 1: fragmentary iron knife handle. Berezanskaya and Klochko 1998: pl. 7: 11; Kashuba and Kulkova 2021: cat. no. 42.
Hordiivka, Vinnytsia Oblast, Tumulus 32, Grave 2: iron two-edged knife and iron awl. Berezanskaya and Klochko 1998: pl. 61: 3.6; Kashuba and Kulkova 2021: cat. no. 43-44.
Hordiivka, Vinnytsia Oblast, Tumulus 35: fragmentary iron one-edged knife blade with decorated gold cuff. Berezanskaya and Klochko 1998: pl. 69: 1; Kashuba and Kulkova 2021: cat. no. 45.
Hordiivka, Vinnytsia Oblast, Tumulus 37: iron two-edged knife. Berezanskaya and Klochko 1998: pl. 73: 2; Kashuba and Kulkova 2021: cat. no. 46.
Hordiivka, Vinnytsia Oblast, Tumulus 38: bimetallic one-edged knife. Berezanskaya and Klochko 1998: pl. 80: 1; Klochko 2011: 50; 52; 71; 134; 179 pl. 19: 1; Kashuba and Kulkova 2021: cat. no. 47.
Kairy, Kherson Oblast, Tumulus 3, Grave 1: iron two-edged knife. Agulnikov and Shilov 1990; Nikitenko 1998: 39 fig. 2: 1; Kashuba and Kulkova 2021: cat. no. 36.
Kochkuvate, Odessa Oblast, Tumulus 29, Grave 1: iron two-edged knife. Vanchugov et al. 1992: 24 fig. 7: 2; Kashuba and Kulkova 2021: cat. no. 31.

Kochkuvate, Odessa Oblast, Tumulus 31, Grave 1: bimetallic two-edged knife. Vanchugov 1990: 80 fig. 33: 15; Vanchugov et al. 1992: 26 fig. 8: 6; Kashuba and Kulkova 2021: cat. no. 30.
Mahala, Chernivtsi Oblast, settlement: two iron knives, one iron ring, one iron 'fitting'. Smirnova 1969: 25; 34; 17 fig. 7: III.14; Kashuba and Kulkova 2021: cat. no. 48-51.
Mala Khortytsia, Zaporizhzhia Oblast, settlement: bimetallic two-edged knife. Berezanskaya et al. 1986: 140 fig. 42: 6; Kashuba and Kulkova 2021: cat. no. 35.
Mala Lepetykha, Zaporizhzhia Oblast, Shiroka Mohila, Tumulus: bimetallic two-edged knife. Grakov 1958: 4 fig. 1: a; Bidzilya et al. 1983: fig. 4: 1; Kashuba and Kulkova 2021: cat. no. 32.
Mikolaiv, Mikolaiv Oblast, hillfort 'Dikiy Sad': iron awl. Pankov 2014: 87 no. 26; 88 fig. 58; Kashuba and Kulkova 2021: cat. no. 38.
Nedilyska, Lviv Oblast, hoard: two iron bracelets, one iron anvil, one iron trunnion(?) axe. Sulimirski 1937: 258 f.; 259 fig. 7; 267 pl. 4: 9-12; Gedl 2001: 63 f.; pl. 80: C60-C64; Bandrivskyi et al. 2014; Kashuba and Kulkova 2021: cat. no. 52-55.
Obloi, Kherson Oblast, Grave(?): iron two-edged knife. Nikitenko 1998: 39 fig. 2: 3; Kashuba and Kulkova 2021: cat. no. 39.
Pervomaivka, Kherson Oblast, Tumulus 5, Grave 3: iron one-edged knife. Evdokimov 1987: 109 f. fig. 2: 4; Kashuba and Kulkova 2021: cat. no. 40.
Zapovitne/Sovchoz Stepnoy, Zaporizhzhia Oblast, Tumulus 5, Grave 2: bimetallic two-edged knife. Otroshchenko 1975: 201 fig. 6: 3; 2003: 349 fig. 10: 7; Kashuba and Kulkova 2021: cat. no. 33.
Zburivka, Kherson Oblast: bimetallic two-edged knife. Otchet 1903: 155 fig. 310; Kashuba and Kulkova 2021: cat. no. 34.

Chapter 7
The Caucasus

The Greater Caucasus forms a border separating the communities living to the south and north of the mountain range; but the mountains and valleys were also a meeting place for cultural and technological innovations arriving from eastern Europe and the Near East. Because of the dynamic topography of the region, a rich variety of local cultural groups developed, which make the archaeology of the Caucasus particularly challenging (for some important cultural groups, see Figure 30). Publications are often in difficult languages, and the state of research is far from satisfactory: while in some areas large numbers of find complexes of the Late Bronze Age and Early Iron Age have been excavated and published, in others it is still difficult to understand the cultural developments at the time of the introduction of iron.

7.1 South of the Caucasus

The volume published in 2009 by Jens Nieling, entitled *Die Einfuhrung der Eisentechnologie in Sudkaukasien und Ostanatolien wahrend der Spatbronze- und Fruheisenzeit* is a good introduction to the subject. Most of the early iron artefacts discussed below are described and analysed in Nieling's book. Since 2009, no further major comprehensive research dedicated to the introduction of iron in Transcaucasia has appeared in print.

Central and Eastern Georgia

Before discussing the earliest iron artefacts from central and eastern Georgia, there follows a brief introduction to the chronology of the Late Bronze and Early Iron Age. Scholarly discussion has focused most intensively on the developments in the Late Bronze Age, involving two competing schemes

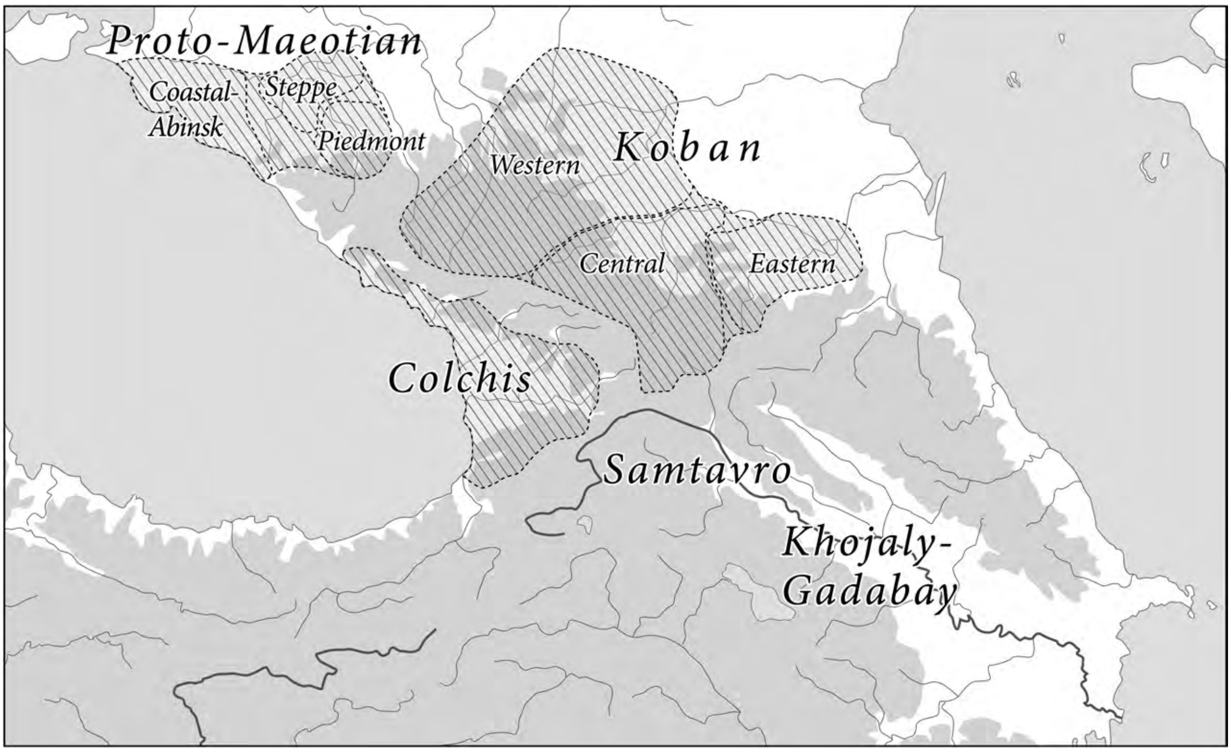

Figure 30. Map showing major cultural groups of the Late Bronze and Early Iron Age in the Caucasus region. — After Reinhold 2005b; Erlikh 2007: 216 f. fig. 12.

proposed by Rostom Abramishvili and Konstantin Pitskhelauri.[1] Today the chronological system for the Late Bronze Age developed by Pitskhelauri is favoured by most authors, while Abramishvili's chronology – first elaborated in a classic article published in 1957 – still remains widely used for the subsequent Transitional phase and the start of the Early Iron Age (corresponding to Pitskhelauri's LBA IV/EIA I).[2] The following chronological phases are widely used in current research:

- LBA I-II (ca. mid-2nd millennium to the mid-13th century BC). These phases encompass the emergence (LBA I) and full establishment (LBA II) of the Lchashen-Tsitelgori (or Central Transcaucasian) culture, as successor to the Middle Bronze Age Trialeti culture.
- LBA III (middle or end of the 13th to the 12th century BC). Significantly different cultural groups emerge in Shida Kartli (Samtavro culture) and in Kakheti (Iori-Alazani culture).
- LBA/EIA Transitional phase (11th to the second half of the 10th century BC). During this phase, the material culture and burial customs in central and eastern Georgia are more uniform, although there are signs of western influence (from central Colchis) in Shida Kartli and Kakheti, whereas Kvemo Kartli shows influence from the Khojaly-Gadabay (or Ganja-Karabakh) culture of western Azerbaijan. In his article, Abramishvili differentiated an Early stage from a Fully Developed stage of the Transitional phase – a distinction which is important for the question of the introduction of iron.
- EIA I (second half of the 10th and 9th centuries BC). The first stage of the widespread adoption of iron.

The relative chronology of the two phases encompassing the introduction of iron, LBA III and Transitional LBA/EIA, appears to be well founded. Taking weaponry as an example, LBA III is characterised by bronze 'Kakhetian' daggers with composite hilts.[3] In the subsequent Transitional phase, bronze daggers and swords were made with solid hilts; typical forms are the swords with blunt, rounded or cut-off tips, and the daggers with a narrow blade and a high pommel.[4] The first fibulae in Transcaucasia are another important feature of the Transitional phase (arched fibulae with unthickened bows).

The absolute chronology of these phases is much less clearly defined, and different authors have suggested varying dates. For example Goderdzi Narimanishvili, who has further refined Pitskhelauri's chronology of the Late Bronze Age, suggests a later date for the end of the Lchashen-Tsitelgori (Central Transcaucasian) culture, and assigns the Samtavro culture to the 12th/11th century BC, which would mean that the Transitional phase starts considerably later than previously thought.[5] Indeed, Konstantin Pitskhelauri also sometimes suggested a later position for the Transitional phase (his phase LBA IV/EIA I), at the turn of the 2nd to the 1st millennium BC or starting at the end 11th century BC.[6]

There is no clear evidence for the use of iron artefacts in LBA I-II. Iron fragments of uncertain function have been reported from some sites of this date, but it is possible that they derive from later disturbance. This is the case, for example, in the wagon grave from Tumulus 4 at Berikldeebi in Shida Kartli, where an iron fragment is mentioned among the finds.[7] And a small iron object of uncertain date was uncovered as a stray find in the Shilda sanctuary in Kakheti.[8]

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[1] For an introduction to the debate, see Abramishvili 2003; Picchelauri 1997; Akhvlediani 2001; 2005; Nieling 2009: 75 ff.

[2] Abramishvili's classic article of 1957 was republished in English translation in 2003.

[3] For the 'Kakhetian' daggers with composite hilts, see examples from Samtavro (e.g. Picchelauri 1997: pl. 53: 805; 54: 826); and from Armenia in Artik, Phase II (e.g. Picchelauri 1997: pl. 61: 950-954; 62: 955-957).

[4] For the daggers with a narrow blade and a high pommel, see examples from Samtavro (e.g. Picchelauri 1997: pl. 59: 921; 60: 923.924). — For the swords with blunt, cut-off tips, see examples from Zemo Avchala (Picchelauri 1997: pl. 37: 467); and from Armenia at Akner/Vornak (Picchelauri 1997: pl. 37: 473).

[5] See Narimanishvili 2010: 331.

[6] See, for example, Pizchelauri 1995: 103; Picchelauri 1997: 10; 20.

[7] Picchelauri 1997: 20; Akhvlediani 2005: 263; Nieling 2009: 86. — For a brief description of the tomb, see Miron and Orthmann 1995: 109 f.; 257 ff.

[8] Abramishvili 2003: pl. 1: 223; Miron and Orthmann 1995: 114; Nieling 2009: 86; 122 ff. — Significantly, the iron fragment is not mentioned in the discussion of Shilda by Maisuradze and Inanishvili (2006).

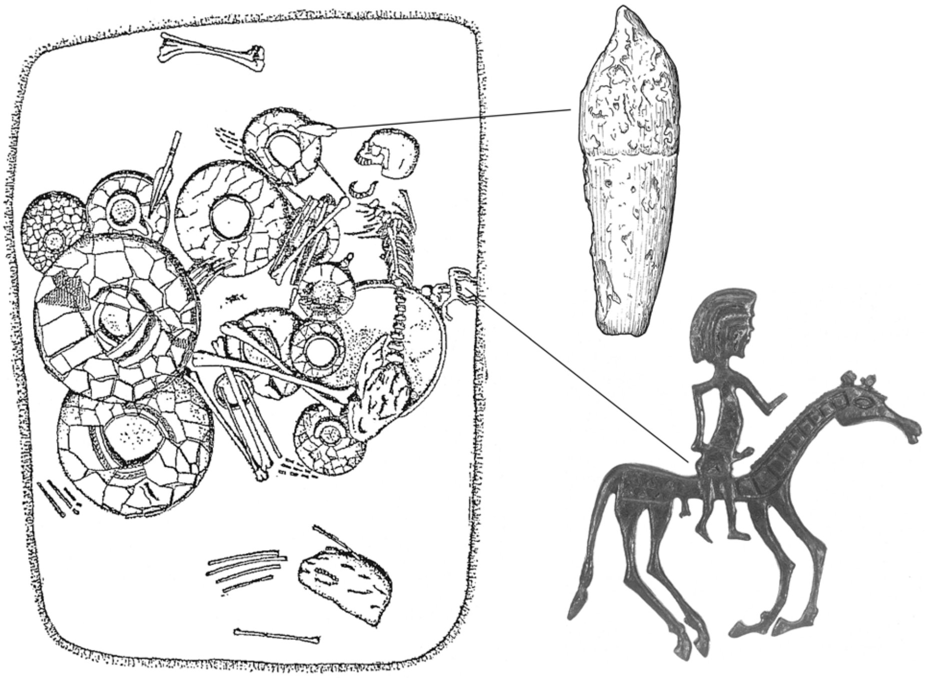

Figure 31. Treli, Grave 65, showing the iron knife and the bronze belt buckle. — After Abramishvili 1978: 122 fig. 76 (plan); Nieling 2009: 289 no. 14 (iron knife); *Jahrbuch des Römisch-Germanischen Zentralmuseums* 48 (2), 2001: 623 fig. 29 (bronze belt buckle).

Iron artefacts are first reported more frequently from contexts of LBA III. Iron objects apparently come from two graves at Beshtasheni, in Kvemo Kartli. A flat iron fragment (L. 3 cm) is included by Rostom Abramishvili and Nino Akhvlediani among the finds from Grave 13; Akhvlediani believes it came from a knife, and mentions "two bronze small nails at the top" of the fragment.[9] The rich grave furnishings from Grave 13, including a bronze helmet and harness for a pair of horses, are generally dated to the 13th or 12th century BC.[10] Grave 18 from the same cemetery is supposed to be of similar date, and contained a much better-preserved knife with a length of 21.5 cm.[11] These assemblages are not easy to interpret, as the grave inventories have never been published comprehensively, and only the preliminary report from 1941 is available.[12] Boris Kuftin, the excavator of the cemetery, stated that iron was only discovered in Grave 18, not in Grave 13.[13] Perhaps he considered the fragment from the latter grave to be insignificant because of its small size; alternatively, he could have judged the piece to be intrusive, not belonging to the original furnishings of the burial. A further iron knife, 11 cm in length, came to light in Treli, Grave 65 in Shida Kartli.[14] Apart from a bronze dagger and spear, the grave contained a splendid bronze belt buckle in the shape of a horseman (Figure 31).[15] Unfortunately, once again this grave remains unpublished, and no detailed information on the inventory is available. Finally, an iron knife was contained in Grave 74 from Tserovani, cemetery II (Shida Kartli), which – according to Vazha Sadradze – is one of the earliest burials in the cemetery, corresponding to LBA III.[16] As this commentary has shown, the present state of publication makes it difficult to reach clear conclusions about this putative evidence for the early

9 Akhvlediani 2001: 273; Abramishvili 2003: pl. 1: 236; Nieling 2009: 128 f.; 286 cat. no. 1.
10 See, for example, Ivantchik 2001: 174; 230 ff.
11 Abramishvili 2003: pl. 1: 234; Nieling 2009: 130; 131 fig. 24; 286 cat. no. 3.
12 Picchelauri (1997: 20) refers to this evidence for iron in LBA III as 'controversial'.
13 See Kuftin 1941: 67 f.
14 Abramishvili 1978: 122 fig. 76 (plan); colour plate VII (belt buckle); Miron and Orthmann 1995: 324 fig. 359; Nieling 2009: 107 f.; 289 cat. no. 14.
15 Miron and Orthmann 1995: 194 fig. 203.
16 Sadradze 1991: 32; 85; pl. 64: 5; Nieling 2009: 114 f.

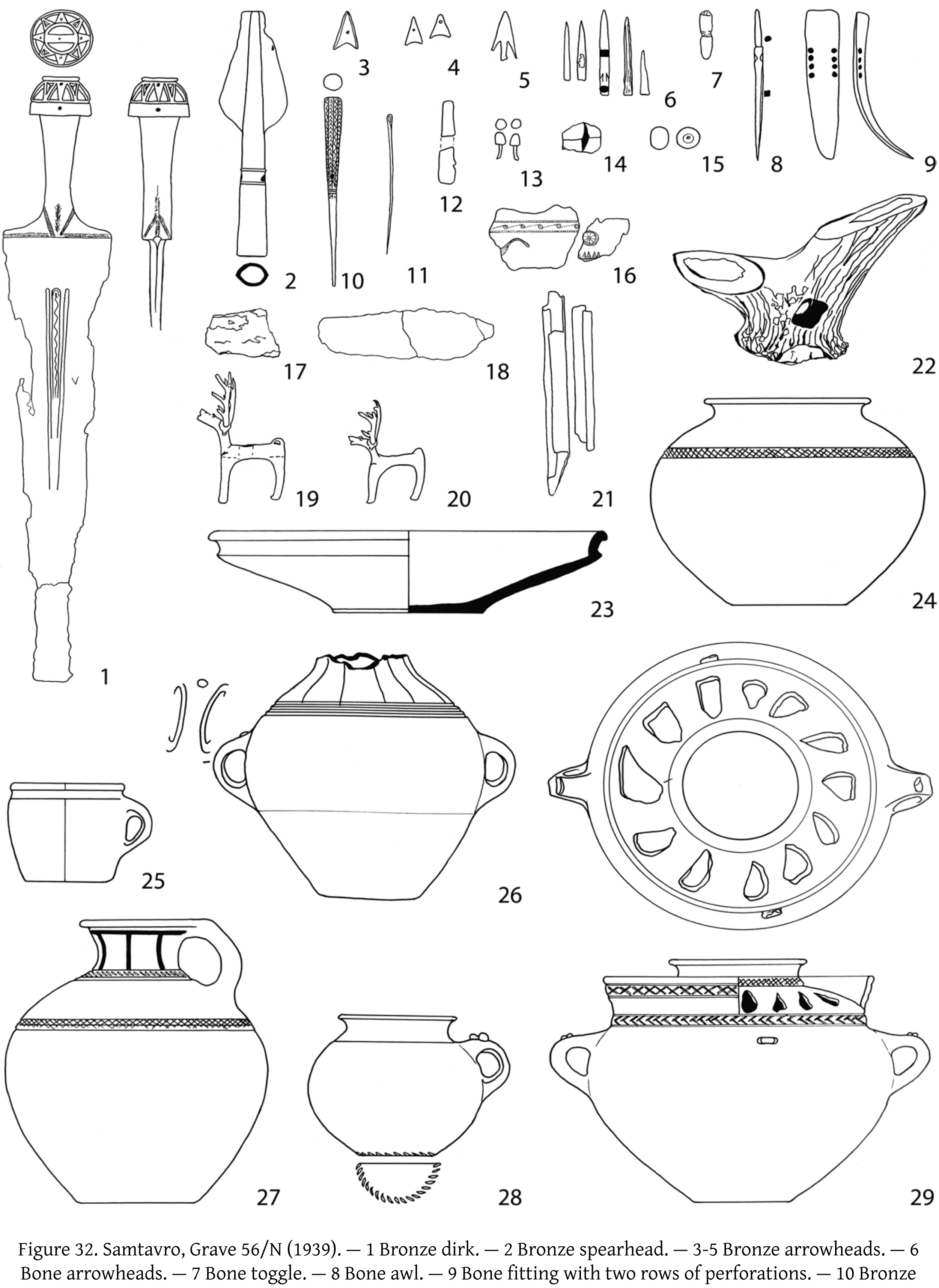

Figure 32. Samtavro, Grave 56/N (1939). — 1 Bronze dirk. — 2 Bronze spearhead. — 3-5 Bronze arrowheads. — 6 Bone arrowheads. — 7 Bone toggle. — 8 Bone awl. — 9 Bone fitting with two rows of perforations. — 10 Bronze pin. — 11 Bronze needle. — 12 Bronze tweezers. — 13 Bronze nails with domed heads. — 14 Obsidian flake. — 15 Carnelian beads. — 16 Fragment of decorated sheet bronze. — 17-18 Fragmentary iron knife blades. — 19-20 Bronze deer figurines. — 21 Sheet bronze cylinders. — 22 Antler pick with shaft-hole. — 23-29 Pottery vessels. — From an illustration provided by N. Akhvlediani (Tbilisi). — 1-22 Scale 1:4; 23-29 Scale 1:6.

introduction of iron. Nevertheless, it is highly likely that the first iron artefacts appeared in central Georgia in LBA III, in the form of one-edged knives.

Rostom Abramishvili identified a number of early graves from the Samtavro cemetery (near Mtskheta, Shida Kartli) which form an Early stage within the Transitional LBA/EIA phase. Bronze solid-hilted daggers with wide blades and low pommels are among the characteristic weapons at this time.[17] He noted that at Samtavro graves of the Early stage generally do not contain iron.[18] The only exception is Grave 56(N), excavated in 1939, which contained an iron knife (L. 9.5 cm); otherwise, the grave goods included a bronze spearhead, a bronze dagger and three bronze arrowheads, illustrating the fact that bronze was still the dominant metal for manufacturing weapons (Figure 32).[19] Grave 223 from Natsargora (Khashuri District, Shida Kartli) can also probably be assigned to the Early stage of the Transitional phase.[20] An iron knife blade fragment, an iron 'pin' fragment, and a bronze belt-hook with iron inlay testify to the use of iron, but the three spearheads, the dirk, the two daggers, the pair of horse-bits and the socketed gouge demonstrate that bronze was still the main metal for tools and weapons.[21] According to the traditional chronology, the Early stage of the Transitional phase should date around the first half of the 11th century BC.

In many respects, the furnishings of Narekvavi (Shida Kartli), Grave 53 resemble those of the tomb assemblages discussed in the previous paragraph.[22] However, the iron objects now comprise a long dagger or knife (L. 21 cm) fitted with a bronze handle terminal, a curved iron knife and two iron arrowheads, testifying to a marked increase in the iron repertoire. The bronzes include a sword, two daggers, three axes, 25 arrowheads, a socketed gouge and a single horse bit. Although some of the grave furnishings are similar to those of the Early stage, and bronze is still the predominant metal, the solid-hilted sword with blunt tip indicates that Narekvavi 53 must be assigned to the Full Transitional phase as defined by Abramishvili.[23]

According to Abramishvili's definition, both bronze and iron were used for the manufacture of tools and weapons in the Full Transitional phase. The iron weapons now include swords, dirks and daggers, socketed spearheads and simple flat arrowheads. Some of the long iron knives could have been used as weapons, others can be interpreted as cutting implements. Among the many examples, Graves 51(N) and 211(N) excavated in 1939 and 1940 at Samtavro are illustrated here. Grave 51 contained an iron sword, an iron spearhead, two iron knives and three iron arrowheads; the bronze weapons included a dagger, a spearhead and ten arrowheads (Figure 33).[24] Grave 211 had a short curved knife, a long straight knife, a sword and one arrowhead of iron, and a dagger, a spearhead and ten arrowheads of bronze (Figure 34).[25]

As mentioned above, arched fibulae with thin, unthickened bows are an important innovation in the Full Transitional phase. The bows can either be plain, twisted, or decorated with an engraved herringbone pattern. Examples from the Full Transitional phase come from Samtavro, Grave 591(N), which contained an iron sword with a hilt covered in bronze sheet, and from Natsargora, Grave 435, with an iron dagger and an iron spearhead.[26] According to the traditional chronology, the Full Transitional phase should be

[17] For this type of weapon, see for example Picchelauri 1997: pl. 60: 925-927.
[18] Abramishvili 2003: 22 f.
[19] The grave furnishings have not been published in detail; I am very grateful to Nino Akhvlediani (Tbilisi) for permission to use her illustration of the finds. — See also Nieling 2009: 288 cat. no. 12. — Nieling (2009: 111) incorrectly states that the grave contents included a bronze fibula.
[20] Ramishvili 2001: pl. 3-4; 2003: 97 f. fig. 1-2; Apakidze 2009: 442 f.; pl. 262-263; Nieling 2009: 105.
[21] Grave 35 from Narekvavi is another assemblage of the Early stage, containing a fragmentary iron object along with bronze tools and weapons. See Apakidze 1999: 84 ff.; 91 (iron object); Castelluccia 2017: 328 fig. 112-113.
[22] Apakidze 2000: 28 ff.; pl. 14-16; Nieling 2009: 111 f. fig. 20; 287 cat. no. 6-8; Castelluccia 2017: 331 f. fig. 114-116.
[23] Samtavro, Grave 208(N) has a similar selection of grave furnishings, in which iron is represented by a single knife. The grave assemblage is unpublished.
[24] See Picchelauri 1997: pl. 114: B; Nieling 2009: 109 f. fig. 19.
[25] The grave furnishings have not been published in detail; I am very grateful to Nino Akhvlediani (Tbilisi) for permission to use her illustration of the finds.
[26] Samtavro, Grave 591(N): Piotrovsky 1949: pl. 5. Note that the long iron weapon with bronze handle should probably be interpreted as a sword, and not as a spearhead. — Natsargora, Grave 435: Ramishvili 2001: pl. 8; Apakidze 2009: 442 f.; pl. 267.

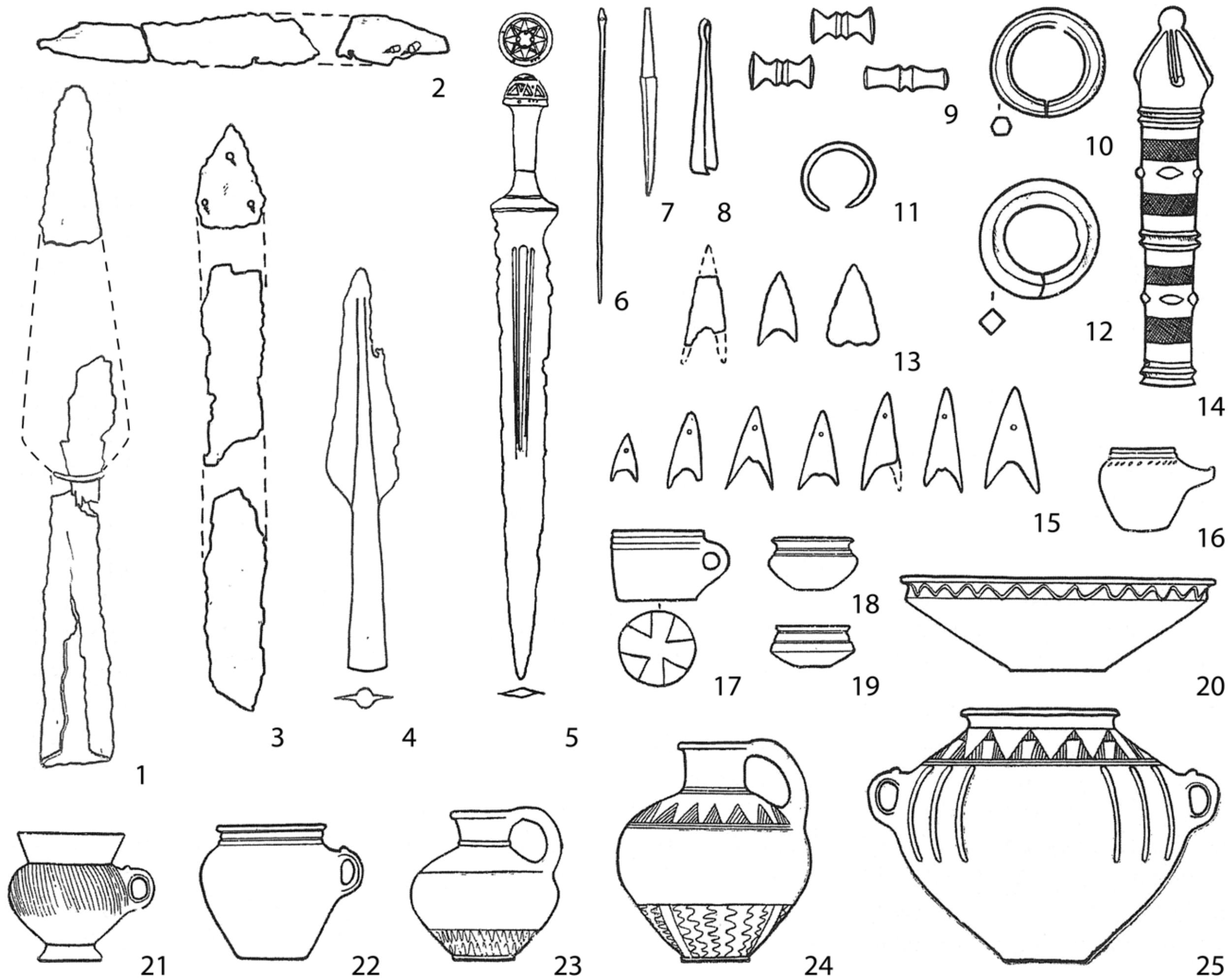

Figure 33. Samtavro, Grave 51/N (1939). — 1 Iron spearhead. — 2 Iron knife. — 3 Iron sword. — 4 Bronze spearhead. — 5 Bronze dirk. — 6 Bronze pin. — 7 Bone awl. — 8 Bronze tweezers. — 9 Bronze toggles. — 10 Bronze facetted ring. — 11 Bronze (finger?) ring. — 12 Bronze ring with rhomboidal cross-section. — 13 Iron arrowheads. — 14 Bronze standard terminal. — 15 Bronze arrowheads. — 16-25 Pottery vessels. — After Nieling 2009: 110 fig. 19. — Not to scale.

assigned to the period between the mid-11th and the second half of the 10th century BC. It is noticeable that the iron artefacts generally have simple shapes which would have been relatively easy for a smith to make; the spearheads, with their hollow sockets, are the notable exception.

By the end of the 10th century BC, in EIA I, iron had replaced bronze as the predominant metal for tools and weapons.[27] According to Pitskhelauri, bimetallic weapons (with a cast bronze hilt) are also a feature of EIA I.[28]

The fibulae, first attested in central Transcaucasia in the Full Transitional period, are of special importance for our discussion. The arched fibulae can have a symmetrical, semicircular bow, but sometimes the outline is asymmetrical or depressed ('oval'); the foot of the fibula is hardly wider than the bow. As many authors have concluded, the fibula must have been introduced to the Caucasus region from the west. They are clearly related to the arched fibulae found in the Submycenaean and Early Protogeometric

[27] Abramishvili 2003: 22.
[28] Picchelauri 1997: 20.

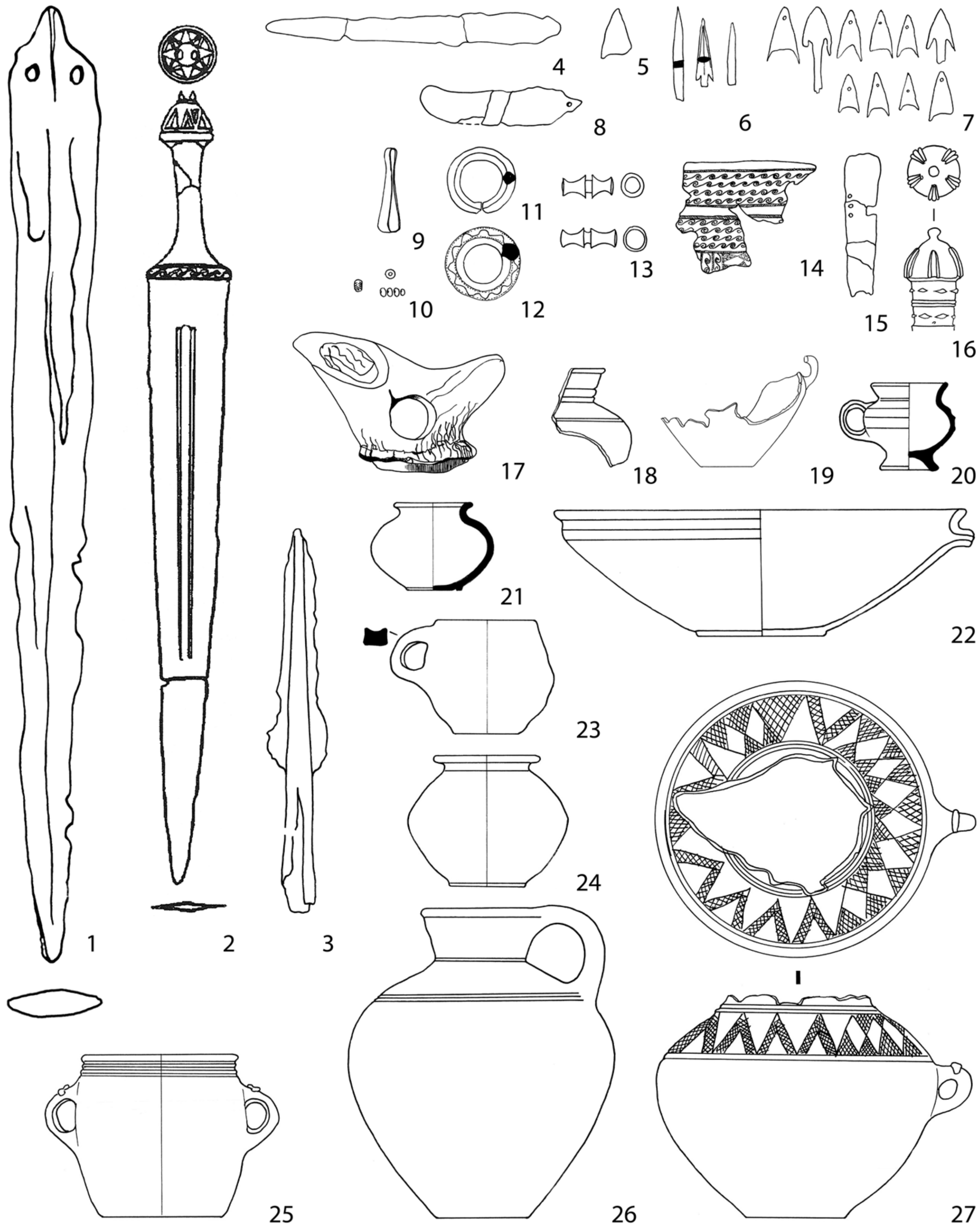

Figure 34. Samtavro, Grave 211/N (1940). — 1 Iron sword. — 2 Bronze dagger. — 3 Bronze spearhead. — 4.8 Iron knives. — 5 Iron arrowhead. — 6 Bone arrowheads. — 7 Bronze arrowheads. — 9 Bronze tweezers. — 10 Carnelian beads. — 11 Bronze ring with rhomboidal cross-section. — 12 Bronze facetted ring. — 13 Bronze toggles. — 14 Fragment of decorated sheet bronze. — 15 Bronze fitting with two rows of perforations. — 16 Bronze standard terminal. — 17 Antler pick with shaft-hole. — 18-27 Pottery vessels. — From an illustration provided by N. Akhvlediani (Tbilisi). — 1-17 Scale 1:4; 18-27 Scale 1:6.

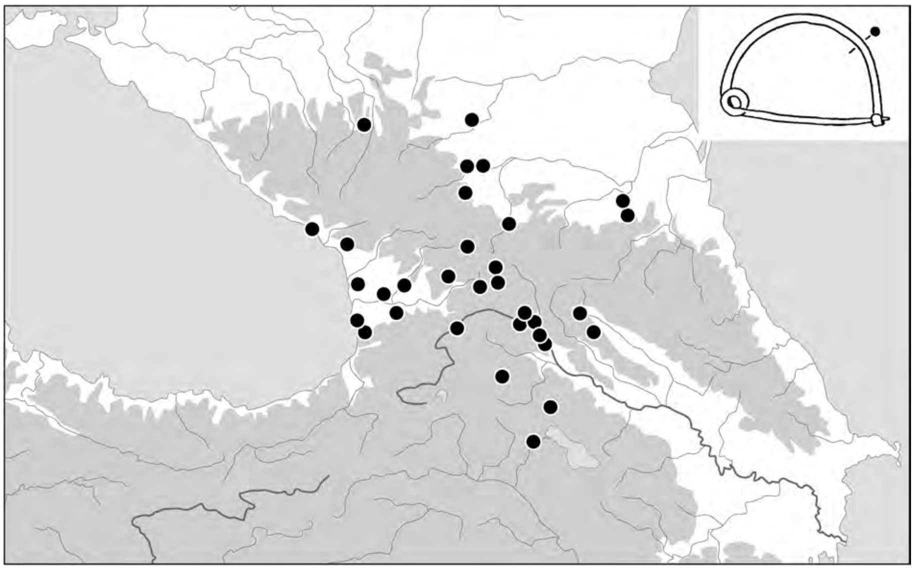

Figure 35. Distribution map of arched fibulae with unthickened bow and narrow foot. The bow of the fibula can be either plain, twisted, or with engraved herringbone decoration. — After Reinhold 2007; Sulava 2011.

Aegean, and in Italy in *Bronzo Finale* 2.[29] Today, there is a general consensus that the earliest arched fibulae in Georgia date to the 11th century BC.[30] Considering that the earliest Aegean *comparanda* are from the Submycenaean period, the Caucasian examples cannot date earlier than the second quarter of the 11th century BC. As explained in Chapter 6.1, early arched fibulae reached the Black Sea between the lower Danube (Coslogeni, Dridu) and the lower Dnipro (Zapovitne), reflecting the existence of long-distance exchange relations (Figure 28). The bimetallic knife and the amber and glass beads from Hordiivka are most impressive witnesses to this exchange network, in which partners in the Aegean were also involved (see Chapter 6.1-2). The distribution map shows how the arched fibulae with unthickened bow were adopted throughout Georgia and reached Armenia; the distribution crosses the central Greater Caucasus and reaches the northern foothills (Figure 35).[31]

The arched fibula was an innovation in the Caucasus which can only be explained by relations with the western Black Sea, and ultimately the Aegean. We must envisage long-distance sea-borne exchange along the Black Sea coastline reaching as far as Georgia. For the purpose of our study, this conclusion has a special relevance. As both the Aegean and central Transcaucasia participated in this communication network, knowledge of the advances made in ironworking was surely widespread along the shore of the Black Sea. The crucial message transmitted by the participants in this exchange network was the manufacture of large iron weapons both in the Aegean and Transcaucasia, which must have been a convincing demonstration of the technical potential of the new metal. It is also very interesting that the innovation of iron seems to have proceeded in a remarkably similar fashion in the Aegean and in central Transcaucasia. In both areas, iron is first introduced in the form of one-edged knives, and in both areas the manufacture of iron weaponry seems to have started around the mid-11th century BC.

[29] For the Aegean and Italy, see Pare 2008b; for the earliest fibulae in the Near East, see Pedde 2000.
[30] See for example: Kossack 1983: 99 ff.; Reinhold 2007: 90 ff.; 173 ff. (KoB1); Apakidze 2009: 174 ff. (Tli IIA).
[31] As the arched fibula with unthickened bow continued in use after the Transitional phase, the distribution map also shows the continued usage of this type of fibula throughout the Early Iron Age.

Western Georgia and the southern foothills of the central Greater Caucasus

A systematic study of the Late Bronze Age and Early Iron Age in western Georgia has been published by Joni Apakidze, which is the most important basis for the following discussion.[32]

The cultural orientation of western Georgia during the Late Bronze and Early Iron Age was distinctly different from that of the central and eastern parts of the country (Figure 30). Western Georgia had much in common with the Koban culture north of the Greater Caucasus. Indeed, the whole region is often treated as a single cultural complex, albeit with significant regional variation. Sabine Reinhold, for example, refers to the 'Colchis-Koban' culture, while Joni Apakidze includes the three main 'Koban' regional groups within his 'Colchis' culture.[33] The close relations throughout this cultural complex are most clearly apparent in the metalwork.

Until recently, there was a consensus among Georgian scholars that western Georgia (Colchis) was a major centre of iron production already during the 2nd millennium BC. This conclusion was based on large-scale surveys of smelting sites in western Georgia initiated in the 1970s by David Khakhutaishvili and his team.[34] A number of radiocarbon and archaeomagnetic dates suggested that these production sites were active by the 12th century BC, or even earlier. However, Jens Nieling analysed slag samples from several of these sites, and was able to show that they derived from the smelting of copper ores, and argued that the previous consensus on early iron production should be rejected.[35] Nieling's results were later confirmed by a group of scientists led by Nathaniel Erb-Satullo.[36] Most of the known production sites with evidence for iron smelting are Medieval, but a few are earlier, dating back to the Classical or Hellenistic period (5th/3rd century BC). At present, these sites represent the earliest known evidence for the smelting of iron ores in western Georgia.[37]

Although the very early evidence for iron smelting can no longer be accepted, it nevertheless remains true that western Georgia was an important centre of metal production. This is shown, for example, by the numerous bronze hoards discovered in the region, and also by the large number of copper and iron smelting sites.[38] However, a crucial problem makes it very difficult to detect the introduction of iron artefacts in western Georgia. Graves are practically unknown in the Late Bronze Age, whereas in the Early Iron Age collective burial rites were predominant, and cemeteries with individual graves only gradually emerged during the early centuries of the 1st millennium BC. For this reason, before the 9th century BC closed artefact associations are much less common than in other parts of Georgia.

As Joni Apakidze concludes, the present state of research makes it impossible to date the earliest iron artefacts in collective burials precisely, although he suspects that they could date to the early 1st millennium BC.[39] Revaz Papuashvili has suggested a sequence of five phases for the collective burials of central Colchis, in which the first iron artefacts, mainly small items with a simple design (knives, dagger blades, tweezers and a fibula), appear in Phase 2 (ca. 10th/9th century BC).[40] According to a revision of this chronological scheme by Sabine Reinhold, the collective tombs were each in use for a considerable length of time, and the oldest metal objects from Papuashvili's Phase 2 cannot be dated earlier than the second half of the 10th century BC (Reinhold's phase KoB2).[41]

[32] Apakidze 2009.
[33] Reinhold 2007: 323 ff.; Apakidze 2009: 24 fig. 1; 267 f.; see also Sagona 2018: 465 ff.
[34] See for example: Inanishvili 2007; Reinhold 2007: 293; Khakhutaishvili 2009; Apakidze 2009: 40; Nieling 2009: 80 ff.; 209 ff.
[35] Nieling 2009: 267; 277 f.
[36] Erb-Satullo et al. 2014.
[37] Erb-Satullo et al. 2017; Erb-Satullo 2019: 570 f.; Erb-Satullo et al. 2020.
[38] See for example: Reinhold 2007: 17 fig. 9; Sagona 2018: 438 f.; 459 f.
[39] Apakidze 2009: 111 no. 3; 243 f.
[40] For examples from Dgvaba and Ergeta, see Apakidze 2009: pl. 202: C; 203: A; 220: 18-19.23-25; Reinhold 2007: pl. 479: 34; 480: 13.19. — See also Papuashvili et al. 2021.
[41] Reinhold 2007: 273 ff.

The situation in Abkhazia is similar: once again, the complexes with early iron artefacts are difficult to date. Krasny Mayak, near Sukhumi, is one of the earliest cemeteries with individual burials. One of the oldest burials, Grave 90, contained an iron object of uncertain function, with a length of 15 cm. The start of the cemetery is set around the beginning of the 1st millennium BC by Apakidze, and around the second half of the 10th/first half of the 9th century BC according to Reinhold's chronological scheme (KoB2/C1).[42] From the arguments put forward by Askold Ivantchik, it seems that iron weapons and tools first appear in graves in Abkhazia during the 9th century BC.[43]

In conclusion, and based on the present scholarly consensus, the evidence from burial contexts seems to indicate that iron was introduced in western Georgia at some point during the 10th century BC.

Against this background, and considering the problems constituted by the fact that the individual burial rite only gradually gained popularity during the 1st millennium BC, the early iron objects found in hoards and settlement contexts necessarily play an important role in the question of the introduction of iron in western Georgia. The hoard from Ude (Adigeni district, south-west Georgia) is an important example. The collection of over 100 artefacts was discovered in 1956 at a depth of 1.5 m. Apart from bronzes, the hoard contained five iron objects: two iron spearheads, one dagger, a mace-head, and a bronze belt-hook with iron inlay.[44] Ude is assigned to the 12th/11th century BC by Apakidze, and around a century later by Reinhold (11th/10th century BC).[45] In my opinion, judging from the parallels for the belt-hook with figural decoration in the cemetery of Tli, a date in the 10th century BC, or even later, seems more appropriate.[46] Zeniti, found in 1926 in the district of Kobuleti, is sometimes mentioned as a further bronze hoard containing iron artefacts.[47] However, according to the report of the discovery, the hoard only contained bronze artefacts and, furthermore, the original composition of the hoard seems to be uncertain.[48] The hoard from Zeniti can therefore not be accepted as evidence for the early use of iron.

As for settlements, Apakidze includes a spearhead from Naochvamu (Senaki district, Mingrelia) among the earliest iron weapons in western Georgia. The excavators uncovered the spearhead in the upper layer of this small Tell (Naochvamu III). As the iron spearhead is typologically identical to bronze examples from the same layer, it is evident that Naochvamu III incorporates the time-span when iron was being introduced for the manufacture of weaponry. Following a detailed chronological analysis, Joni Apakidze assigns Naochvamu III to the 11th/10th century BC (his phase Late Bronze Age III/Early Iron Age I).[49] Apakidze also draws attention to the engraved decoration of a bronze spearhead from Naochvamu III which, he believes, could only have been executed using a pointed iron implement (burin) which was harder than bronze. If this theory can be accepted, then it would also be significant that engraved decoration is first encountered on bronzes in the cemetery of Tli around the second half of the 11th century BC (Tli IIA).[50] The iron implements and iron slag found in the settlement of Ochkhomuri appear to be later, as most of the finds from the site have been dated to the 9th/8th century BC (Late Bronze Age IV/Early Iron Age II).[51]

As we have seen, some authors have argued for an early introduction of iron metallurgy in central Colchis and Abkhazia, before the end of the 2nd millennium BC.[52] However, as the iron ore smelting sites can no

[42] Apakidze 2005: 336; 2009: 40; 393 f.; for the chronology, see also Reinhold 2007: 267 ff.
[43] Ivantchik 2001: 253 f.; see also Reinhold 2007: 270 f.
[44] Koridze 1965: 19 f. no. 24; 22 fig. 11; Nieling 2009: 104; Apakidze 2009: 39 f.
[45] Apakidze 2009: 39 f.; Reinhold 2005a: 349 fig. 2.
[46] Compare Apakidze 2009: 195 fig. 79: 8; 203 fig. 85: 7.8. According to Apakidze, these belt-hooks date from the second half of the 10th to the 8th century BC.
[47] See Apakidze 2009: 39 f.; Nieling 2009: 104; for the chronology, see Reinhold 2005a: 354; 349 fig. 2.
[48] Koridze 1965: 22 no. 31; 25 fig. 14; Ramishvili 1974: 20 ff. no. 34; pl. 14: A.
[49] Apakidze 2009: 39 ff.; pl. 54: 2 (iron spearhead); see also Nieling 2009: 100.
[50] Apakidze 2009: 40 f.; 177; pl. 54: 1.
[51] Apakidze 2009: 44 ff. — Note that Apakidze states that some of the pottery from Ochkhomuri has parallels in Naochvamu III, suggesting that the periods of occupation of the two sites probably overlapped, perhaps during the 10th century BC. See Apakidze 2009: 47.
[52] Apakidze 2005: 336; 2009: 39 ff.

longer be dated to the Late Bronze Age, this now seems unlikely. There is, as yet, no compelling evidence for iron in western Georgia before the second half of the 10th century BC. Apparently, iron only gradually replaced bronze for tools and weapons, and only became the dominant metal from the late 8th century onwards.[53] However, because closed metal artefact assemblages in individual graves are so rare before the 9th century BC, the available data offer much less detail on the introduction of iron than in the other regions of Georgia. For this reason, it remains possible that iron artefacts were adopted earlier in western Georgia, but potentially are not reflected in the archaeological record. For example, the earliest horizon of iron artefacts in central Georgia – the iron knives – would almost certainly not be detected in western Georgia, owing to the lack of individual graves. Furthermore, the earliest iron artefacts known from graves, hoards and settlements could have been imported from central Transcaucasia, where iron production certainly developed before the end of the 2nd millennium BC. At present, it remains uncertain exactly when the local production of iron started in western Georgia.

Finally, the cemetery of Tli offers an important insight into the adoption of iron in the southern foothills of the central Greater Caucasus (South Ossetia).[54] The cemetery of 481 graves was excavated by Bagrat Tekhov between 1955 and 1984, and is of fundamental importance for chronology, not only for the Central group of the Koban culture, but also for Colchis. In the context of our study, it is significant that there is a broad consensus among scholars on the introduction of iron at the site. Since the publications by Bagrat Tekhov and Georg Kossack, it has been accepted that iron artefacts first appear at Tli around the end of the 10th century or ca. 900 BC.[55] During the 9th century BC the Tli graves generally only contain one or two iron artefacts, mainly knives and daggers; iron fibulae are less common, while only one spearhead was provided in a grave of this date.[56] As in western Georgia, it seems that iron was only gradually accepted for the manufacture of tools and weapons.

Joni Apakidze argues that the manufacture of iron artefacts in western Georgia began around the same time as in central and eastern Georgia, ca. 100-200 years earlier than in Tli and the Central group of the Koban culture. Furthermore, he believes that the technology of iron production, along with certain forms of artefacts (especially iron daggers), was transmitted to Tli and the central Greater Caucasus from western Georgia.[57] However, in the course of our critical review, it has become apparent that there is scant evidence for iron in western Georgia dating before the introduction of iron at Tli. Indeed, considering the similarity between the metal inventories in Tli and in western Georgia during the Late Bronze and Early Iron Age, it seems reasonable to assume that metalworking technology developed in step in both areas. In conclusion, and bearing in mind the unfavourable character of the archaeological record in western Georgia, which makes it difficult to detect the earliest iron artefacts, it nevertheless seems likely that iron was introduced later in the west than in central and eastern Georgia.[58]

Armenia

Unfortunately, the poor state of published research hinders a clear reconstruction of the adoption of iron in Armenia. I will restrict my discussion to a few general comments. In the chronological system developed for the Aragats project, and used in most current publications, the Late Bronze Age is divided into three phases (LBA 1-3), followed by Early Iron Age 1A and 1B. EIA 1A is understood as a transitional phase, in which the first iron knives and weapons were introduced.[59] Until recently, EIA 1A was dated to

[53] Apakidze 2009: 261.
[54] Note that iron objects (several pin or nail fragments) have been reported from Brili, Grave 12 in the Upper Racha region. The collective tomb, excavated in 1939, has been dated between the end of the 14th and the beginning of the 12th century BC. It is likely that the iron 'nails' are later, possibly modern, intrusions. See Motzenbäcker 2005: 152 ff.; 153 fig. 13: 30.31; see also Sagona 2018: 354-357.
[55] Iron artefacts first appear in the following phases: Tekhov Tli IV; Kossack Tli C-jung; Motzenbäcker Tli C [EIA I]; Reinhold KoC1; Apakidze Tli III. — For a review of previous research and the most recent analyses, see Reinhold 2007: 136 ff.; 181 f.; Apakidze 2009: 162 ff.; 190; 196; 264.
[56] Reinhard 2007: 148; Apakidze 2009: 197; see also Erlikh 2007: 17.
[57] Apakidze 2009: 39 f.; 120; 264; 327 ff.
[58] This conclusion is in agreement with the views expressed in Erb-Satullo 2019: 571; Erb-Satullo et al. 2020: 2.
[59] Avetisyan 2009: 60; Smith et al. 2009: 84.

ca. 1150-1050 BC; but with more numerous radiocarbon dates available, this has recently been revised to ca. 1075-1000 BC.[60]

Pavel Avetisyan notes that bimetallic daggers (with a cast bronze hilt) occur among the weapons of EIA 1A.[61] A bimetallic spearhead from Akner (formerly Vornak), Grave 16, can also be mentioned; the leaf-shaped iron spearhead was set in a bronze socket. The grave from Akner also contained an iron knife, along with a solid-hilted sword, a socketed axe and a trunnion axe made of bronze.[62] The bronze weapons from Akner resemble those from Digomi, located close to Tbilisi, which were associated with two arched fibulae.[63] From these few comments, it seems evident that EIA 1A in Armenia has much in common with the Full Transitional period in central and eastern Georgia.

The cemetery of Artik in western Armenia (Shirak province) provides a tantalizing insight into the introduction of iron grave furnishings. The cemetery contains 640 graves, which are divided by most authors into three phases (Artik I, II, III).[64] In our context, it is most interesting that the graves of Artik phases I and II never contained iron; the new metal first appears in Artik III, which is thought to belong to the phase EIA 1A. From the total of 19 graves of Artik III, ten contained iron artefacts: eight knives (some with a curved, sickle-shaped outline), one bracelet, and one spearhead.[65] A radiocarbon date from a sample of wood from Grave 223, which contained the iron bracelet, provided a date of 1208-898 BC.[66] Unfortunately, these grave associations from Artik do not provide a good basis to date the introduction of iron in Armenia. This is because collective burial was customary in Artik phase III, with the graves containing 3-7 individuals, implying that they may have been used for a long period of time.[67] However, Artik does show that, initially, iron was mainly provided in the form of iron knives. This provides an interesting comparison to the situation in central and eastern Georgia, where knives also appear to be the first artefacts which were made from iron. The graves with iron knives from Artik could date to a time corresponding with Abramishvili's Early Transitional phase at Samtavro; however, considering the present state of research in Armenia, it is impossible to establish a reliable date for the finds from phase III at Artik.

Azerbaijan

Because of its position between the Caucasus and north-west Iran, Azerbaijan could potentially provide a very enlightening insight into the relationship between Transcaucasia and neighbouring regions of the Near East. However, the state of publication can only be described as disappointing.

It is very difficult to obtain a clear picture of the introduction of iron in Azerbaijan. The available information comes from burials of the Khojaly-Gadabay (or Ganja-Karabakh) culture which, unfortunately, are not comprehensively published. Furthermore, it is often the case that the large burial chambers were re-used over a long period of time, making the construction of a reliable relative chronology beset with problems. There have been two recent attempts to develop a systematic chronology of the Khojaly-Gadabay culture. In her 2011 monograph, Mariya Pogrebova states that iron objects are absent, or only occur in very small fragments from questionable contexts, in her LBA III phase (end of the 13th-12th century BC). In LBA IV (end of the 12th-9th century BC), the first iron artefacts appear, although they are few in number. For example, Tumulus 28/1899 from Chanlar, 'Oesterle' contained a small iron ring (2.7 cm in diameter), an iron pin fragment, an iron bead, and some bronze sheet with iron nails. It is significant that iron grave

[60] Manning et al. 2018: 1548 fig. 10.
[61] Avetisyan 2009: 60.
[62] Martirosyan 1964: 115 f. pl. 11: 1-9; Kossack 1983: 137 fig. 23; Castelluccia 2017: 371 f.; 373 fig. 173. The spearhead is illustrated on Martirosyan 1964: pl. 11: 2; Kossack 1983: 137 fig. 23: 2.4.
[63] Sulava 2011: fig. 27.
[64] Khachatryan 1979; Badalyan and Avetisyan 2007: 67-79; Nieling 2009: 137 f.
[65] See Badalyan and Avetisyan 2007: 79 pl. X: 1-11.31. — Note that the iron spearhead from Grave 222 was the only grave furnishing, which means that its date is unclear. See Khachatryan 1979: 51 f.; 202: P-222.
[66] Khatchadourian 2011: 471. The uncalibrated date is 2850 +/- 50 bc, resulting in a 2-sigma calibration of 1208-898 BC.
[67] Badalyan and Avetisyan 2007: 67 ff.

furnishings are absent in many of the very richly furnished tumulus graves of Pogrebova's LBA IV, for example from Archadzor, Beimsarov, Borsunlu and Sarychoban.[68] According to the chronological system published in the same year by Minavvar Guseinova, the first iron artefacts occur in graves of her phase LBA III (10th/9th century BC), and the use of iron only became widespread in the Early Iron Age (8th/7th century BC).[69] Andreas Schachner also concludes that iron remained rare in the first quarter of the 1st millennium BC, and was introduced to Azerbaijan later than in Georgia.[70]

Although there seems to be a consensus that iron was adopted relatively late in Azerbaijan, and iron artefacts remained rather uncommon in the first two centuries of the 1st millennium BC, it needs to be emphasized that the present state of research does not allow definite conclusions.

Discussion and conclusions

The Greater Caucasus mountain range and the isthmus between the Caspian and Black Seas form the frontier between Eastern Europe and Western Asia. This special geographical position, and its influence on the course of cultural and technological developments, make the archaeology of Transcaucasia particularly instructive. At the same time, the study of this region is beset with serious hindrances because of the uneven state of research. For example, it is unfortunate that hardly any information is available on the early development of ironworking in Azerbaijan and eastern Anatolia. And, as most of the earliest iron artefacts come from graves, our knowledge is very dependent on burial customs; in areas with collective burials, where graves could be used for generations, and perhaps even several centuries, it is often difficult to date the individual grave furnishings. This problem is encountered in western Georgia, and also in Armenia, in Azerbaijan, and in the cemeteries around Lake Van.

The following discussion will focus on two aspects: the earliest iron artefacts which appear in the archaeological record; and the commencement of the production of iron weapons.

The iron one-edged knives from central Georgia constitute the earliest evidence for iron in the Caucasus region. As explained above, at least four and possibly as many as six examples date before the mid-11th century BC. As we have shown in previous chapters, knives played a conspicuous role among the earliest iron artefacts in a number of geographical regions: Cyprus; the Aegean (see Figure 13); between the Carpathians and the Dnipro (see Figure 26); and in settlements in the forest steppe in Ukraine (Chernoles and Bondarikha cultures). As we will see in Chapter 7.2, knives are also prominent among the earliest iron objects in the Western and Eastern groups of the Koban culture and in the Maklasheevka culture in the Volga/Kama region.[71] As explained above, we lack reliable information on the adoption of iron in western Georgia and Azerbaijan. However, in Armenia, the eight iron knives discovered in the cemetery of Artik constitute a further example in which knives are predominant among the earliest iron artefacts.

In all the cases listed above, knives play a special role among the earliest iron artefacts to appear in the archaeological record. The various examples for this phenomenon are obviously not contemporary: roughly three centuries separate the earliest (Cyprus) and latest regional case studies (e.g. the Volga/Kama region, or the northern Caucasus). For this reason, we cannot speak of a single 'knife horizon' involving all these regions, but instead a number of 'knife horizons'.

Despite this chronological heterogeneity, this special role of knives becomes significant when compared with the situation in the Near East. As explained in Chapter 2, items of ring jewellery, such as bracelets, finger rings and anklets – rather than knives – are predominant among the earliest iron artefacts in the Near East (the geographical extent of the 'ring horizon' is illustrated schematically on Figure 7). The 'ring

68 Pogrebova 2011: 117 ff.; 137 ff.
69 Guseinova 2011: 96 ff.
70 Schachner 2004: 186.
71 In the forest steppe and in the northern Caucasus, alongside the knives, bimetallic daggers also appear among the earliest iron objects (see also Chapter 12.1).

horizon' is most apparent in Mesopotamia and the Levant, but evidence for the special role of early iron ring jewellery reaches as far north as Lakes Van and Urmia. In the Caucasus region, rings are uncommon during the initial stage of the adoption of iron – the exceptions include single examples of bracelets in the cemeteries of Artik (Armenia) and Zandak (Chechnya). After a detailed discussion, it was argued in Chapter 2 that in Mesopotamia and the Levant the new technology of ironworking was at first applied primarily in the production of ring jewellery. So, the 'ring horizon' apparent in the archaeological record derives from the fact that, at first, iron use was tightly circumscribed; presumably this was because iron still retained some of the symbolic meanings the metal traditionally possessed in the Bronze Age palaces and temples, both in the Near East and in Egypt.

The question then arises, how to account for the fact that knives appear as the earliest iron artefacts in so many regions spanning Cyprus, the Aegean, the area north of the Black Sea, the Volga/Kama region, the northern Caucasus and central Transcaucasia? Two possible explanations can be envisaged. The diffusionist explanation would require that the practice of making knives spread after ca. 1200 BC from Cyprus to the Aegean, and subsequently to the Black Sea and Transcaucasia. There are two weaknesses in this model. Firstly, the chronology of the earliest iron knives in central Georgia is at present uncertain, with suggested dates ranging between the 12th and 13th centuries BC; in the latter case, knives would have been produced earlier in Transcaucasia than in the Aegean or Cyprus. Secondly, there is no other evidence for direct contact between the Aegean and central Transcaucasia at this time, specifically during the 12th century BC. In the second possible explanation, the choice of knives as the first artefacts made by the earliest smiths is simply a case of parallel or convergent evolution. Considering that the first products must necessarily have required relatively little blacksmithing experience, there is only a limited range of suitable artefacts. Because of their small size and simple, flat shape, knife-blades are an obvious choice. And in a scenario in which most communities were as yet unable to produce iron, simple iron knife-blades would have been well suited for gift-giving and trade. Convergent evolution is the most economical explanation, as it does not presuppose the exchange of information over vast distances and between unrelated cultures. Following this reasoning, the manufacture of knives can be regarded as the 'default setting': if iron did not possess a traditional symbolic meaning, as it did in Mesopotamia and the Levant, then knives represented the obvious choice as the most suitable (and easy) artefacts for the first blacksmiths to make.

Although the central Transcaucasian smiths did not choose to make iron ring jewellery, this doesn't mean that there was no contact with the Near East. As the technology of iron smelting and smithing was slowly becoming available in many regions of the Near East during the 13th and 12th centuries BC, it is more likely that this expertise was somehow transmitted to Transcaucasia from Mesopotamia, rather than imagining a transfer of technology by sea from the Aegean.

Turning to the second question, the commencement of the production of iron weapons in central Transcaucasia has already been discussed above. According to the evidence presently available, in central and eastern Georgia, and probably also Armenia, iron weapons such as swords, dirks, daggers, spearheads and arrowheads first appear in the archaeological record around the middle of the 11th century BC. This important advance in ironworking seems to have taken place at approximately the same time as in Cyprus, the Aegean, and probably also further to the east, at Marlik in northern Iran. The important aspect of this observation is that it must have led to a profound transformation in the perception and status of the new metal in many areas of the East Mediterranean and the Near East: the understanding that the new metal could be used to manufacture large weapons.

The advances in ironworking technology could have been transmitted very quickly between regions. This is certainly true in the case of Cyprus and the Aegean, which were in close contact with each other during the 11th century BC. It is also conceivable in the case of Transcaucasia. The discussion of the finds from Hordiivka, in Ukraine, showed clearly that Aegean seafarers must have been active in the Black Sea around the mid-11th century BC (see Chapter 6.2). And the introduction of the arched fibula in Transcaucasia also shows that some sort of contact with the Aegean must have existed, presumably involving long-distance, sea-borne exchange (Figure 35). Perhaps a memory of this ancient contact is even reflected in the ancient saga of the Argonauts' journey to Colchis.[72]

It is difficult to account for the precocious development of ironworking in central Transcaucasia. The technology of iron production could conceivably have been transmitted from Mesopotamia or Anatolia. And it is probably significant that the production of iron weapons also started during the 11th century in Marlik, on the southern coast of the Caspian Sea. However, it is also surely significant that the process of innovation in the Aegean and in central Transcaucasia apparently took place in parallel: in both regions, the initial production of iron knives was followed, around the mid-11th century BC, by the onset of the manufacture of iron weapons. While it seems unlikely that the technology of iron production was brought to Georgia by Aegean seafarers, the possibility cannot be ruled out. At present, the reasons behind the early start of iron production in Transcaucasia remain an open question.

7.2 North of the Caucasus

In current research on the Early Iron Age of the northern flank of the Caucasus, two major cultural entities are distinguished: the classic Koban culture reaching from Karachay-Cherkessia in the west to Chechnya in the east and northwards into the Stavropol Upland; and the Proto-Maeotian culture in the Kuban region. The monographs published in 2007 by Sabine Reinhold and Vladimir Erlikh are extremely valuable for gaining an insight into the introduction of iron in this area.[73]

To understand the following discussion, it is necessary to introduce some more detail concerning the regional differentiation within these cultural complexes (Figure 30). In the fundamental studies by Valentina Kozenkova, the Koban culture is divided into three regional groups: Western, Central and Eastern.[74] An important concentration of Koban sites is found in the Western group around Kislovodsk and Pyatigorsk in the so-called Caucasian Mineral Waters (Kavkazskie Mineral'nye Vody) region. Regional groups are also distinguished within the so-called Proto-Maeotian culture, and will be described below.

The subject of the spread of iron metallurgy to the regions north of the Caucasus has been discussed in a wide-ranging article by Sergey Dudarev.[75] He concludes that there is a general consensus that iron spread northwards from Transcaucasia, involving both the importation of iron artefacts and the transfer of smelting technology. It is generally accepted that the earliest iron artefacts in the regions north and north-west of the Caucasus appear around the end of the 10th or the beginning of the 9th century BC.[76] However, Valentina Kozenkova mentions occasional earlier evidence for iron in the 10th century BC, including a few simple artefacts such as knives and awls. According to Kozenkova, iron was first used in the Central group of the Koban culture as an inlay on bronze artefacts, especially belt-hooks and shaft-hole axes, in the first half of the 10th century (late Koban IIA), or possibly in the second half of the 11th century BC, at the time of the earliest arched fibulae.[77]

Vladimir Erlikh argues for a much later introduction of iron in the northern and north-western Caucasus; apart from rare exceptions, for example the knives from Tereze (see below), he believes that the first iron artefacts appear north of the Caucasus in the late 9th or first half of the 8th century BC.[78] He agrees that the transition to iron mainly took its impulse from the Transcaucasian tradition of ironworking. However,

[72] It is uncertain why the Greek seafarers should have travelled to Colchis. As Nathaniel Erb-Satullo explains, it is unlikely that Colchis could offer large quantities of gold during the Late Bronze and Early Iron Age. See Erb-Satullo 2022.
[73] Reinhold 2007; Erlikh 2007.
[74] The cemetery of Tli, discussed in Chapter 7.1, belongs to Kozenkova's Central group of the Koban culture.
[75] Dudarev 2004.
[76] Dudarev 2004: 3.
[77] Kozenkova 1992: 60; 1996; 93. — Note that bronze belt-hooks with iron inlays have been mentioned above, in Chapter 7.1, from the Ude hoard and from Natsargora, Grave 223. — For bronze artefacts with iron inlays, see for example the finds from excavations in the 1880s at Verchniy Koban: Chantre 1886: 49-53; pl. 9bis: 1.2.3; 10: 1. — For an early bronze dagger with iron 'incrustation' on the handle, see Chantre 1886: pl. 4: 2.
[78] Erlikh 2007: 21-24; 2012.

he recognises two distinct ironworking traditions in the northern Caucasus.[79] The South Caucasian/ Near Eastern tradition, transmitted from Transcaucasia, is characterised by an advanced technology involving controlled carburization and thermal treatment (quenching), and was able to produce tools and weapons which were technically superior to bronze. According to Erlikh, metallographic analyses show that this advanced technology was introduced to the Central Koban group (Tli), the Eastern Koban group (Serzhen Yurt) and the Eastern/Piedmont group of the Proto-Maeotian culture. Erlikh believes that some of the early iron objects in these regions were probably imported from south of the Caucasus; alternatively, craftsmen from south of the Caucasus may have travelled to the north. By contrast, in the regions of the Caucasian Mineral Waters and in the Central/Steppe group of the Proto-Maeotian culture, metallographic analyses were able to detect a distinctly different, East European or Steppe tradition of ironworking. This was a simple technology, with no signs of intentional carburization. He argues that the roots of this tradition are to be sought in the Bilozerka culture, where the development of iron smelting was supposedly brought about by a crisis in the bronze supply.[80] As the new metal was introduced simply as a substitute for bronze, it was not a crucial disadvantage that the iron artefacts were no improvement compared to the bronzes. According to Erlikh, the East European tradition spread eastwards through the steppes during the pre-Scythian period.

In her important monograph, Sabine Reinhold studied the chronology of the various cultural groups in the northern Caucasus systematically, using computer seriation techniques. In the present context, the results concerning the dating of graves with bronze or iron weaponry are an especially valuable contribution. She came to strikingly different conclusions concerning the date of the introduction of iron to the northern Caucasus. Reinhold agrees with Kozenkova that iron first appeared in the Central group of the Koban culture as inlays on bronze artefacts, but she dates the earliest examples of such decoration to the 11th or even 12th century BC.[81] Furthermore, she believes that the earliest bimetallic daggers were already manufactured in the Western group of the Koban culture during the 11th century BC.[82] Iron spearheads were then supposedly introduced during the 10th century BC in the Caucasian Mineral Waters region.[83] These ideas will be discussed further below; it is only necessary here to draw attention to the fact that Reinhold envisages a much earlier introduction of iron to the Koban culture than Kozenkova and Erlikh. According to the results of Reinhold's chronological research, iron was adopted considerably earlier in the Western Koban group (and in the Kuban) compared to the Central group of the Koban culture, where iron artefacts are first documented around 900 BC. In view of the high level of smelting technology (carburization) and the preference for bimetallic artefacts in the north-west Caucasus (Western Koban and Kuban), Reinhold believes that iron metallurgy was introduced to these regions from north-west Iran, where iron production had started earlier.[84]

From this brief review of previous research, there are some issues which seem to be particularly interesting. Firstly, the manner in which iron was first introduced. The use of iron as an inlay suggests that it was initially valued as a rare and precious metal. Secondly, there are conflicting ideas about the absolute chronology of the first iron objects: traditional, high (Reinhold) and low (Erlikh). Thirdly, regarding the question of the transfer of iron metallurgical technology, three alternatives have been suggested: from north-west Iran, from Transcaucasia, and from the North Pontic steppe (Bilozerka and Chernogorovka cultures). Finally, the regions north-west of the Caucasus (Western Koban and Proto-Maeotian cultural groups) seem to be particularly important in the adoption and dissemination of ironworking. These issues will be discussed in the following paragraphs.

[79] See also Zavyalov and Terekhova 2018.
[80] The theory that iron was 'invented' in the Bilozerka culture following a crisis in bronze supply was rejected in Chapter 6.1.
[81] Reinhold 2007: 303; 307 (KoB1). — For the dagger with a decorative iron inlay on the hilt, dated by Reinhold to KoA, see: Chantre 1886: pl. 4: 2; Reinhold 2007: 165; 166 fig. 68. — For a summary of the chronological phases used by Reinhold (KoA, KoB1, KoB2 etc.), see Reinhold 2007: 278; 279 fig. 132.
[82] Reinhold 2007: 303; 307 (KoB1).
[83] Reinhold 2007: 303; 307 (KoB2).
[84] Reinhold 2007: 307.

The following discussion will concentrate on the bronze and iron artefacts from funerary contexts. In fact, the focus will be restricted almost entirely to male graves containing weapons and cutting implements. The reason for this is that iron artefacts are normally not found in female graves, which mainly contain jewellery and costume accessories made of bronze and other materials, making them irrelevant for the question of the introduction of iron.

The Koban culture

Unfortunately, most of the finds of the Central ('Highland') group of the Koban culture stem from early, unprofessional excavations, and reliable contexts containing early iron artefacts have not been documented. Most evidence for early iron in the Koban culture comes from the Western group, particularly in the Caucasian Mineral Waters region and surrounding areas. However, there are two cemeteries in the Eastern group of the Koban culture which offer an interesting insight into the early introduction of iron.

The well-known cemetery of Serzhen Yurt is located in the foothills of the Caucasus close to the steppe in eastern Chechnya. In her monograph devoted to the site, Valentina Kozenkova noted that the use of the cemetery progressed from west to east: in Figure 36 the burials on the left-hand side are apparently earlier than those on the right. This means that the horizontal stratigraphy of the cemetery can provide us with an illustration of how iron was introduced among the grave furnishings at different stages in the development of the cemetery. As Kozenkova explained, graves with iron artefacts are confined to the eastern end of the cemetery.[85] For example, whereas the western part of the cemetery only has bronze knives, iron examples are only found in the east.

Iron is first found in Grave 70 as an inlay ('incrustation') on the hilt of a bronze solid-hilted dagger of Kabardino-Pyatigorsk type; the crouched inhumation burial was accompanied by the skeleton of a horse. Iron artefacts first appear in a group of graves with small iron knives (Graves 42, 44 and 46); Grave 44 also contained a bimetallic dagger of Golovyatino type. The harness equipment from three horse-rider graves (Graves 38, 39 and 56) suggests that this part of the cemetery was probably being used during the 9th century BC.[86] Iron weapons (daggers, spearheads, shaft-hole axes, arrowheads) are only found in later graves, at the eastern end of the cemetery (Graves 16, 24, 26, 28, and Graves 1, 3 and 4 in area II). According to this reconstruction of the horizontal stratigraphy at Serzhen Yurt, it is suggested that three stages can be distinguished in the introduction of iron in this site of the Eastern group of the Koban culture: 1) at first, iron was only used as a decorative metal; 2) iron artefacts appear initially in the form of knives and a bimetallic dagger; 3) in the final stage, iron was used for a wide range of large iron weapons. Two of the earliest artefacts with iron are solid-hilted daggers, which are very likely objects of high status.

The cemetery at Zandak is located further to the east, close to the border with Dagestan. The graves are less richly furnished than at Serzhen Yurt, and the contexts are more difficult to interpret.[87] Nevertheless, Zandak offers another illustration of how iron was introduced. In this case, the use of the cemetery apparently progressed from north to south (Figure 37). In the northern half of the cemetery there are elements of horse harness made of bone, which are characteristic for the Final Bronze Age (Graves I/3, II/15 and IV/2). The cheek-pieces from Graves I/3 and II/15 belong to a type which will be discussed below.[88] Iron appears midway in the cemetery's southward development (Graves II/14.17.29, V/60), in the form of three knives and one bracelet. The knife from Grave V/60 is associated with a fragmentary antler cheek-piece, which probably originally had three equally sized round perforations. According to this, the cheek-piece should probably be assigned to the pre-Scythian period.[89] If so, iron artefacts might have appeared at the same time in Zandak and Serzhen Yurt. Further iron knives are found at the

85 Kozenkova 1992: 60-66; see also Reinhold 2007: 191 f.

86 See particularly the cheek-pieces of Kamyshevakha type, which are known from contexts of Ha B3 in Central Europe.

87 See Markovin 2002.

88 For the rod-shaped cheek-pieces, see Val'chak 2009: 229 fig. 42: 4.9. — The bronze rein-knob in the shape of a ram's head from Grave II/15 seems to be a prototype for comparable rein-knobs of the early Chernogorovka period, see for example Erlikh 2007: 256 fig. 57: 4 (Pshish, Grave 3).

89 Val'chak 2009: 244 fig. 57: 6; compare 244 f. fig. 57-58.

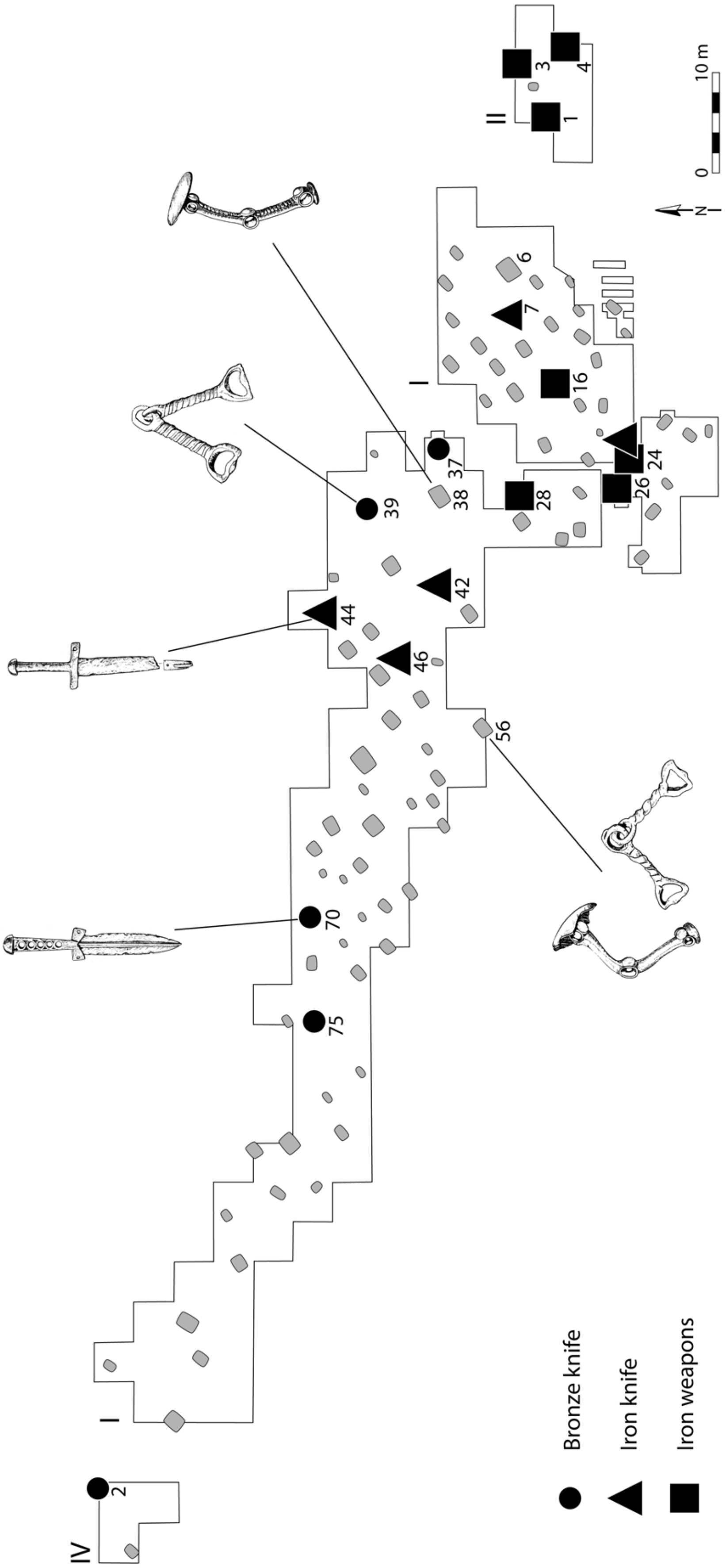

Figure 36. Plan of the cemetery at Serzhen Yurt (Chechnya) with indications of a horizontal stratigraphy.

southern end of the cemetery (Graves III/35.38.51), but are now associated with iron weapons (two iron spearheads). The horse harness of classic Novocherkassk type from Grave III/38 provides an approximate date in the 8th century BC for this late part of the cemetery.

The horizontal stratigraphies proposed for Serzhen Yurt and Zandak illustrate a plausible succession of three stages in the adoption of iron: 1) The new metal was first used for decorative purposes on high-status artefacts; 2) Iron artefacts, mainly knives, were first included among the grave furnishings in the second stage; at this time, iron was also used to manufacture prestigious bimetallic daggers; 3) In the final stage, the graves contain large iron weapons. According to the evidence outlined above, before the 9th century BC iron was either unknown, or seems to have been treated as a rare and precious metal.

Turning to the north-west Caucasus, the most important information on the early adoption of iron again comes from funerary contexts. As female burials were generally provided with jewellery and costume accessories made of bronze, our focus will once again concentrate on weapon-graves. And because spearheads are a regular feature in weapon-graves, it is most enlightening to analyse these weapons as an example for the transition from bronze to iron. The most important cemeteries, with relatively large numbers of well-recorded graves, come from the Caucasian Mineral Waters region of the Western group of the Koban culture, and the so-called Proto-Maeotian cultural groups in the foothills and steppe regions of the Kuban. In her important work on the relative chronology of these cultural groups, Sabine Reinhold argued that in these areas it seems possible to distinguish an initial stage in which the weapon-graves have bronze, rather than iron spearheads.[90]

The Caucasian Mineral Waters region is centred on the thermal springs around Kislovodsk and Pyatigorsk. The cemeteries in the vicinity of Kislovodsk, such as Klin-Yar, Mebel'naya Fabrika, Belorechenskiy, Berezovskiy and Echkivash, are especially important. Whereas in this region the Final Bronze Age is ill-defined, with only a small number of graves exhibiting heterogeneous burial customs, the situation in the Early Iron Age is in sharp contrast. Now, burial took place in large, flat inhumation cemeteries with individual graves; the burial customs are strictly standardized, and the material culture is quite distinct from the preceding period.[91] A recent fieldwork project in the area around Kislovodsk has demonstrated a drastic change in settlement organisation in the 10th/9th century BC, at the Bronze/Iron transition. The numerous Final Bronze Age settlements with a pastoral economy on the upland plateaus were abandoned. In the Early Iron Age large settlements of 2-7 ha were established in the valleys, surrounded by field systems, and with an intensive agricultural economy.[92]

There is a well-defined early phase in the cemeteries of the Caucasian Mineral Waters region, in which iron spearheads occur regularly; among the other frequent grave furnishings are solid-hilted daggers, mace-heads, bronze hammers, stone axes, whetstones, and bronze harness fittings for a ridden horse (a horse-bit and a pair of cheek-pieces).[93] Grave contexts of this chronological horizon are well represented in the vicinity of Kislovodsk; typical examples include Klin-Yar 3, Grave 313/Belinskiy; Mebel'naya Fabrika 1, Grave 15; and Echkivash, Grave 4/1966.[94] Judging from the horse-gear in these graves, this horizon should be dated approximately to the 9th century BC.[95]

As Sabine Reinhold argues, a few graves with bronze spearheads appear to be slightly earlier, in which case they would belong to the Initial stage in the flat cemeteries in the Caucasian Mineral Waters region. Apart from the bronze spearheads, the graves contain bronze and bimetallic solid-hilted daggers, iron knives, and low carinated bowls with a simple decoration on the neck.[96] It is significant that horse

[90] Reinhold 2007: 223 ff.; 251 ff.; 255 ff.
[91] For a more detailed discussion, see for example the comments in Reinhold 2007: 223; 237; 303.
[92] See Reinhold 2017; Reinhold et al. 2012; 2020.
[93] See Reinhold 2007: 223 ff.
[94] Reinhold 2007: pl. 334: 1-8; 347: 7-18; 369: 9-22.
[95] This corresponds to the traditional scholarly consensus on the chronology of the pre-Scythian period; see Reinhold 2007: 303. — For an authoritative discussion, see Metzner-Nebelsick 2002: chapter 9; see also Metzner-Nebelsick 2009: 206.
[96] Reinhold 2007: 223 ff. — Reinhold et al. mention that another grave (Belorechenskiy 2, Grave 17) has a pottery vessel with an

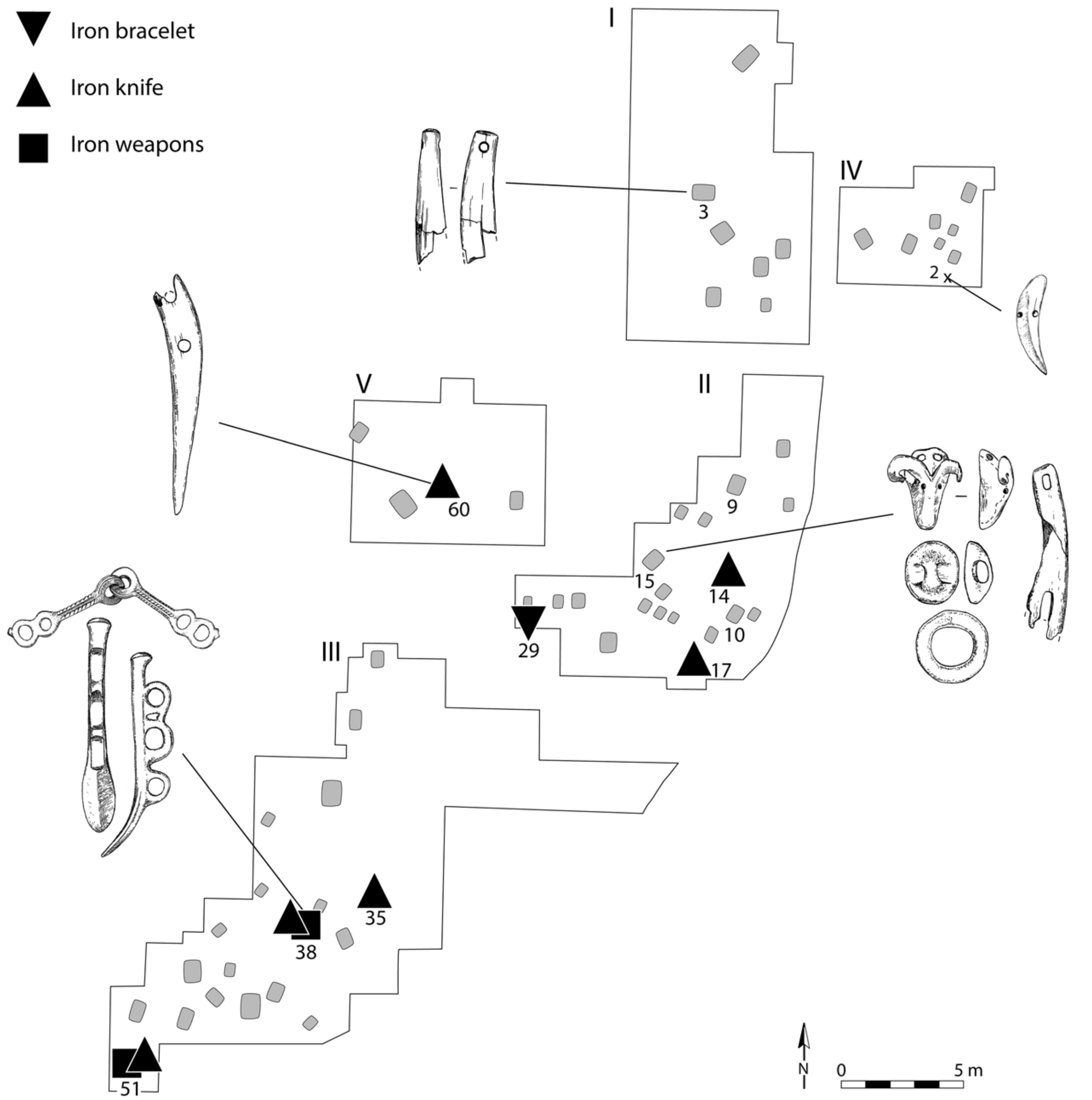

Figure 37. Plan of the cemetery at Zandak (Chechnya) with indications of a horizontal stratigraphy.

harness does not yet occur in these graves. Examples include Belorechenskiy 2, Grave 27; Klin-Yar 3, Grave 331/Belinskiy; and Mebel'naya Fabrika 1, Grave 28.[97] Further examples with bronze spearheads can be cited from Kamennomostskoye, located to the south-east of the Caucasian Mineral Waters region, in Kabardino-Balkaria.[98] Some grave inventories of the Initial stage are shown on Figure 38.

According to our schematic chronology, the Initial stage of graves with bronze spearheads, iron knives and bimetallic daggers should date ca. 900 BC. It is probably no coincidence that the earliest iron objects in these cemeteries of the Western Koban group – small knives and bimetallic daggers – are the same

early form of decoration similar to the pottery from Late Bronze Age sites; the flat iron fragment from this grave assemblage could well be from another small iron knife dating to the Initial stage of the Early Iron Age cemeteries at Kislovodsk. See Reinhold et al. 2012: 16; Reinhold 2007: pl. 294: 1-5.

[97] Reinhold 2007: pl. 297: 20-22; 335: 13-16; 351: 6-12.

[98] Kammenomostskoye, Grave 4/1921 and 34/1971; see Reinhold 2007: pl. 279: 13-14; 280: 1-5.

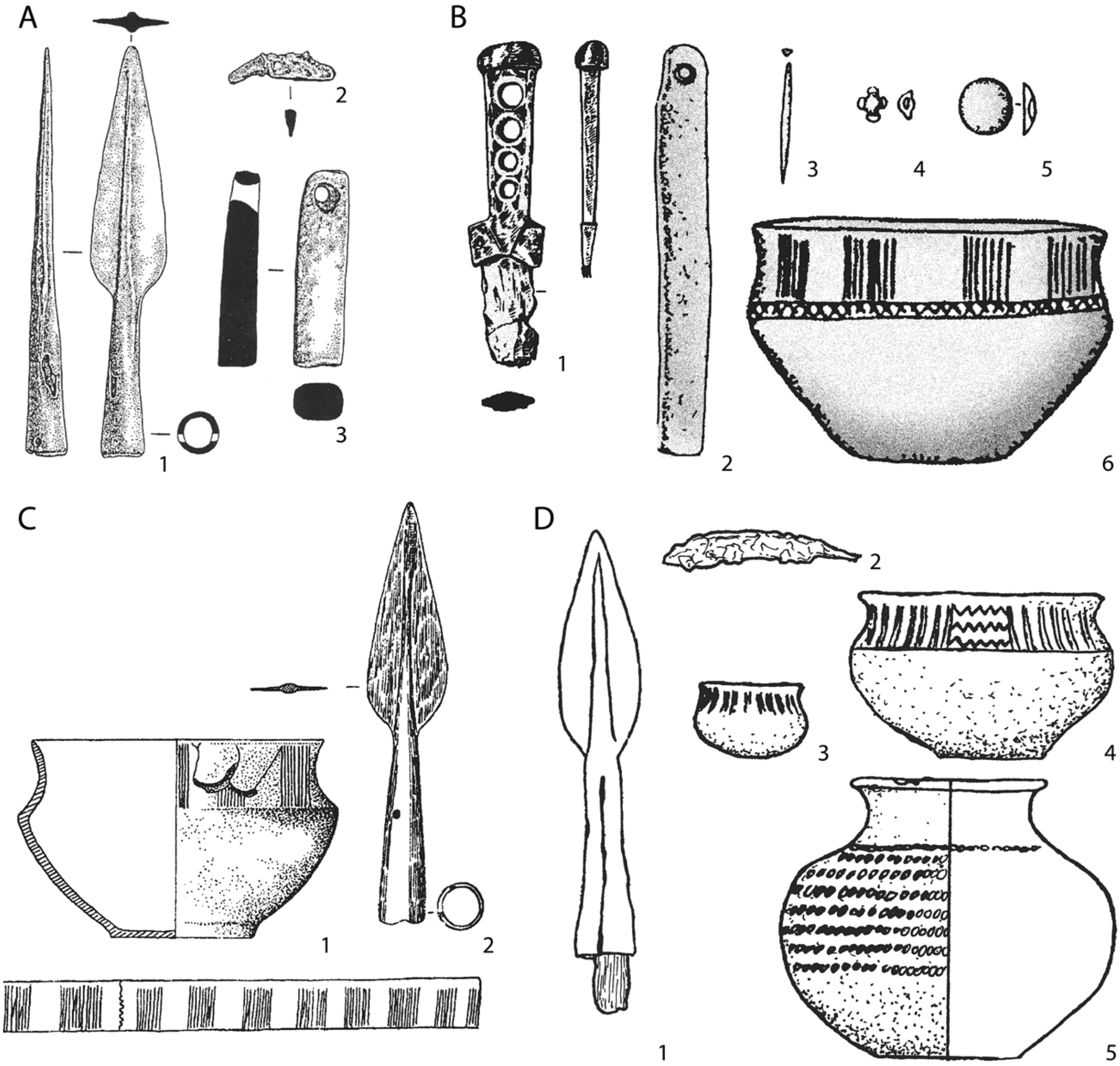

Figure 38. Grave inventories from the Western group of the Koban culture. — A Belorechenskiy 2/Grave 27. — B Klin-Yar 3/Grave 331. — C Mebel'naya Fabrika 1/Grave 28. — D Kamennomostskoye, Grave 34/1971. — A1, B3-5, C2, D1 bronze. — A2, D2 iron. — B1 bronze and iron. — A3, B2 stone. — Otherwise, pottery. —After Reinhold 2007: pl. 280; 297; 335; 351. — Metal and stone: Scale 1:3; pottery: Scale 1:4.

as in the earliest graves with iron artefacts in the cemetery of Serzhen Yurt. The coincidence becomes more significant, however, considering the collective graves excavated by Valentina Kozenkova at Tereze, located just west of Kislovodsk in Karachay-Cherkessia. Although the chronology of the various depositions in these graves is far from straightforward, it is most likely that the iron finds from Grave 1 (two small knives) and Grave 2 (the hilt of a bimetallic dagger) should be assigned to the transition from the Final Bronze to the Early Iron Age.[99] As Vladimir Erlikh notes, the bronze and iron knives from Grave 1 are similar in shape, which suggests that the iron examples might have been made locally.

[99] Kozenkova 2004: pl. 18: 4; 25: 1.2; Kozenkova dates the finds from Grave 1 to between the 11th and the first half of the 8th century BC; the finds from Grave 2 to between the 12th and the 10th century BC. — Erlikh (2007: 21 f.; 2012: 29) believes that the knives from Tereze are the earliest iron finds in the Western Koban group; see also Kozenkova 1996: 93 table 2; 95 (Tereze, Graves 1 and 2 assigned to the 10th century BC).

The definition of the Initial stage in the Caucasian Mineral Waters region is important, as it represents the time when iron was introduced in the Western group of the Koban culture, before the stage when iron was widely used for the manufacture of weaponry. After the Initial stage, iron was adopted very rapidly for making spearheads, and iron spearheads were doubtless manufactured locally during the 9th century BC. The situation in Serzhen Yurt is different: bronze spearheads were still in use during the later stage of the cemetery's development (Graves 6, 37, 39, 42), indicating that iron only gradually replaced bronze at this site.

The Proto-Maeotian culture

North-west of the Caucasus mountain range lies the Kuban region, reaching westward to the coast of the Black Sea and the Sea of Azov. Vladimir Erlikh has published a fundamental monograph on the Early Iron Age of this region. Together with Aleksandr Leskov, he also published the important cemetery of Fars/Klady.[100] Erlikh distinguishes three cultural groups between the Caucasus and the middle and lower course of the Kuban River in the Early Iron Age: the Eastern or Piedmont group, the Central or Steppe group and the Western or Coastal/Abinsk group.[101] According to Erlikh, all three groups belong to the so-called Proto-Maeotian culture (Figure 30).

The flat inhumation cemeteries of the Kuban were an innovation at the start of the Early Iron Age. Hardly any burials are known in the Final Bronze Age, and the few exceptions were only provided with meagre furnishings.[102] In this period, roughly dating from the 13th to the 10th century BC, the steppe between the Lower Don and the Kuban was occupied by the Kobyakovo culture, which is related to the Bilozerka culture situated further to the west. Kobyakovo settlements are rare, and seem chiefly to be located close to wetter areas such as the Don Delta; the settlement excavated at Krasnogvardeiskoye close to the Kuban River in Adygea is an important example. For our purposes, it is important to note that iron has never been found in contexts of the Kobyakovo culture.[103]

Erlikh defined three phases within the Early Iron Age Proto-Maeotian culture, mainly based on the typology of horse harness accessories, weaponry and handled pottery cups: 1) Pre-Novocherkassk/Early Chernogorovka; 2) Pre-Classic Novocherkassk/Transitional; and 3) Classic Novocherkassk. Sabine Reinhold suggested that an Initial stage can be distinguished within Erlikh's first phase, which is characterised, among other things, by short bronze spearheads and bronze bracelets. As explained above, spearheads are very common in Early Iron Age weapon-graves in this region, and they are particularly important for the question of the introduction of iron metallurgy.[104]

In the Eastern/Piedmont regional group, typical grave assemblages of the Initial stage include Fars/Klady, Graves 16, 21, 25 and 28 (Figure 39).[105] Apart from the bronze spearheads and bracelets, the grave furnishings include bronze knives, a bimetallic dagger, short bronze horse bits with round or triangular terminal loops, and bronze cheek-pieces of Erlikh's type IA.[106] The sickle-shaped bronze toggle from Grave 16 is similar to an example from Tereze, Grave 2, discussed above.[107] The horse bit with triangular loops from Grave 25 recalls the example from Hordiivka, Tumulus 34, which is probably slightly earlier, as it has been dated to the 10th century BC.[108] Finally, the bimetallic dagger from Grave 25 belongs to a type which is also found in later graves; however, similar daggers from Tereze, Grave 2 and Serzhen Yurt, Grave 44 show that the type was already produced in the Initial stage of the Early Iron Age. Iron spears subsequently became predominant in the course of Erlikh's Pre-Novocherkassk phase. Typically, they

[100] Erlikh 2007; Leskov and Erlikh 1999.
[101] Erlikh 2007: 216 f. fig. 12.
[102] Reinhold 2007: 248 ff.
[103] Erlikh 2007: 21-24; 2012: 29.
[104] Reinhold 2007: 262.
[105] For the Fars/Klady grave assemblages, see Leskov and Erlikh 1999.
[106] For the cheek-pieces of type IA, see Erlikh 2007: 366 f. fig. 184-185.
[107] Kozenkova 2004: pl. 23: 9.
[108] See Metzner-Nebelsick 2005a: 297 fig. 4b: Z4. — For the Hordiivka cemetery, see Chapter 6.2.

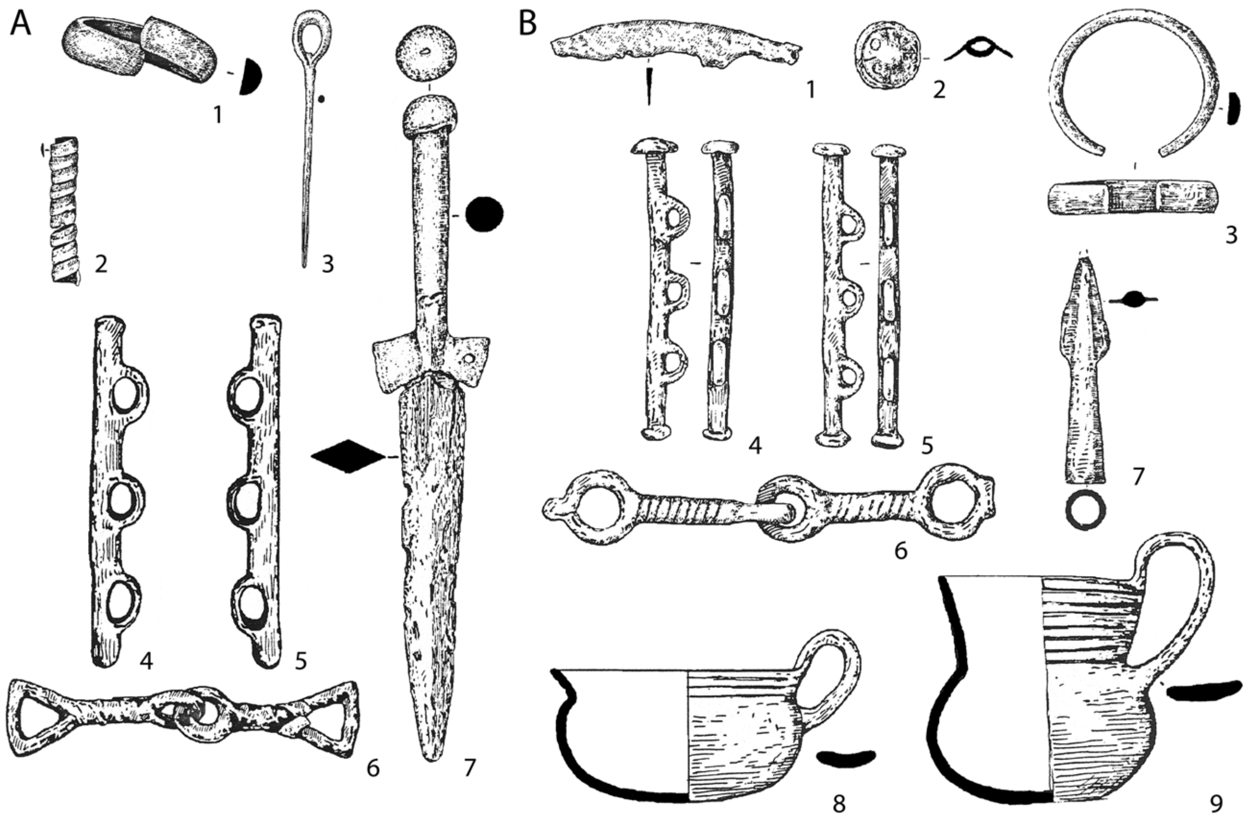

Figure 39. Grave inventories of the Eastern/Piedmont group of the Proto-Maeotian culture. — Fars/Klady, Graves 25 (A) and 28 (B). — A1-6, B1-7 bronze; A7 bronze and iron; B8.9 pottery. — Metal: Scale 1:3; pottery: Scale 1:5.

are associated with horse-gear with band-shaped cheek-pieces (Erlikh's type IIA), for example in Fars/Klady, Graves 2, 6, 9 and 13.[109] As for the absolute chronology, both Erlikh and Reinhold agree that the Pre-Novocherkassk phase is contemporary with hoard phase V in the Carpathian Basin. In my opinion, this indicates an approximate date in the 9th century BC.[110]

In the Central/Steppe regional group, graves of the Final Bronze Age are again practically unknown and the flat inhumation cemeteries begin at the start of the Early Iron Age. In its early stage, the Steppe group entertained close relations with the Chernogorovka culture of the steppe around the Lower Don and north of the Black Sea, as shown for example by the antler horse-gear from Pshish, Graves 83 and 93.[111] A number of graves have artefacts which might be contemporary with the Initial stage in the Eastern/Piedmont regional group, such as short bronze spearheads, bronze knives, short bronze horse bits with triangular terminal loops, cheek-pieces of Erlikh's types IA and IIIA (Chernogorovka), and early varieties of pottery cups. Several examples come from the cemetery of Pshish (e.g. Graves 40, 41 and 61), and a similar inventory comes from Yastrebovskiy, Kurgan 1, Complex VII in the Abinsk District of the Western regional group of the Proto-Maeotian culture.[112] However, in the Central/Steppe regional group, iron still seems to be absent at this time; the bimetallic dagger from Pshish, Grave 41, which closely resembles the example from Fars/Klady, Grave 25, mentioned above, is a possible exception.[113] Bronze weapons continued to play an important role throughout the Early Chernogorovka phase in the Central/Steppe

109 For the cheek-pieces of type IIA, see Erlikh 2007: 370 fig. 189. — For the Fars/Klady grave assemblages, see Leskov and Erlikh 1999.
110 Erlikh 2007: 410 table V; Reinhold 2007: 259. — For hoard phase V (DFS/Depotfundstufe V), see Pare 1998.
111 Erlikh 2007: 255 fig. 56.
112 Pshish, Graves 40, 41 and 61: Erlikh 2007: 257 fig. 59: 4-6; 263 fig. 65: 30-38. — Yastrebovskiy: Erlikh 2007: 230 fig. 27: 1-6.
113 Erlikh 2007: 263 fig. 65: 32.

regional group. For example, in graves with developed horse-gear, with cheek-pieces of Erlikh's type IB, daggers, spearheads and arrowheads were still often made of bronze.[114] Nevertheless, iron weapons were sometimes used in the Early Chernogorovka phase as shown, for example, by two graves from Pshish with iron shaft-hole axes and an iron spearhead associated with cheek-pieces of Tsimbalka type.[115]

Discussion and conclusions

While the relative chronologies developed by Sabine Reinhold and Vladimir Erlikh appear to be well founded, their arguments concerning the absolute chronology of the early iron artefacts are less convincing. The long-distance contacts existing between the Caucasus and Central Europe, evident from the similar forms of weaponry and horse-gear across this vast space, support the generally accepted view that iron implements were introduced in the northern Caucasus around the late 10th or early 9th century BC; this corresponds with the earliest appearance of iron in the cemetery of Tli in South Ossetia. The 'traditional' view that in the Koban culture, during the 11th/10th century BC, iron was at first regarded as a precious commodity and used as a decorative metal (iron inlays) also remains valid.

The analysis of spearheads, based on Sabine Reinhold's research, revealed an Initial stage in the introduction of iron. In the various regional groups discussed above, the earliest iron artefacts found in the graves at the Bronze/Iron transition were typically knives and bimetallic daggers. After the Initial stage, iron was very rapidly adopted in the Western group of the Koban culture, and also probably in the Piedmont group of the Proto-Maeotian culture in the Kuban. Bronze weapons remained in use longer in the Kuban Steppe group and in the Eastern group of the Koban culture (Serzhen Yurt). The Caucasian Mineral Waters group of the Koban culture and the Piedmont group of the Proto-Maeotian culture evidently played a major role in the spread of ironworking to neighbouring regions on the northern flank of the Caucasus.

Without doubt, iron weapons were already manufactured in large quantities in the north-west Caucasus during the 9th century BC. The onset of ironworking in the north-west Caucasus has a special significance, as it represents an important element in the emergence of the so-called pre-Scythian phenomenon which marks the start of the Early Iron Age in the North Pontic steppe. During this horizon, similar types of artefacts – especially harness components and weapons – are found throughout a vast area, reaching from the Caucasus to the Alps. Apart from 'Pontic-Caucasian' weapons and horse-gear, the use of iron for tools and weapons is an important element of the pre-Scythian horizon (see, for example, Figure 53). This phenomenon involved technological, economic, cultural and ideological innovations which galvanized the steppe. The reasons behind this abrupt transformation over such a vast area, and specifically the origin of the pre-Scythian complex, have been the object of intensive research. In the following, some ideas from influential authors will be discussed.

In his 1976 monograph, Alexey Terenozhkin sought the origin of the pre-Scythian complex in the North Pontic steppe.[116] He believed that the nomadic 'Cimmerians' from the grass steppe brought ironworking technology, among other things, to the northern Caucasus.[117] In a similar vein, Sergey Makhortykh argued that the bimetallic technology used on weaponry in the northern Caucasus originated in the steppe, where bimetallic knives were already manufactured in the Bilozerka culture during the Final Bronze Age.[118]

However, the fact that iron artefacts appeared in the southern part of the Koban culture, in the cemetery of Tli, at the same time as in the area north-west of the Caucasus, at around 900 BC, can hardly be a coincidence, and makes it difficult to avoid the conclusion that ironworking was transmitted to these

[114] See, for example, Pshish, Graves 100 and 102: Erlikh 2007: 263 fig. 65: 25-29; Reinhold 2007: pl. 464: 21-27.
[115] Pshish, Graves 77 and 107: Erlikh 2007: 261 fig. 63: 1-11.
[116] Terenozhkin 1976.
[117] Terenozhkin 1976: 200.
[118] See Makhorykh 2008: 110-112.

regions from central Transcaucasia. Furthermore, it can hardly be doubted that iron artefacts were available in greater quantities in the northern Caucasus – for example in the Caucasian Mineral Waters region, and in the Piedmont group in the Kuban – than anywhere in the North Pontic steppe during the 9th century BC. For example, iron seems to have been adopted relatively late in the regions to the east of the Dnipro: graves of the Chernogorovka culture in eastern Ukraine and around the Lower Don, for example, still mainly contained bronze rather than iron knives.[119] For these reasons, Vladimir Erlikh's proposal that there were two separate traditions of ironworking is more convincing: an East European tradition rooted in the Final Bronze Age Bilozerka culture, and a South Caucasian/Near Eastern tradition which spread north from Transcaucasia.

In her influential study of the pre-Scythian finds in the Carpathian Basin, Carola Metzner-Nebelsick argued that the northern Caucasus was of primary importance as the main source of impulses in the creation of the pre-Scythian phenomenon.[120] The innovations introduced by the dominant mounted warrior class in this area, for example in harnessing techniques, had a profound effect on the North Pontic steppe and Central Europe. The cultural groups in the area north-west of the Caucasus, with their focus on the ownership and military use of the horse, were perceived as a model to be imitated.

In her 2002 monograph, the grass steppe north of the Black Sea played an insignificant role, and functioned primarily as a transit area for innovations originating in the foothills of the Caucasus and transmitted to the Carpathian Basin.[121] But in a later article she concentrated on developments in the North Pontic steppe, which clearly did play a crucial role in the formation of the pre-Scythian complex. In her far-sighted discussion of Hordiivka, she showed that during the later stages of the cemetery, from around the turn of the 2nd/1st millennium BC, the deceased were already buried as members of an equestrian nomadic élite, with a new steppe-orientated identity.[122] Furthermore, she suggested that the communities between the eastern Carpathians and the Dnipro played a significant role in the formation of the élite pre-Scythian, steppe-nomadic culture, with their influence reaching as far as the north-west Caucasus and even Siberia. According to Metzner-Nebelsick, members of the Hordiivka community were a driving force in the historic transformation process in these regions, unfolding at the beginning of the 1st millennium BC.[123]

The rod-shaped cheek-pieces made of bone, horn or antler lend support for this thesis (Figure 40).[124] The cheek-pieces are mainly found in settlements distributed between the Prut and the Danube Delta in the west, and the Dnipro in the east. According to their contexts (Bilozerka, Babadag, Fluted Ware cultures), most can be assigned to the Final Bronze Age. According to Viacheslav Podobed and his colleagues, the examples further to the east, in the Volgograd district and in the area of the Maklasheevka culture in the Volga/Kama region, represent influence from the late Bilozerka culture (ca. second half of the 11th and 10th century BC).[125] The importance of this innovation is succinctly explained in the following quotation: "... there can be little doubt that the invention [of the rod-shaped cheek-pieces] played a revolutionary role in the use of the horse. As a result, within a short space of time, the rod-shaped cheek-pieces spread over a vast area from western Europe in the west to modern north-eastern China in the east ...".[126]

[119] In the regions around the Lower Don and Donets, 79% of the knives associated with crouched inhumation burials of the Early Chernogorovka culture are made of bronze (Dubovskaya 1994: 25 fig. 5). — In the Late Chernogorovka culture, the graves in the west (around the Dnipro and Dnister) still contained more iron objects than in the east (Dubovskaya 1997: 302). — See also Chapter 6.5 and Kašuba et al. 2019: 180.

[120] See, for example, Metzner-Nebelsick 2002: 488 f.; 492.

[121] Metzner-Nebelsick 2002: 489.

[122] Metzner-Nebelsick 2005a: 304 ff. — The finds from the cemetery of Hordiivka are discussed in detail in Chapter 6.2.

[123] Metzner-Nebelsick 2005a: 311.

[124] The rod-shaped cheek-pieces are thickened in the middle and have three transverse openings; the central opening is larger, with a rectangular or oval shape. The cheek-pieces are symmetrical, with both terminals having the same size; the terminals are sometimes enlarged to form caps. Some of the cheek-pieces are unfinished (Dereivka, Fontany, Staraya Igren', Usovo Ozero). Examples where the fragmentary preservation does not allow a definite interpretation are marked as uncertain on the distribution map. — See List 7.1. — For a discussion of the typology of the rod-shaped cheek-pieces, see Val'chak 2009.

[125] Podobed et al. 2017.

[126] Podobed et al. 2014: 99 (my translation).

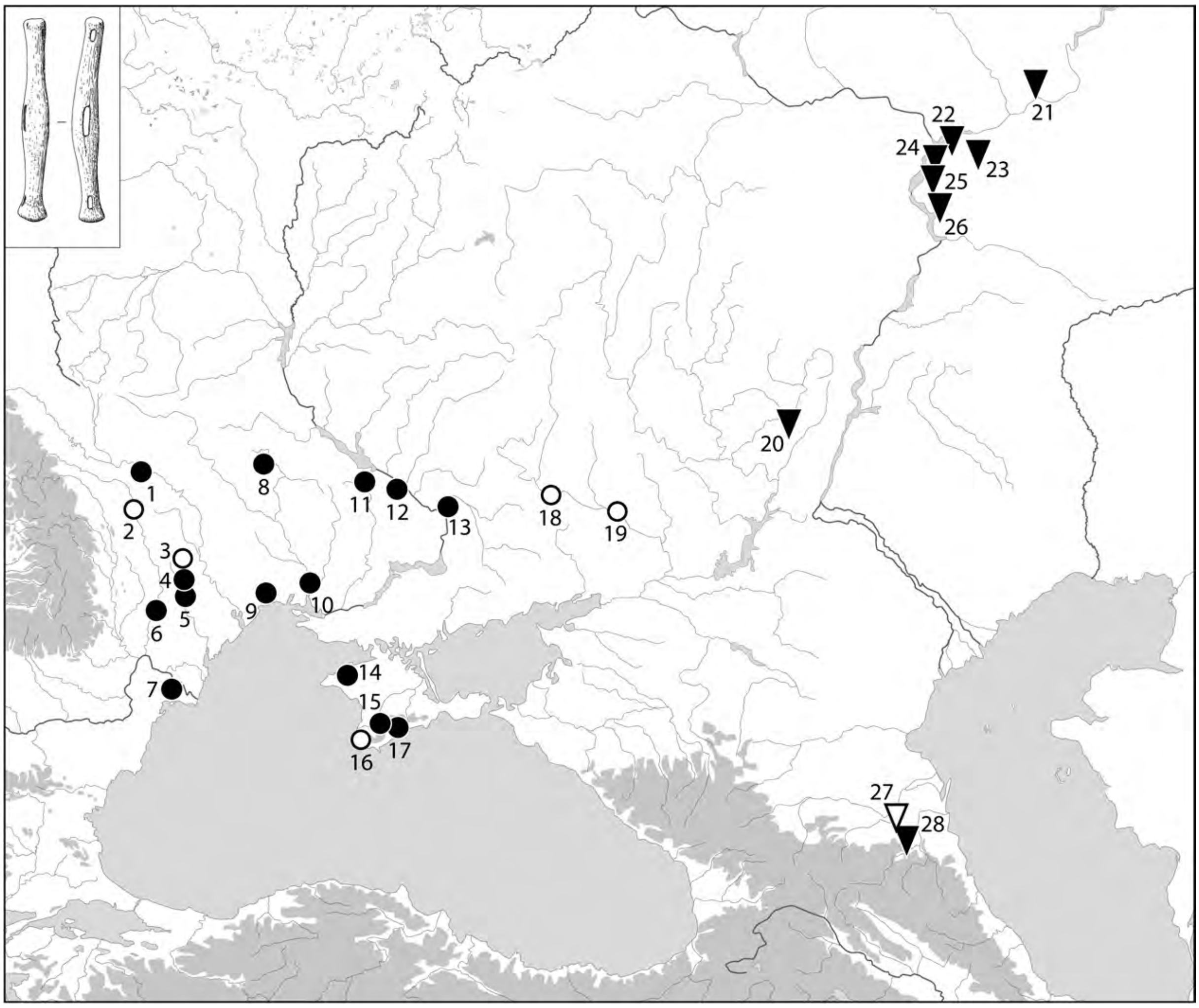

Figure 40. Distribution map of rod-shaped cheek-pieces made of bone, horn or antler (see List 7.1). — Circles: settlements; triangles: graves; empty symbols: uncertain objects. — 1 Trinca. — 2 Costeşti. — 3 Chişinău. — 4 Hansca. — 5 Lipoveni. — 6 Cavadineşti. — 7 Babadag. — 8 Belogrudovka. — 9 Usatovo. — 10 Dikiy Sad. — 11 Subbotovo. — 12 Dereivka. — 13 Staraya Igren‘. — 14 Bay-Kiyat. — 15 Fontany. — 16 Uch-Bash. — 17 Druzhnoe. — 18 Usovo Ozero. — 19 Zakatnoe. — 20 Podgornyi. — 21 Murzikha. — 22 Izmeri. — 23 Devichiy Gorodok. — 24 Polyanki. — 25 Maklasheevka. — 26 Kaybely. — 27 Mayrtup. — 28 Zandak.

Indeed, they were the prototypes for the bronze cheek-pieces of the early pre-Scythian horse-riders (Chernogorovka, Kamyshevakha and Tsimbalka types).

From these brief comments, it is clear that in the formation of the pre-Scythian complex, vital contributions came both from the north-west Caucasus and the North Pontic steppe. As explained above, in the Proto-Maeotian and western Koban cultures, large inhumation cemeteries were established at the Bronze/Iron transition, with a distinctly new material culture. Furthermore, in the Caucasian Mineral Waters region, large settlements were founded which practised intensive agriculture. Evidently, these regions underwent a profound structural transformation around the late 10th and early 9th century BC. These centres on the north-western flank of the Caucasus developed a mutually beneficial relationship with the equestrian nomadic groups in the steppe. According to Vladimir Erlikh and Sabine Reinhold, they supplied bronze horse-gear and bronze and iron weapons, including bimetallic daggers and swords, to the communities north of the Black Sea and in the Volga/Kama region.[127] This symbiotic relationship

[127] Reinhold 2007: 305; Erlikh 2012: 30 f.

was a crucial factor contributing to the pre-Scythian phenomenon. The economic transformation at the Bronze/Iron transition is also reflected in another aspect: the widespread adoption of tin-bronze at this time in the northern Caucasus, instead of the locally available arsenic or antimony alloys used previously.[128] This development must have required the intensification of long-distance trade, which again underlines the important economic role played by this region.

Environmental change was a further factor in the pre-Scythian transformation. As explained in Chapter 6, the turn towards a more mobile, nomadic pastoralist way of life is thought to have been caused by increased aridity in the steppe associated with climatic deterioration (cooler and drier conditions). In the steppe around the Don Delta and north-east of the Sea of Azov, for example, after a peak in sedentary settlements at the time of the Srubnaya (Timber Grave) culture, there was a dramatic collapse in the number of settlements and burials in the Final Bronze Age, particularly in the drier parts of the landscape, presumably because the population had adopted a nomadic lifestyle.[129] It is important to understand that with the increased mobility associated with an equestrian, nomadic lifestyle, innovations and technological expertise were rapidly transmitted between communities in and bordering on the steppe at the end of the Final Bronze Age, as we have seen in the case of the rod-shaped cheek-pieces. From this point of view, the vast expanse of the steppe should be regarded as a dynamic zone of innovation in the 10th/9th century BC.

The increased mobility through the steppe also led to the introduction of iron in the Volga/Kama region. Andrey Chizhevskiy has discussed the earliest iron finds and the first evidence for the local production of iron in this area.[130] The earliest iron comes from contexts of the Maklasheevka culture (12th/11th to the mid-9th century BC). Apart from some amorphous pieces of 'iron', which might not represent the remnants of metallic iron artefacts, there are three iron knives from settlements at Lugovskaya I and Erzovka, and an iron 'awl' from Murzikha II, Grave 199.[131] Iron artefacts, particularly weapons, became much more common in the Ananino culture, which followed after the Maklasheevka culture. Some of them are typological variants characteristic for the Volga/Kama region, including bimetallic spears and imitations of Caucasian bimetallic daggers, proving that iron was worked locally during the Early Ananino period (second half of the 9th to the 7th century BC).[132]

Most scholars agree that the northern Caucasus was instrumental in the introduction of iron to the Volga/Kama region.[133] But it is interesting to note the similarity of the range of iron objects found in settlements in different regions of the forest steppe during the 10th and 9th centuries BC. In the Chernoles, Bondarikha and Maklasheevka cultures, one-edged knives are the most frequent artefacts, with a total of ca. 19 examples from all three cultures; otherwise, only awl- or pin-like objects have been found (ca. four examples).[134] In all these cases, these early iron artefacts could have been obtained from equestrian-nomadic groups travelling through the steppe.

The spread of pre-Scythian horse-gear and weapon sets over vast distances testifies to the potency of a new ideology, profound structural changes, and the emergence of a new economic constellation at the start of the Early Iron Age. The steppe became a dynamic zone of innovation, linking developments in military technology and ironworking between the Caucasus, the Volga/Kama region and the Carpathian Basin. As explained in Chapter 6, owing to the paucity of tools and weapons in graves of the Bilozerka and Chernogorovka cultures, it is difficult to judge the level of ironworking technology in the area north of the Black Sea during the 10th and 9th centuries BC. Nevertheless, it seems unlikely that the nomadic

[128] See Reinhold 2007: 250; 293 f.; 307. For the earlier adoption of tin bronze south of the Caucasus, see Erb-Satullo et al. 2015.
[129] Van Hoof et al. 2013.
[130] Chizhevskiy 2012.
[131] All three sites are located in the Republic of Tatarstan. — See Chizhevskiy 2012: 385 fig. 1: 5-6; 386 fig. 2: 3. — See also Kashuba and Kulkova 2021: 134 cat. no. 111-117.
[132] See, for example, Chizhevskiy 2012: 388 fig. 3: 6-7.9-10; 389 fig. 4: 2.3.
[133] See, for example, Dudarev 2004: 14; Reinhold 2007: 305; Chizhevskiy 2012; Kašuba et al. 2019: 180.
[134] The importance of the finds from settlement excavations for an understanding of the everyday usage of iron implements has already been emphasized in Chapter 6.

communities of the North Pontic steppe could have been responsible for the massive surge in the production of utilitarian iron in the pre-Scythian horizon. Metallurgical technology seems to have been much more advanced in the north-west Caucasus, and this was probably the source of the more advanced ironworking expertise which spread so rapidly in the pre-Scythian horizon.

List 7.1. Rod-shaped cheek-pieces made of bone, horn and antler (Figure 40).

1. Trinca: Leviţki and Sîrbu 2016: 244 fig. 9: 1.
2. Costeşti VII: Leviţki 1994a: fig. 61: 2.
3. Chişinău: Dietz 1998: pl. 40: 598.
4. Hansca: Leviţki 1994a: fig. 61: 3.
5. Lipoveni: Matveev and Vornic 2017: 136 fig. 13: 1.
6. Cavadineşti: Boroffka 1998: 97 fig. 7: 13.
7. Babadag: Ailincăi and Mihail 2010: 191 fig. 2: 2.
8. Belogrudovka: Dietz 1998: pl. 39: 595.
9. Usatovo: Dietz 1998: pl. 40: 604; Podobed et al. 2014: 108 fig. 7: 7.
10. Dikiy Sad: Podobed et al. 2014: 110 fig. 9: 1.
11. Subbotovo: Dietz 1998: pl. 40: 603.609; Gershkovych 2016: 348 fig. C15: 1.2.
12. Dereivka: Dietz 1998: pl. 39: 596; Podobed et al. 2014: 111 fig. 10: 1.
13. Staraya Igren‘: Podobed et al. 2017: 107 fig. 3: 6.
14. Bay-Kiyat: Podobed et al. 2014: 109 fig. 8: 2.
15. Fontany: Dietz 1998: pl. 40: 610; Podobed et al. 2014: 109 fig. 8: 1.
16. Uch-Bash: Dietz 1998: pl. 36: 543; Kravchenko 2014: 62 fig. 19: 5.
17. Druzhnoe: Podobed et al. 2014: 109 fig. 8: 4.
18. Usovo Ozero: Podobed et al. 2017: 107 fig. 4: 2.
19. Zakatnoe: Podobed et al. 2017: 107 fig. 4: 1.
20. Podgornyi: Podobed et al. 2017: 106 fig. 2: 4-7.
21. Murzikha, Kurgan II, Grave 173: Podobed et al. 2017: 106 fig. 1: 9.10.
22. Izmeri, Kurgan VII, Grave 14 and Kurgan XVI, Grave 1: Kazakov 2017: 85 fig. 5: 4.5; Podobed et al. 2017: 106 fig. 1: 7.
23. Devichiy Gorodok, Kurgan IV, Graves 9 and 16: Podobed et al. 2014: 108 fig. 7: 8; 110 fig. 9: 5.6; Podobed et al. 2017: 106 fig. 1: 1.2.6.
24. Polyanki: Dietz 1998: pl. 40: 601.602; Podobed et al. 2017: 106 fig. 2: 1.2.
25. Maklasheevka: Dietz 1998: pl. 40: 600.
26. Kaybely: Dietz 1998: pl. 40: 597.
27. Mayrtup: Vinogradov and Dudarev 2000: 396 fig. 24: 9.10.
28. Zandak, Graves 3 and 15: Dietz 1998: pl. 40: 605.606; Markovin 2002: 27 fig. 18: 3; 43 fig. 28: 4.

Chapter 8
The central and western Balkan Peninsula

For the central and western Balkan Peninsula, i.e. Albania and ex-Yugoslavia (Montenegro, Bosnia-Hercegovina, Croatia, Slovenia, Serbia, Kosovo, North Macedonia), comprehensive studies on the introduction of iron only exist for certain regions: Sineva Kukoč and Martina Čelhar on the Liburnian area of western Croatia, Neva Trampuž Orel and Biba Teržan on Slovenia, and Borivoj Čović on Bosnia.[1] Otherwise, dedicated research publications are lacking. For this reason it is difficult to provide a systematic treatment and our review will often concentrate on particular regions and case studies.

8.1 Albania, Dalmatia and Istria

Unfortunately, the early evidence for iron in Albania has not been the subject of detailed study. However, in a number of publications, Frano Prendi has stated that the use of iron in Albania began in the 11th century BC.[2] The earliest evidence seems to be the iron knife and tweezers found in a grave from Kakavijë (Gjirokastër County), which also contained a bronze dirk.[3] As explained in Chapter 4.3, for typological reasons the bronze dirk most likely dates to the second half of the 11th century BC.[4] Although the knife from Kakavijë is only partially preserved, its bronze rivets are significant. As bronze rivets are a characteristic feature of early iron knives in the Aegean and Cyprus, it is likely that the knife from Kakavijë was imported.

Another iron knife was found in Grave 75 in the tumulus at Patos (Fier County); it raises interesting questions (Figure 41: 2).[5] The knife is ca. 32 cm long and has rivets for organic hilt fittings. The hilt ends in a discoidal pommel, and the blade is unusually long, curving downwards towards the tip. The shape of the knife is similar to the examples with discoidal or ring-shaped hilt pommels from the beginning of the Iron Age in the eastern Mediterranean, most of which are made of iron, for example from Tel Miqne (Figure 41: 1), Tel Qasile, Megiddo, etc. As explained in Chapter 2.3, bronze knives with ring-shaped pommels are not only known from the second half of the 12th century BC from Ialysos (Rhodes) and Enkomi (Cyprus), but also from Roca Vecchia (Prov. Lecce) from a context dating to the transition from *Bronzo Recente* to *Bronzo Finale*.[6] The Patos knife also recalls the bimetallic knife from Kouvaras in Acarnania, with its ivory handle with ring-shaped or flabelliform pommel. As explained in Chapter 4.2, this richly furnished tomb has been assigned to the Submycenaean period.[7] Although the Patos knife cannot be reliably dated, as there are no associated grave furnishings, it is best interpreted in the context of these high-status knives, which would suggest an early chronological position, possibly in the 11th century BC. If this is true, then the Patos knife would belong to an early horizon of prestigious knives, not only including the example from Kouvaras, but also the bimetallic knives from Thasos in the northern Aegean and Hordiivka in Ukraine (see Figure 29).

The large tumulus at Lofkënd (Fier County), excavated by John Papadopoulos and his team between 2004 and 2007, is very important for the question of the introduction of iron in Albania.[8] Iron artefacts are first encountered during phase II of the tumulus, including arrowheads, a pin, tubular beads, and a piece of wire twisted into loops.[9] In phase III, the range of iron products is expanded, now also including an iron

[1] See Kukoč and Čelhar 2009; Trampuž Orel 2012; Teržan 2017; Čović 1980.
[2] For example, Prendi 1975: 113; 1976: 157; 1982: 225 ff.
[3] Prendi and Budina 1970: 64; pl. 2: 1.8-10; Kilian-Dirlmeier 1993: 96 no. 234; pl. 35: 234.
[4] For a discussion of this type of weapon, see also Kilian-Dirlmeier 1993: 100; Pabst 2013a: 109 ff. and fig. 4.
[5] Korkuti 1981: 27 f.; pl. 8: V.75; 17: 2.
[6] Benzi 2009; Courtois 1984: 26 fig. 8: 13; Pagliara et al. 2008: 247; 258; 267; 264 fig. 15: B.V.2.
[7] Stavropoulou-Gatsi et al. 2012: 255 f.; 255 fig. 8; Jung et al. 2017.
[8] Papadopoulos 2010: 247; Papadopoulos et al. 2014: 120; 574.
[9] Graves of Phase II with iron objects: XXI, XXIII, XXVIII, XXXII.

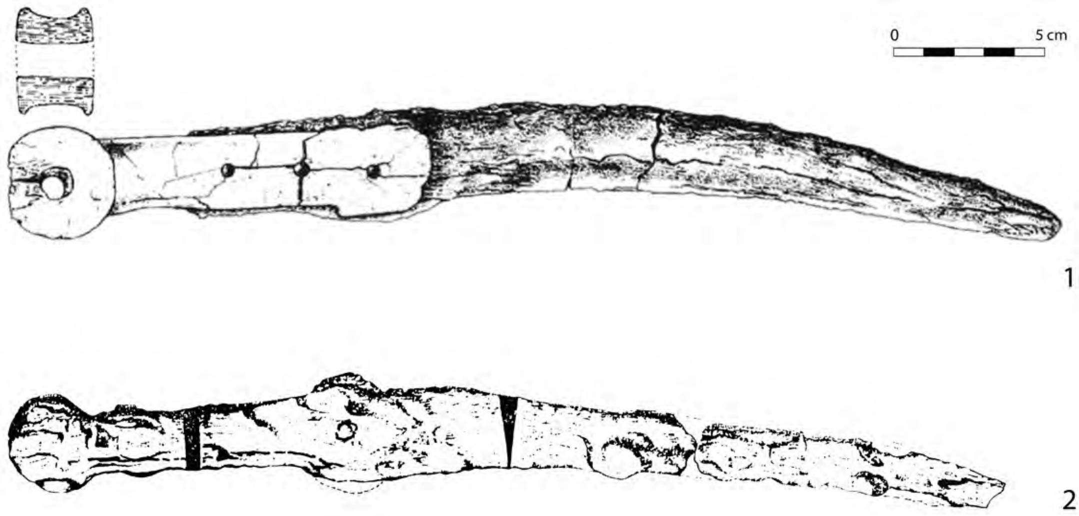

Figure 41. Iron knives from Tel Miqne, Israel (1), and Patos, Albania (2). The knife from Tell Miqne has an ivory handle. — 1 after Dothan 2002: 15 fig. 13. — 2 after Korkuti 1981: 45 pl. 8: V75. — Scale 2:5.

knife and a spearhead (Figure 42).[10] On the basis of a radiocarbon analysis of bone from grave XLV, phase III can be assigned to the 10th century BC. A further radiocarbon date from a grave of phase II is less reliable, as it was obtained from charcoal from oak wood, and is therefore susceptible to the 'old wood' effect.[11] The iron wires twisted into loops, found in two graves, provide a further indication of the chronological range of Lofkënd Phases II-III, as they probably come from arched fibulae similar to examples from central Italy dating to *Bronzo Finale* 3 and the start of the Early Iron Age.[12] Accordingly, a date in the later 11th and 10th century BC seems most plausible for these early iron finds from Lofkënd.

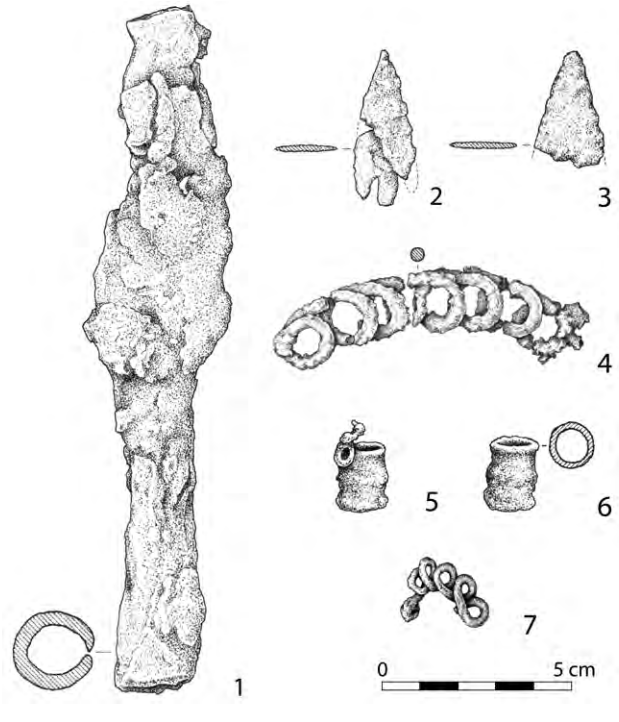

Figure 42. Early iron artefacts from Lofkënd (Albania), Phase II-III. — After Papadopoulos et al. 2014. — Scale 1:2.

The Albanian group of early iron finds can be explained not only by its proximity to Greece, but also to the nearby Strait of Otranto (see Figure 60). This narrow crossing was vital for maritime traffic travelling from the East Mediterranean to southern Italy and Sicily; as a consequence, south-west Albania played a part in this important east-west axis of communication. Contact with foreign travellers doubtless allowed access to new

[10] Graves of Phase III with iron objects: XXXIV, XXXV, XXXVIII, XLIV, XLV, XLVIII, L. — Judging by the characteristic spectacle-shaped fibula, grave LVIII also probably belongs among the early graves with iron artefacts; on this kind of fibula (Maribor type), see Pabst 2012: 109 f.

[11] For the radiocarbon dates, see Papadopoulos et al. 2014: 112 ff. — Grave XXIII (Phase II): 1129-1011 cal. BC; Grave XLV (Phase III): 1006-900 cal. BC (both with 2σ calibration range).

[12] Compare Savella 2015: 67-69; pl. 37: 266-275. — The 'Cassibile' fibulae from Lofkënd, Graves XXI and XXVIII, assigned to Phase II, can hardly be earlier than the 10th century BC.

technologies. And against this background, the close relationship between Albania and southern Italy, demonstrated by a number of case studies, is not surprising. For example, the finds from the cemetery of Castellace in Calabria, and their parallels in Albania, have been analysed by Marco Pacciarelli (see Chapter 10.1), and some two-looped fibulae from Albania are related to the Sicilian Cassibile type.[13] Finally, the almost identical bimetallic weapons from Psar and 'Calabria' provide further evidence for close contacts across the Strait of Otranto.[14]

Apart from the rivets on the bronze sword from Vrana (discussed below), early iron finds are absent along the Croatian coast of the Adriatic.[15] The only exception is the trunnion axe of type III1D1 (according to Anke Wesse's typology) from Pećina na Gradini, near Premantura (Istria).[16] Kristina Mihovilić compared the example from Istria with an iron axe from Troy which, as noted in Chapter 4.2 and 4.4, came from a context dated to the Protogeometric period or later.[17] The Istrian axe is related to the early group of iron trunnion axes in the Aegean and Bulgaria, which share the common feature that the 'butt' of the axe comprises at least one-third of the total length of the axe (e.g. Figure 19: 12-14). As large iron artefacts are so rare at this time in the Adriatic region, the axe from Pećina na Gradini can best be interpreted as an Aegean import, possibly from the second half of the 10th or first half of the 9th century BC. The trunnion axes from Mali Drinić und Dugiš in the Cetina valley (Split-Dalmatia County) belong typologically to more developed forms, and presumably belong to the full Iron Age.[18] Finally, two iron awls or chisels from the hillfort of Monkodonja, near Rovinj in south-west Istria, deserve a brief mention.[19] Excavations have shown that the site was settled mainly during the Early and Middle Bronze Age (ca. 1850/1750-1500/1450 BC), and so it is conceivable that these artefacts could be the earliest iron implements ever found in continental Europe. However, owing to the severe erosion characteristic for the Karst environment, the great majority of the finds from Monkodonja are unstratified. It is perfectly possible that the iron awls/chisels derive from a later period of use of the site; however, it is sadly impossible to be more precise about their chronological position.[20] From our discussion so far, it is apparent that there is little evidence for the use of iron before the 9th/8th century BC along the coast between Albania and Istria; however, the cluster of finds from southern Albania and the axe from Pećina na Gradini do show that knowledge of iron was transmitted to the region between the second half of the 11th and the first half of the 9th century BC.

8.2 Slovenia

The introduction of iron in Slovenia has been discussed in articles by Neva Trampuž Orel and Biba Teržan.[21] The oldest iron finds come from the Karst/Soča region, the westernmost part of the country.[22] The objects were found in three graves assigned to the time-span between the second half of the 11th and the 10th century BC, from the cemeteries of Tolmin and Brežec pri Divači.[23] In the case of Tolmin, Grave

[13] See, for example, Bodinaku 1984: 57 pl. 1: 1 (Patos, Grave 67); Papadopoulos et al. 2014: 1016 fig. 10.9-10 (Lofkënd).

[14] The hilt of a bimetallic dirk from Psar, and the bronze dirk with iron rivets from Vajzë will be discussed below (Chapter 8.6).

[15] Items of bimetallic jewellery are found both in Liburnia and in Istria in the 8th century BC; see Kukoč and Čelhar 2009: 93 f.

[16] Mihovilić 2002: 9 f.; 2007: 344; pl. 87: j2. — For the typology of trunnion axes, see Wesse 1990.

[17] Mihovilić 2007: 344; Becks and Thumm 2001: 421 fig. 482. — The trunnion axe from Pećina na Gradini is 13.3 cm long (information from Kristina Mihovilić, Pula), while the axe from Troy is 15 cm long (information from Diane Thumm-Doğrayan, Tübingen).

[18] Milošević 2002: 252; 264 pl. 1: 1.2. — Some unprovenanced axes from Dalmatia could possibly be as early as the example from Pećina na Gradini, although this is very uncertain. See, for example, Milošević 2002: 264 pl. 1: 5.10.

[19] Hänsel et al. 2020: 162; 242 pl. 5: 1-2.

[20] For comments on the lack of stratified sediments at Monkodonja, and Late Bronze Age/Early Iron Age activity at the site, see Hänsel et al. 2015: 75 ff.; Hellmuth Kramberger 2017: 321; 338 f.; Hänsel et al. 2020: 200. — For the latest radiocarbon dates of the 13th/10th century cal. BC, see Hänsel et al. 2015: 425 ff.

[21] Trampuž Orel 2012; Teržan 2017.

[22] In a preliminary report on excavations in the settlement of Ljubljana, Tribuna, an iron awl, some iron fragments and two pieces of iron slag have been reported from contexts of the 10th century BC. This potentially represents important new evidence for early iron production in Slovenia. — Škvor Jernejčič and Vojaković 2020; and see now also Vojaković 2023.

[23] See also Teržan 1995: 360 f.; 2002: 86 f.; 92. — The pin with biconical head from Tolmin, Grave 417, has parallels in Swiss lakeside settlements, which suggest a date in the 10th century BC (Rychner-Faraggi 1993: 48 f.; Speck 2004: 29 f.). — According to Sabine Pabst, the spectacle fibula from Brežec, Grave 272, very probably belongs to her Metaponto type, for which she suggests a date in the 11th or 10th century BC (Pabst 2012: 30 ff.). — A third iron knife from Matavun near Brežec is mentioned by Elisabetta

417 and Brežec, Grave 272, iron was used to make knives.[24] In Brežec, Grave 158 there was an unusual bimetallic axe, with a ribbed bronze socket cast onto the iron blade. The latter grave also contained a bronze tanged knife and a bronze pin with a thickened and twisted neck, which make a date in the second half of the 10th century BC (Ha B2) plausible.[25] As Biba Teržan has argued, knowledge of the new metal, and perhaps the iron knives themselves, probably reached the Karst/Soča region from the Aegean or Cyprus.[26] In the case of the bimetallic axe, the iron blade might have derived from an imported trunnion axe; in this hypothetical scenario, the bronze socket would represent a repair-job on a broken iron axe.

This cluster of early iron artefacts in the Karst/Soča region is particularly interesting. This is a key region for long-distance exchange, and especially for access to the eastern Alps. From the Soča Valley, the upper Sava and Gail Valleys are easily reached by crossing the Predil Pass. This route was probably used to transport metals from the eastern Alps or amber from the Baltic to the *Caput Adriae*. Biba Teržan was able to demonstrate that the Karst/Soča region was in contact with the Aegean in the 11th/10th century BC, as the single-looped crescent-shaped fibulae show.[27] Apparently, trade routes along the eastern Adriatic coast, reaching as far as the Karst/Soča region, already existed at this time, providing a plausible context for the early appearance of iron. The knives from Tolmin and Brežec can therefore by understood as belonging to an early horizon in the dissemination of iron, when the new metal was transmitted along the coastlines of the Mediterranean and Black Sea and used initially in the form of knives. Perhaps the early iron knives from Budapest-Békásmegyer, Grave 347, and Chotín, Grave 108, should be seen in this context, considering that the example from Budapest has a bronze rivet, a typical feature of early Aegean and Cypriot knives.[28] If so, the Karst/Soča region would have played a role in the introduction of iron in the western part of the Carpathian Basin.

Until recently, it was believed that iron was first introduced more widely in Slovenia during the 8th century BC, in the so-called 'iron horizon'.[29] However, radiocarbon dates from grave assemblages from Zidanica pri Podnanosu (Karst/Soča region), Križna Gora (Notranjska region) and Miklavž na Dravskem (Drava valley) have subsequently demonstrated that iron was more common in the 9th century BC than previously thought.[30] The graves contain items of iron jewellery which are typical for Slovenia, suggesting that they were not imported, but made locally.[31]

In fact, iron objects dating before the 8th century BC have been found in burials throughout Slovenia (corresponding to the Ruše II and Lubljana Ib chronological phases). Apart from the radiocarbon-dated burials mentioned above, early graves with iron artefacts are known from Ljubljana, Ruše, Brežec and from Budinjak in the Žumberak region of Croatia.[32] Nevertheless, iron grave furnishings were still rare at this time. In the cemetery excavated at Ruše in 1875/76, for example, Graf Gundekar von Wurmbrand

Borgna und Emanuela Montagnari Kokelj (1999: 138).

[24] Svoljšak and Pogačnik 2001: pl. 82; Ruaro Loseri 1977.

[25] Ruaro Loseri 1977: 92; pl. 16: T.158; 33: T.158. — For a date in the early part of Ha B, see Teržan 1995: 360; Trampuž Orel 2012: 21; Laharnar and Turk 2018: 21. — For the axe, see parallels from Velika Gorica, Grave 7/1908 (Starè 1957: Y7, 2), Románd (Říhovský 1983: pl. 32: 7) and Haslau-Regelsbrunn (Mayer 1977: pl. 80: 1114; 81: 1115). — For the pin from Grave 158, see better preserved examples from the 'Mušja jama' at Škocjan (Teržan et al. 2016: 223 f.; pl. 33: 9-10) and Dobova, Grave 411 (Starè 1975: pl. 59: 3). See also the similar pin from Brežec, Grave 124/125 (Ruaro Loseri 1977: 82 f.; pl. 10: T.124 und T.125; for the chronological position of the sword, see Pare 2008b: 88 fig. 5.9: A). — For the flange-hilted knife of Fontanella/Vadena type, see for example De Marinis (1999: 530 ff. fig. 13) and the piece from Velika Gorica, Grave 1/1911 (Starè 1957: Y6b, 3).

[26] Teržan 1995: 360.

[27] Teržan 1990a: 49 ff.; 2002: 96 map 2; 100 ff.

[28] Miketta 2017: 270 cat. no. HU-1; 275 cat. no. SK-2; pl. 14: 6; 15: A2; and see Chapter 9.2.

[29] For the 'iron horizon', see: Gabrovec 1973: 371 f.; Teržan and Trampuž 1973: 437 f.; Trampuž Orel 2012: 21 ff.; Teržan 2002: 85 f.; see also Dular 2013: 118 f.

[30] Teržan and Črešnar 2014: 209 fig. 10.5 (1001-835 cal. BC); 213 fig. 10.9 (926-821 cal. BC); 527 fig. 32.4 (897-802 cal. BC); 553 fig. 34.6 (912-799 cal. BC). — The calibrated dates are given with 2σ-ranges.

[31] Teržan and Črešnar 2014: 706 ff.

[32] Ljubljana, Grave 36 (iron knife, iron ring); Grave 54 (iron neck-ring); possibly Grave 258 (iron rod wrapped with bronze wire, possibly remains of an iron neck-ring); see Starè 1954; Puš 1971; Budja 1980; Škvor Jernejčič and Vojaković 2020: 155. — Ruše, Grave 31 (iron 'handle'); Grave 70 (small iron ring); Grave 140 (iron neck-ring); see Wurmbrand 1879: 239; 418; pl. 12: 11.28; Teržan 1990b: 23; Teržan 2017: 118. — Brežec, Grave 165 (iron neck-ring); see Ruaro Loseri 1977: 93; Mizzan 1994: 105 note 2. — Budinjak, Tumulus 98, Grave 1 (iron neck-ring); see Škoberne and Bugar 2017: 80 f.

uncovered only four iron objects, compared with 120 of bronze.[33] As Brina Škvor Jernejčič and Petra Vojaković have ascertained, iron is mainly found at this time in the form of neck-rings, and they conclude that the iron neck-rings were markers of high status, which is most convincing in the case of Ljubljana, Grave 54, and Brežec, Grave 165.[34] These conclusions are important, indicating that iron was still a rare metal at this time. The situation changed markedly in the following phase (Ruše III/Ljubljana II), when iron became much more common for grave furnishings.

Based on this new evidence, Biba Teržan and Matija Črešnar propose that the 'iron horizon' should now be dated earlier, to the time-span between the mid-9th and the mid-8th century BC.[35] However, in my opinion this suggestion conflates two stages in the introduction of iron, which should be distinguished: the earlier stage, dating before the later 9th century, when iron was a rare metal used as a marker of social distinction (especially neck-rings), and the later stage, in which iron was much more common and used for a wider range of jewellery and implements.[36]

In a recent article, Biba Teržan discussed an important new grave assemblage from Ptuj, Ulica Viktorina Ptujskega.[37] This is evidently one of the earliest grave inventories from Slovenia containing iron tools and weapons, comprising a dagger or sword blade fragment; a spearhead with a pair of perforations at the base of the blade; and a socketed axe with a split socket – all made of iron. A radiocarbon date is available for the Ptuj grave, but it is somewhat unreliable, having been obtained from a charcoal sample. Although the date-range is 1193-805 cal. BC (with a 2σ calibration), taking the potential 'old wood' effect into account, it is possible that the warrior was buried around 800 BC or even later; the grave evidently belongs to the early Ruše III phase.[38] Teržan drew attention to the fact that the iron weapons belong to types which were foreign in the Slovenian context, and are otherwise known from regions further east, where iron production was more advanced and iron tools and weapons are much more frequently attested (see Chapter 9.4). At this time there are other signs of cultural and technological influence from the Iron Gates region (Basarabi culture). It is therefore most likely that the iron objects in the Ptuj grave were obtained from the area of the Basarabi culture, where similar tools and weapons are well known from hoards of the Bâlvăneşti-Vinţ group (see below). Further evidence in Slovenia for influence from the area of the Basarabi culture includes elements of pottery decoration, new types of two-looped fibulae (e.g. Vače knobbed fibulae, fibulae with triangular foot), and the bimetallic spectacle fibulae of Balta Verde type.[39]

As the most intensively studied region in the western Balkans, Slovenia represents a very important case study. However, despite the high level of research activity, it remains difficult to bridge the gap between the earliest finds of the 10th century BC in the Karst/Soča region, and the so-called 'iron horizon'. Before the late 9th century BC, iron remained uncommon and seems to have been used most consistently for neck-rings, probably prestigious jewellery for females of high status. Unfortunately, male burials were hardly ever provided with distinctive grave furnishings (weapons, implements, etc.) at this time. The funerary record is therefore severely biased, with the masculine component markedly under-represented; graves with weapons only becoming more frequent during the 8th century BC.[40] Nevertheless, there is little reason to believe that local iron production already began during the 10th century BC in the Primorska (Slovene Littoral) and gradually developed during the following century. Iron finds of the 9th century BC

[33] Wurmbrand 1879: 239. — The excavated burials from this cemetery mainly date to the Ruše II phase.
[34] Škvor Jernejčič and Vojaković 2020: 156. — Seven examples are known, from: Miklávz, Graves 2 and 5; Ruše, Grave 140; Ljubljana, Grave 54; Brežec, Grave 165; Zidanica, Grave 2; Budinjak, Tumulus 98/1.
[35] Teržan and Črešnar 2014: 706 ff.; 725 fig. 46. — According to Biba Teržan (2017: 117), the 'iron horizon' can be detected all over Slovenia.
[36] As the new radiocarbon dates show, in contrast to my chronological study published 25 years ago, the start of the Ruše III/ Lubljana II phases should now be dated a few decades earlier, perhaps ca. 830/820 BC, rather than 800 BC as proposed in Pare (1998).
[37] Teržan 2017. — See also Dular and Lubšina Tušek 2014.
[38] Teržan and Črešnar 2014: 201 fig. 9.5.
[39] See Teržan 2017; Škvor Jernejčič 2017: 130 fig. 8; 173 ff.
[40] See Teržan 2017: 119 f.; Škvor Jernejčič and Vojaković 2020: 154 f.

still seem to have been rare, and used for a very limited range of products, and the metal might well have been imported from regions with a more advanced iron technology, for example in the central or eastern Balkans, or in the Alföld. It is quite plausible that local iron production (smelting of iron ores) only began in Slovenia during the 8th century BC, when the metal was used to manufacture a broader spectrum of artefacts.

8.3 Bosnia-Hercegovina and central and northern Croatia

In the recent literature, it has been stated that iron was introduced to Bosnia and central and northern Croatia around the later 9th or early 8th century BC.[41] However, the present state of research hardly allows reliable conclusions.

Borivoj Čović presented evidence for early iron artefacts (especially knives) and ironworking (slag) from a number of settlement excavations in Bosnia, including Vis near Derventa (Layers II and I); Kopilo near Zenica; Zecovi near Prijedor (Layer II); Pod near Bugojno (Layer C); and Velika Gradina near Varvara.[42] In his monograph on the Late Bronze and Early Iron Ages in Bosnia, Mario Gavranović analysed and discussed these settlement excavations exhaustively.[43] It transpires that the earliest evidence for iron from these settlements, from Kopilo (iron slag, 9th century BC?) and Vis II (iron knife, late 9th/early 8th century BC?) cannot be regarded as completely reliable, and the contexts could be considerably later.[44]

The earliest iron artefacts from the tumulus graves on the Glasinac plateau in eastern Bosnia might date to the 9th century BC; these include items of ring jewellery and a knife blade.[45] Gavranović notes that in Bosnia, iron was introduced along with new types of pottery derived from the Bosut culture of northern Serbia (Kalakača and early Basarabi pottery), indicating the most likely source of the new metal.[46] As in other areas of the western and central Balkans, iron use became more widespread during the 8th century BC.

The iron socketed axe from Grapska in north-east Bosnia could be considered as a further indication for iron use during the 9th century BC, but it is not certain that the axe originally belonged to the Grapska hoard.[47] Finally, Borivoj Čović regarded two copper casting cakes with iron contents of 8.98% and 9.70% in the hoard from Osredak (hoard phase V) as evidence for local iron smelting in north-west Bosnia.[48] However, casting cakes with similar high iron contents are known from much earlier hoards, and it is very likely that in such cases copper ores containing iron were smelted, more or less accidently.[49] There is certainly no reliable evidence for the use of iron in Bosnia-Hercegovina before the 9th century BC.

It remains to mention an interesting iron fibula from Vukovar, Lijeva bara, Grave 75 in north-east Croatia: a two-looped arched fibula with a triangular foot and three knobs on the bow. In the grave, the fibula was associated with pottery vessels assigned by Carola Metzner-Nebelsick to phase II of the Dalj-Batina culture, roughly corresponding to Ha B3 (ca. 9th century BC).[50] In this case, the fibula was probably obtained from Bulgaria or the northern Aegean, where this type of fibula is found frequently.[51] The fibula

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41 See e.g. Ložnjak-Dizdar 2004: 29; Gavranović 2021: 392.
42 Čović 1980: 74 f.; 1983: 451; 1984: 139; 1987: 515. — According to information kindly provided by Mario Gavranović (Vienna), the iron slags from Velika Gradina mentioned by Borivoj Čović probably come from Iron Age layers; see Čović 1980: 74; Gavranović 2011: pl. 82: 5-7.
43 Gavranović 2011.
44 See Čović 1980: 74. The author is grateful to Mario Gavranović (Vienna) for advice on these excavations.
45 For example: Taline, Tumulus XIX/4; Taline, Tumulus XX/2; Vrlazje, Tumulus IV/2. — See Čović 1980: 75 f.; 78; 1999: 83; Pare 1998: 333 ff.
46 Gavranović 2021.
47 Čović 1980: 73; König 2004: 153 ff.; 198 f. no. 10; pl. 78: 12.
48 Čović 1980: 72 f.; 1984: 135; see also König 2004: 153.
49 See e.g. Zagreb-Dežmanov Prolaz and Pustakovec: Karavanić 2009: 76.
50 Vinski-Gasparini 1973: pl. 124: 7; Metzner-Nebelsick 2002: 98; 178 fig. 78; 413.
51 Kašuba 2006; Ailincăi 2020: 455 f. — For a distribution map of this kind of fibula, see Pare 2015: 312 fig. 13: B.

from Vukovar is the earliest iron object presently known from northern Croatia, suggesting that the eastern Balkans were the most likely source for the first acquaintance with the new metal in this region.

8.4 The central Balkans

The introduction of iron in northern Serbia, Vojvodina, and the Iron Gates is particularly interesting, because the adoption of the new metal seems to be associated with a radical cultural reorientation at the time of the Bronze/Iron Age transition. Among other authors, this view has been expressed by Rastko Vasić in his reconstruction of the cultural sequence between the Late Bronze and Early Iron Age:[52]

1. The Late Bronze Age was characterised by the black polished and fluted pottery of Belegiš II-Gáva type (Ha A1-B1). Bronze hoards containing scrap metal are a typical feature (during Ha A) of the Belegiš II-Gáva culture.
2. There follows a phase which Vasić called the Earliest Iron Age, which saw the emergence of the Bosut Culture, with incised pottery of Kalakača type. The Kalakača phase (Bosut IIIa) saw fundamental changes in material culture. Apart from the new kind of pottery, the general lack of bronze artefacts is remarkable, coupled with the appearance of the first iron objects.[53] The iron finds mainly comprise items of ring jewellery and fragments of knives. At the same time, the traditional cremation burial rite of the Late Bronze Age was replaced by inhumation, sometimes under a tumulus.[54] Vasić assigned the Kalakača phase to the late 10th and 9th century BC (according to Vasić: late Ha B1-Ha B3).
3. Finally, pottery of Basarabi type is typical for the first stage of the Older Iron Age in the Bosut culture (Bosut IIIb, Vasić's 'Horizon I'). According to Vasić, in this stage, starting at the beginning of the 8th century BC, all tools and weapons were now made of iron instead of bronze.

In our context, it is important to emphasize that in Vasić's scheme, major cultural transitions are linked to changes in technology: the introduction of iron in the Bosut IIIa/Kalakača phase, and the exclusive use of iron for utilitarian implements in the Bosut IIIb/Basarabi phase. While Vasić's scheme is widely accepted, alternative interpretations have been put forward by other authors. In Milutin Garašanin's scheme, the Iron Age already started during the 12th century BC; but considering that iron finds dating to the 12th or 11th century BC are unknown, this early date for the start of the Iron Age can be rejected. Bernhard Hänsel and Predrag Medović set the start of the Iron Age and the Kalakača phase at ca. 1000 BC. And in my 1998 study, I proposed that the Gornea-Kalakača culture began around 950/920 BC. Finally, Miloš Jevtić regards the Kalakača phase as the final stage of the Late Bronze Age or as transitional to the Early Iron Age.[55] Clearly, the question of the start of the Iron Age depends on the interpretation of the Bosut IIIa phase, known mainly from settlements with Kalakača pottery. However, as hoards are absent at this time, and grave finds are uncommon, interpretation is far from straightforward.

Few metal finds are known from the Kalakača culture, making it difficult to judge the level of iron technology. The most significant context is probably the second mass grave from Gomolava, discovered in 1972, which contained a bracelet, an awl, a chisel, and a knife made of iron.[56] These objects demonstrate

[52] See e.g. Vasić 1977: 6 f.; 1982; 1999: 5 f.; 2010: 7. — See also Pare 1998: 408 ff.

[53] See for example Vasić 1997: 141 f.; 342 ff.; see also Medović 1988: 432; 1994: 47; Popović and Vukmanović 1998: 45 ff.; 55 f.; 60 f. — Note that according to Miloš Jevtić, the iron trunnion axe from Gradina na Bosutu does not belong to the Kalakača phase, but instead to the time of the earliest appearance of the Basarabi culture. See: Medović and Medović 2010: 65 fig. 57: 1; 300 f.; 312 ff.; Jevtić 2016: 9 ff. — The 'iron remains' from Kalakača (Beška District, Syrmia), mentioned by Katarina Dmitrović and Marija Ljuština (2008: 89 f.), do not derive from an iron artefact, but were instead formed by geological processes (information kindly provided by Miloš Jevtić, Belgrade).

[54] The inhumations were buried either in crouched or extended position. Extended inhumations seem to be more common in late Kalakača burials (e.g. Signal site near Svrljig; Mojsinje, Tumulus V; Vajuga Pešak), anticipating the burial custom typical for the Basarabi culture. — See Kapuran 2018: 84 ff.

[55] For a review of previous research, see Gumă 1995: 112 ff.; Pare 1998: 407 ff.; Gavranović 2021: 384 ff. — For the excavations at Feudvar, see Falkenstein et al. 2014: 113 fig. 2, with references to further literature. — For Miloš Jevtić's standpoint, see for example Jevtić 2016: 13.

[56] See: Tasić 1972: 30; 1976: 116 fig. 59; 118 fig. 76 and 82; 1988: 55.

that both iron jewellery and iron utilitarian implements were already in use before the onset of the Basarabi culture. Further iron finds are known from tumulus cemeteries such as Mojsinje near Čačak and, further south, the Signal cemetery at Palilula near Svrljig.[57]

At the end of the Late Bronze Age, the fluted pottery found in the vast area between Vojvodina, the Banat and Oltenia in the west, and the middle Dnister in the east formed a communication network (the Fluted Ware *koinè*), in which the typical pottery was everywhere very similar.[58] Therefore, it is likely that the rejection of fluted pottery in northern Serbia described by Rastko Vasić is related to the analogous rejection of fluted pottery in Bulgaria and along the Lower Danube described by Elena Bozhinova and Sorin-Cristian Ailincăi (see Chapter 5.1). This suggests that the cultural transition at the start of the Kalakača culture (Vasić's Earliest Iron Age) was related to the cultural change at the transition to the Stamped Pottery *koinè* in the eastern Balkans. As explained in Chapter 5.1, the Stamped Pottery *koinè* reflects a cultural reorientation towards the Thracian Plain.

New research shows that the pottery of Basarabi type started earlier than previously thought, in the mid- or second half of the 9th century BC.[59] The Bosut IIIa/Kalakača phase must have started sometime in the 10th century BC. It seems plausible that the end of the Fluted Ware *koinè* and the start of the incised and Stamped Pottery cultures in the central and eastern Balkans took place in the decades around the middle of the 10th century BC. Further north, pottery with fluted decoration persisted longer, lasting into the 9th century BC in parts of Transylvania (Gáva) and around the upper Dnister (Gáva-Holihrady). In eastern Hungary, the Gáva culture came to an abrupt end at around 900 BC, with the advent of pre-Scythian intruders and the start of the Mezőcsát culture (see Chapter 9.5).[60]

These considerations are of crucial importance for our understanding of the Bronze/Iron transition in central and south-east Europe. In the area to the south and south-east of the Carpathian Mountains, in the central Balkans and in the Carpathian Basin, three cultural disjunctions can be linked together to form a hypothetical framework for understanding the Bronze/Iron transition: the emergence of the Stamped Pottery *koinè* south and south-east of the Carpathian Mountains (Insula Banului, Pshenichevo, Babadag, Cozia-Saharna); the start of the Bosut culture, with the incised pottery of the Kalakača culture; and the appearance of the cemeteries of the Mezőcsát culture in the Great Hungarian Plain. In all three cases, the rejection of the Fluted Ware *koinè* represents a radical cultural transformation. They can best be understood as Post-Fluted Ware cultures (see Figure 43).[61]

The collapse of the Fluted Ware *koinè* and the emergence of the Post-Fluted Ware cultures marks a fundamental change in the cultural geography of central and south-eastern Europe. If the expansion of the Fluted Ware *koinè* essentially reflects the influential role of the bronze-producing regions of the north-eastern Carpathian Basin, then the collapse of the *koinè* could reflect the disintegration of an economic and political system founded on the production, exchange, and display of bronze. According to this hypothesis, the ensuing reversal of cultural orientation could reflect the influence of iron-producing cultures: initially the Stamped Pottery groups of Thrace, and later the Basarabi complex. Similar ideas were already expressed by Georg Kossack in an article published in 1980, in a discussion of the profound changes at around 900 BC.[62]

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[57] Mojsinje: Nikitović et al. 2002. — Palilula, Signal cemetery: Filipović and Bulatović 2010. — The iron fibula from Mojsinje has parallels at Lofkënd (phase IV) and Kënet in Albania, and Liatavouni in Epirus, which apparently date to the (late?) 9th century BC. See Papadopoulous 2010; Papadopoulos et al. 2014: 337 f.; 1017 fig. 10.12.

[58] For the close resemblance of the pottery in the area between northern Serbia and the middle Dnister, see Pare 1998: 409 fig. 47. — In the west, this pottery corresponds to the Vučedol-Novi Begej and Ticvaniul Mare-Karaburma III cultural groups, in the terminology introduced by Marian Gumă. In the east, the pottery belongs to the Corlăteni-Chişinău culture in Moldavia.

[59] Early radiocarbon dates for the Basarabi culture have been reported from Tărtăria and Teleac, both in jud. Alba, Transylvania. — Tărtăria: mass grave with typical Basarabi pottery, radiocarbon date: 972-811 cal. BC (2σ calibration range). See Borş 2021: 303 ff.; 316 fig. 17; Gogâltan 2021: 415 f. — Teleac: mid- to late 9th century BC. See Uhnér et al. 2022: 285; 298. — The emergence of the Basarabi culture at ca. 850 BC was already suggested in a study by Sabine Pabst (2008).

[60] See e.g. Metzner-Nebelsick 2010a.

[61] For a similar map showing these cultural groups, see Metzner-Nebelsick 2010a: 136 ff.; 139 fig. 5a.

[62] Kossack 1980: 137 (quoted in Chapter 9.7). — Kossack suggests that the end of the Fluted Ware *koinè* could have been triggered

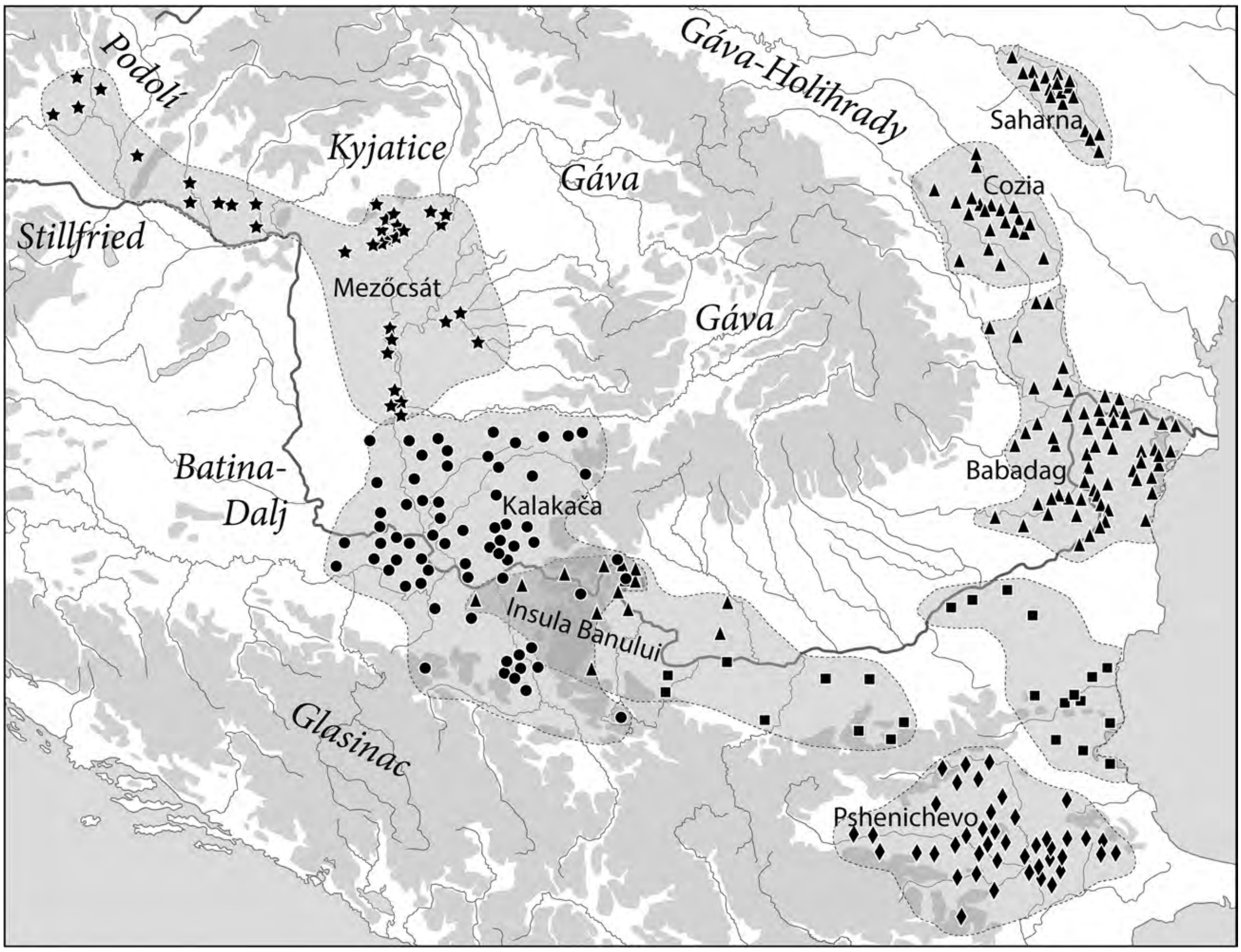

Figure 43. Distribution map of Post-Fluted Ware cultures. — After Ailincăi 2020: 448 fig. 1; Gumă 1995: 136 pl. 18; Metzner-Nebelsick 2010a: 139 f. fig. 5; Mogyorós 2018: 364 fig. 4; Parma and Stuchlík 2017: 208 fig. 1.

In a number of publications, Carola Metzner-Nebelsick has emphasized the important role of the Bosut culture in the eastern Carpathian Basin during the early stages of the Iron Age. This is indicated by the presence of pottery of Kalakača and Basarabi type in the Alföld and south-west Transylvania and, as mentioned above (Chapter 8.2), the influence of the Basarabi culture as far west as Slovenia and the eastern Alps.[63] On the other hand, the area of the Bosut culture was probably effected by the disruption following the arrival of pre-Scythian equestrian nomads in the Great Hungarian Plain, as shown by the presence of burials of Mezőcsát type in Vojvodina and the mass graves from Gomolava and Novi Sad.[64] Metzner-Nebelsick also emphasized the close links maintained by the Bosut culture with the cultures in the grass and forest steppe north of the Black Sea during the 9th and 8th century BC.[65] This might explain the change from cremation to inhumation following the end of the Belegiš II-Gáva culture.

Unfortunately, the present state of research does not allow a detailed account of the Bronze/Iron transition in southern Serbia, Kosovo, and North Macedonia. However, there is one early iron implement from

by the onset of iron production.

63 See e.g. Metzner-Nebelsick 2010a: 137 f.; 2012b: 439 f.

64 The burial customs of several crouched inhumations from the Vojvodina seem to be related to the Mezőcsát culture: Pećine near Vrdnik; Vagan near Jaša Tomić; Asfaltna Baza in Zemun. See Metzner-Nebelsick 2002: 477 note 820. — The mass burials from Hrtkovci-Gomolava and Novi Sad, Klisa in Vojvodina are related to similar burials found further to the north, such as Pusztataskony-Ledence and Tărtăria. — See Kapuran 2018: 84 ff.; Koledin 2020.

65 See e.g. Metzner-Nebelsick 2012b: 439.

southern Serbia which deserves a brief treatment.[66] Excavations at Leskovac, 'Hisar' uncovered an iron trunnion axe associated with a bronze socketed axe (Figure 44).[67] The socketed axe belongs to a specific variant with a parabola-shaped decorative element below horizontal ribs. Comparable axes from Serbia, Hungary and Romania show that this axe variant mainly occurs in hoard phase IV (Ha B1), although some similar axes are still found in hoards of phase V.[68] The iron trunnion axe has a relatively long 'butt' above the vestigial arms, and resembles bronze and iron examples from the Aegean (e.g. Figure 19: 3-6.11). These parallels suggest an early date for the iron trunnion axe from Leskovac, 'Hisar', perhaps around the second half of the 10th century BC. As iron tools are extremely rare at this early stage in the central Balkans, it seems most likely that the axe was imported. It is surely significant that at this time stamped decoration is found on pottery in the South Morava basin and the Nišava valley, indicating contact with and influence from the Pshenichevo culture of southern Bulgaria.[69] Indeed, similar early trunnion axes are known from Bulgaria (see e.g. Figure 19: 10).

Figure 44. Bronze socketed axe and iron trunnion axe from Leskovac, 'Hisar' (Serbia). — After Stojić 2010: 501 fig. 24; 26.

Our discussion has revealed that the introduction of iron very likely proceeded very differently in the central Balkans compared with the regions west of the River Drina. In the following sections, two aspects will be discussed in more detail, which again underline the important role of the central Balkans in the innovation of iron.

8.5 Bronze and iron in hoard depositions

Hoards of metal objects obviously provide important information on the artefacts which were used in a particular area, on the metals which were available, and on the level of metallurgical technology. However, it must be emphasized that the occurrence of hoards depends on depositional practices. Current scholarly opinion favours the interpretation of most of the hoards as ritual offerings; as a consequence, hoard deposition is primarily an expression of ritual *praxis* and religious beliefs, and so hoards certainly do not provide an unfiltered insight into the metals in circulation. It is therefore necessary to make a clear distinction between positive and negative evidence. While the presence of iron or bronze artefacts in a hoard demonstrates the availability and use of these metals at a certain time and place (positive evidence), the absence of a particular metal in hoards (negative evidence) is not admissible as evidence that the metal was not in circulation. In the latter case, religious beliefs may simply have considered bronze or iron offerings to be unsuitable as 'gifts to the gods'. Keeping this exercise in source criticism in mind, important differences can be recognised between the eastern and central Balkans on the one hand,

[66] Milorad Stojić (2002; 2006) has discussed a number of other problematical iron discoveries from southern Serbia, and argued that all of them should date to the Late Bronze Age (including a fibula from Gornja Stražava; a trunnion axe from Rajkinac; and a pin from Leskovac, 'Hisar'). These all very likely date to the developed Iron Age, or later.
[67] Stojić 2010: 490; 501 fig. 24; 26. — For the bronze socketed axe, see Gavranović and Kapuran 2014: 38 f.; pl. 2: 7.
[68] See Boroffka and Ridiche 2005: 202 fig. 8, variant E/3-4; Kemenczei 2005: 76 variant F; Rezi 2012: 52 f.; Gavranović and Kapuran 2014: 39.
[69] Bulatović 2007: see for example 82 table 1. — Note that pottery with Pshenichevo-style decoration is also found in the Signal cemetery at Palilula near Svrljig in the Nišava valley, where items of iron jewellery were found; see Filipović and Bulatović 2010.

and the western Balkans on the other. The following discussion concentrates on utilitarian objects (tools and weapons). The subject will be discussed further in Chapter 9.4.

In Serbia, as in the regions north and south of the Lower Danube (see Chapter 5.1), the last hoards with bronze implements can generally only be dated imprecisely to hoard phases III-IV (Ha A2-B1).[70] As hoards are absent in the following hoard phase V, it is possible that the deposition of bronze hoards had already ceased by the early 10th century BC.[71]

The situation is very different in the western Balkans – broadly corresponding to the regions to the west of the River Drina. In the westernmost part of Serbian Syrmia, in central and northern Croatia, and in Bosnia-Hercegovina, hoards with bronze tools and weapons are still found in hoard phase V, and in Bosnia-Hercegovina the practice of bronze hoard deposition seems to have continued into hoard phase VI. Well-known examples dating to hoard phase V-VI can be mentioned from Adaševci (Serbia), Gajina pećina, Kamena Gorica and Matijevići (Croatia), Grapska, Osredak and Veliki Mošunj (Bosnia), and Krehin Gradac and Ometala (Hercegovina) (see Figure 49).[72]

In Slovenia, the development of hoarding practices at the end of the Bronze Age is rather more complex. Nevertheless, it is abundantly clear that bronze tools and weapons continued to be included in hoards until the 8th century BC and even later. As the subject has been studied comprehensively, only a few comments are necessary here to provide a broad outline of the main changes in hoard composition.[73]

1. As Biba Teržan has noted, in Ha A2-B1 Slovenia experienced a marked change of cultural orientation, with the hoards now exhibiting strong links to Italy and other Mediterranean areas, in contrast with the previous orientation towards the Carpathian Basin.[74] The most prominent evidence for this change is provided by the hoards with plano-convex and pick-shaped ingots (*pani a piccone*), which were mainly deposited in a fragmentary state. The ingots were sometimes made of unusual copper alloys, often with a high level of lead, reaching 25-50% Pb.
2. In the following centuries, hoards typically have a chronologically heterogeneous composition, containing objects manufactured over a long time-span, sometimes covering several centuries. The most famous example is the ritual deposition in the Mušja jama cave, in which the earliest objects date to the 12th century, and the last metal offerings probably date to the early 7th century BC. The vast majority of the tools and weapons in the Mušja jama are made of bronze (spearheads, axes, swords, knives, sickles, flesh-hooks, saws); the iron offerings comprise a sword, ten spearheads and an arrowhead.
3. The large hoard from Šempeter pri Gorici (originally weighing over 400 kg) also contained artefacts of widely different date (ca. 13th-6th century BC). The hoards of Šempeter type, most of which were deposited during the Early Iron Age, contain the remains of countless non-functional axe-ingots, regularly made of lead-rich alloys (30-50% Pb), mostly in a severely fragmented state. The ingots, in the form of semi-finished shaft-hole axes, may have had a pre-monetary function.
4. Finally, the hoards of Tržišče-Porpetto type mainly comprise weapons – which were mostly made of iron. The earliest example of this kind of hoard, from Tomaj, was probably deposited in the late

[70] Vasić 1982; Pare 1998: 359 note 119. — The hoard from Liborajdea (jud. Caraş-Severin), on the left bank of the Danube to the west of the Iron Gates, belongs to hoard phase IV; see Pare 1998: 361; 408.

[71] For this interruption in hoarding activity, see Pabst 2008: 623 note 167 ("Fundlücke"). — Note that the hoard from Adaševci, close to the Serbian border in Syrmia, will be discussed together with the hoards from the western Balkans.

[72] For references to these hoards, see Pare 1998: 354 ff. — Note that there is a further hoard with a (miniature) bronze socketed axe from Janjevo II in Kosovo; see Pare 1998: 370.

[73] See e.g. Teržan 1996: 89 ff. (P. Turk); 243 ff. (B. Teržan); Teržan et al. 2016: 345 ff. (B. Teržan); Turk 2018.

[74] Teržan 1996: 252 f.: "It can be hypothesized that at the transition of the millennia, a cultural and economic network of connections ... was formed, extending from the eastern Mediterranean to the Alps, and thus encompassing the western Balkan and Italic regions, as is well expressed in the archaeological material — in the ingots and tools, in the jewellery (particularly in bow fibulae and amber beads), and also in the introduction of new technological processes in both 'nonferrous' and 'black' metallurgy."

8th century BC; most of the weapons were made of iron (spearheads and a *machaira*), but the hoard also contained a winged axe and some spearheads made of bronze.[75]

The Slovenian hoards demonstrate that bronze was still widely used for making tools and weapons during the 9th and 8th centuries BC. Large numbers of iron weapons (especially spearheads) were, however, already manufactured and used by the end of the 8th century BC, as the hoards from Mušja jama and Tomaj demonstrate.

Compared with the small number of utilitarian iron artefacts in hoards from the western Balkans prior to the late 8th century BC, the area between the eastern borderlands of Croatia and Oltenia has a much greater quantity of iron tools and weapons from hoard depositions. These include well-known examples such as Šarengrad in east Croatia, Rudovci and Miroč in northern Serbia, and related finds in Romania such as Bâlvăneşti (Oltenia) and Vinţu de Jos (Transylvania).[76] Since the fundamental study by Mircea Rusu in 1963 these hoards are normally referred to as the Bâlvăneşti-Vinţ group.[77]

The hoards of the Bâlvăneşti-Vinţ group typically contain sets of objects regarded as masculine (tools, weapons, perhaps horse gear) or feminine attributes (items of jewellery), and they correspond – both chronologically and spatially – to the Basarabi culture (Bosut IIIb). The hoards contain a wide range of iron tools and implements, including daggers, arrowheads, knives, chisels, trunnion axes, double-axes, horse bits, etc. The hoard discovered in 1897 at Šarengrad in north-east Croatia is one of the most interesting representatives of the Bâlvăneşti-Vinţ group.[78] The iron artefacts comprise: a spearhead with a pair of perforations at the base of the blade; a socketed axe with a split socket; an iron chisel; an iron two-piece horse bit; four iron rings, probably from horse harness; and a pair of tongs, 41.5 cm in length. The tongs are important because this type of tool was previously unknown in Central Europe during the Bronze Age.[79] Metalworkers' tongs are known much earlier in the Levant and Cyprus, and reached Sardinia in the Late Bronze Age.[80] Pairs of bronze tongs then appear in Portugal and north-east England during the 9th century BC, revealing the transmission of metalworking practices originating in the East Mediterranean along the Atlantic seaboard.[81] The iron tongs presumably reached Šarengrad along with new technological knowledge, in this case in the field of blacksmithing.

As mentioned above, new radiocarbon dates show that the Basarabi culture began sometime around the mid- or second half of the 9th century BC. The large hoard of Bâlvăneşti-Vinţ type from Tărtăria – Podu Tărtăriei Vest (jud. Alba) in south-west Transylvania has been dated by radiocarbon to the late 9th or early 8th century BC.[82] Therefore, iron was fully established as the preferred metal for manufacturing utilitarian artefacts in the area of the Basarabi culture by the end of the 9th century BC. Judging from the sheer quantity of iron artefacts in the Bâlvăneşti-Vinţ hoards, iron smelting must have been conducted on a considerable scale in the area of the Basarabi culture, and it was apparently no longer necessary to produce tools and weapons of bronze. Furthermore, as the Basarabi culture must be considered as belonging to the fully developed Iron Age, there must have been a preceding phase, in which the technology was introduced. This recalls Rastko Vasić's chronological scheme, in which Horizon I of the Older Iron Age (Bosut IIIb/Basarabi culture/Bâlvăneşti-Vinţ hoards), corresponding to the full Iron Age, was preceded by the Earliest Iron Age (Bosut IIIa/Kalakača culture), when the technology of iron production was introduced.

[75] Turk 2018. — For the date of the Tomaj deposition, see also Guštin and Božić 2021: 501.
[76] For the hoards in northern Serbia with iron tools or weapons, see Pare 1998: 369 ff. (Aljudovo, Rudovci, Rujište); Jevtić 2016 (Miroč).
[77] Rusu 1963: 199 ff.
[78] Brunšmid 1990; Vinski-Gasperini 1973: pl. 130: B; 131; Kemenczei 2005: 137 f. cat. no. B35; pl. 37-38; Teržan 2017: 124; 125 fig. 6; 126 fig. 7.
[79] For the tongs, see Brunšmid 1900: 63; pl. 3: 11; Teržan 2017: 125 fig. 6: 3.
[80] See for example: Catling 1964: 99; fig. 11: 5; Lo Schiavo et al. 1985: 23-25; Giardino 2005: 502.
[81] Freixianda (Cabeço de Maria Candal), L. 28.4 cm: Vilaça 2013c: 25 f. fig. 9: 6. — Heathery Burn Cave, L. 38.5 cm: Britton and Longworth 1968: cat. no. 70.
[82] Tărtăria, Hoard I, radiocarbon date: 837-787 cal. BC (2σ calibration range). See Borş 2021: 303 ff.; 316 fig. 17.

There is a clear contrast between the hoards in the western Balkans (Slovenia, northern Bosnia, central Croatia) and those in the central and eastern Balkans (Serbia, the Lower Danube, Bulgaria) (Figure 49). Whereas hoards with bronze utilitarian implements continued to be deposited in the area to the west of the Drina during the 9th and 8th centuries BC, further east the deposition of bronze tools and weapons ceased during the early 10th century BC. Following a gap of perhaps ca. 100-150 years, hoards with large quantities of iron were deposited in the area of the Basarabi culture. In contrast to the continuity in hoard deposition practices in the western Balkans, the central Balkans demonstrate a profound cultural disjunction around the transition from bronze to iron. From our review of the hoards, we can safely conclude that the transition to utilitarian iron production must have taken place earlier in the central Balkans than in the regions to the west of the Drina. Unfortunately, hardly any information is available on this crucial innovation phase in the central Balkans, because metal finds – whether iron or bronze – are extremely rare during the time of the Bosut IIIa/Kalakača culture.[83] The interpretation of the changing practices in hoard deposition in the Balkans and the Carpathian Basin is discussed in Chapter 9.4.

8.6 Bronze and iron in the manufacture of swords, dirks and daggers

The development of swords, dirks and daggers, and the transition from bronze to iron in their manufacture, offers an interesting comparison to the case-study of the hoards. The bronze examples will be treated first, then the earliest iron swords, and finally bimetallic weapons.

Two bronze dirks and two swords from the central and western Balkan Peninsula apparently had iron nails or rivets, and may represent a developmental stage in which iron was known and occasionally used, but not yet for large objects. They come from Duškovci in Serbia, Vajzë (Vlorë County) in Albania, Sivec (Prilep) in the Republic of North Macedonia, and Vrana (Zadar County) in Croatia.[84] As Anthony Harding stated, the dirk from Duškovci can with all probability be assigned to the older part of the Middle Bronze Age.[85] Its bronze pommel fitting was supposedly fastened with an iron nail – potentially one of the oldest iron objects in Europe. As it was apparently hammered into the organic hilt of the sword, the nail would have been almost invisible, and as the iron was not displayed prominently it seems that the metal did not have a particularly high value at that time. The other three weapons have iron rivets which were used to fasten organic hilt-plates. The sword from Vrana belongs to the Stätzling type, and can be dated approximately to the second half of the 12th or the first half of the 11th century BC. The dirk from Vajzë belongs to the 'post-Naue II/Allerona' typological grouping, relating to the second half of the 11th and 10th century BC.[86] And the bronze sword from Sivec has been compared by Anthony Harding and Sabine Pabst to the earliest swords from Vergina, which probably date around the end of the 11th or the start of the 10th century BC.[87] Dragi Mitrevski is of the opinion that the rivets on the sword from Sivec are the earliest iron finds in the Republic of North Macedonia.[88] The significance of these small iron elements is rather difficult to gauge. It is worth mentioning that the 'iron nail' on the dirk from Duškovci has not been analysed, and it is therefore not certain that it is made of metallic iron. And it is possible that the iron rivet on the sword from Vrana stems from a later repair of the hilt-plates of the weapon: indeed, its central position at the lower end of the flanged hilt is untypical for the Stätzling sword type. Therefore, it is somewhat uncertain whether these rivets should be counted as evidence for the use of iron much before the 10th century BC.

As explained in Chapter 4.3, bronze sword production came to an end in Greek Macedonia around the turn of the 2nd/1st millennium BC, with the swords of Vergina type, and the same applies to North Macedonia.[89] In Epirus and Albania bronze swords and dirks were still in use during the 10th century,

[83] Mario Gavranović (2021: 389) refers to the "almost non-existent spectrum of local metal items" in the central Balkans at this time.
[84] Kilian-Dirlmeier 1993: 98 no. 252; pl. 38: 252; Harding 1995: 14 no. 9; 51 no. 179; 55 no. 189; pl. 1: 9; 21: 179; 22: 189.
[85] Harding 1995: 14.
[86] For the chronology of Vrana and Vajzë, see Chapter 4.3; see also Pabst 2013a: 106 ff.
[87] Harding 1995: 55; Pabst 2009: 21 ff.; 57 fig. 6: 2; Bräuning and Kilian-Dirlmeier 2013: 30 ff. — See also Chapter 4.3-4.
[88] Mitrevski 1997: 242.
[89] The sword with iron rivets from Sivec; possibly the re-used sword from Lakavica. — See Harding 1995: 40 cat. no. 99; 55 cat. no. 189.

but are no longer found in contexts of the 9th century BC. Turning to the regions further north, in the central Balkans the use of bronze swords apparently ceased by the middle of the 10th century BC; the latest sword seems to be the example from the confluence of the Danube and Morava at Smederevo, dating to Ha B1.[90] This is in sharp contrast with regions to the west of the River Drina (Dalmatia, central and northern Croatia, Bosnia-Hercegovina, Slovenia), where bronze sword, dirk and dagger production continued throughout the 10th, 9th, and 8th centuries BC.[91]

The earliest iron swords in the central and western Balkans come from Milci-Gevgelija and Visoi-Beranci in the Republic of North Macedonia.[92] Dragi Mitrevski assigns the sword from Milci, Grave 56 to the first phase of the Iron Age in the Lower Vardar Valley.[93] And Reinhard Jung suggests a Submycenaean or Protogeometric date for the wheel-made, painted skyphos supposedly associated with the sword in Visoi, Grave III.[94] Although their contexts are difficult to interpret, these iron swords are doubtless related to comparable weapons from Greek Macedonia, for example from Vergina, Aghios Panteleimon and Agrosykia, where their manufacture probably started in the 10th century BC (see Figure 24). Another iron flange-hilted sword was discovered in the famous Mušja jama ritual cavern near Škocjan in Slovenia, which has already been discussed above.[95] Biba Teržan believes that it was obtained from the Protogeometric or Geometric Aegean. [96] However, as the sword has a very close parallel in a Bulgarian private collection, it is more likely that the iron sword from Škocjan represents contact with the eastern Balkans.[97] As the objects from the cave indicate ritual activity over a long period (from the 12th/11th until the early 7th century BC), the individual pieces cannot be closely dated.

A new type of iron sword, which I call the 'Basarabi-Novi Sad' type, was developed somewhat later and has a wide distribution, with a concentration around the Iron Gates (Vojvodina, Banat, Oltenia, south-west Transylvania), but there is also an example from Vergina and several from Albania.[98] The sword hilt has high, steep shoulders and a large circular swelling in the middle of the handle; some of the better-preserved examples have a pronounced mid-rib, a serrated ricasso, or a cylindrical chape. The related 'Orlova Čuka' variant has a smaller swelling on the hilt.[99] The swords from Star Karaorman, 'Orlova Čuka' and Basarabi have been assigned by Rastko Vasić to Horizon I of the Older Iron Age in the central Balkans (contemporary with the hoards of the Bâlvăneşti-Vinţ series), and the sword from Vergina belongs to the same chronological horizon.[100] As related weapons from the Basilicata region in southern Italy have been found in tombs dating to the first half of the 8th century BC, it is very likely that the Basarabi-Novi Sad

[90] Harding 1995: 79 cat. no. 247; pl. 32: 247.
[91] The following weapon types, according to Anthony Harding: Dalmatian; Celldömölk; Kostel; Tešanj; Kulen Vakuf; 'Nierenknauf'; Veliki Mošunj; Tarquinia; Weltenburg; Mörigen; and Tachlovice types. — See Harding 1995: pl. 52: A.B; 54: A.B; see also Gavranović 2011: 112 ff.
[92] Milci, Gevgelija, Graves 7 and 56: Georgiev 1984: 68 fig. 6: D; Mitrevski 1991: 152 pl. 1: 2. — Visoi, Beranci (Bitola Municipality), Tumulus I, Grave III: Kilian 1975: pl. 60: 8; Papazovska 2018: 94 fig. 2; 96; 97 fig. 5.
[93] Mitrevski 1991: 157 Plan 1. — Rastko Vasić refers to the Early Iron Age culture in the Lower Vardar Valley as the Gevgelija group.
[94] Jung 2002: 243 f.
[95] Teržan et al. 2016: pl. 14: 3. - See Chapter 5.2.
[96] Teržan et al. 2016: 369; 372; 378 f.; 399; 409.
[97] The Bulgarian sword (length 60 cm) is in the Vatevi Collection. It is similar in length to the sword from Škocjan (Length 59 cm). — See Torbov 2018: 6 cat. no. 2; 2020: 9; pl. 1: 1.
[98] The Basarabi-Novi Sad type is earlier than the better-known Glasinac sword-type, which dates to the 7th and 6th centuries BC, and is a typical feature of the Glasinac-Mati culture of Bosnia and northern Albania. — Swords of Basarabi-Novi Sad type: Basarabi, Tumulus III, Grave 3: Vulpe 1990: 72f. cat. no. 99; pl. 19: 99; 32: 212. — 'Vicinity of Novi Sad': Koledin 2012: 11 fig. 1. — 'Banat' (jud. Caraş-Severin): Bader 1991: 172 ff. cat. no. 469; pl. 57: 469. — Probably Teleac: Uhnér et al. 2019: 191 fig. 14. — Vergina, Tumulus LXVIII, Grave Z: Bräuning and Kilian-Dirlmeier 2013: 290; 296 fig. 256: 33. — Kuç i Zi (Albania): Andrea 1985: pl. 28: 2; 32: 2; 33: 3; 35: 1. — Pazhok (Albania): Bodinaku 1982: 94 pl. 5: 6.7. — Dolné Vestenice (Slovakia): Čambal 2018: 130 pl. 1: 1. — Possibly also an example from the Glasinac plateau: Ilijak, Tumulus III, Grave 1: Benac and Čović 1957: pl. 13: 9.
[99] Star Karaorman 'Orlova Čuka', Tumulus V, Grave 2 (Republic of North Macedonia): Pašić-Vinčić 1970: pl. 3: 2; Kilian 1975: pl. 44: 1. — 'Bulgaria': Thraker 2004: 103 fig. 152; Torbov 2018: 4 cat. no. 1618; 9 cat. no. 5; Kabakchieva 2000: 33 cat. no. 18. — Tilişca, jud. Sibiu (south-west Transylvania): Vulpe 1990: 72 f. cat. no. 99A; pl. 19: 99A.
[100] See particularly the fibulae from Star Karaorman, 'Orlova Čuka': Vasić 1999: 54 cat. no. 337-338; pl. 28: 337.338. — For the chronological position of the Orlova Čuka cemetery before the classic 'Macedonian Bronzes', and the discussion concerning Milci-Gevgelija, Grave 31/35 (with a fibula similar to that in the Orlova Čuka sword-grave), see Heilmann 2018: 52 f. — For Vergina, Phase IVA, see Chapter 4.4.

swords were produced in the central Balkans by ca. 800 BC at the latest.[101] Judging from the distribution of the known swords, with concentrations around the Iron Gates and in Albania, and isolated examples in Macedonia, it is likely that the Basarabi-Novi Sad swords were also used in the remaining areas of the central Balkans, including southern Serbia and Kosovo, even though relevant swords have not yet been found there. The sword of Basarabi-Novi Sad type from Dolné Vestenice in Slovakia is clearly an import, presumably from the area of the Basarabi culture.[102]

Finally, five early bimetallic dirks or short swords are known from the central and western Balkans.[103] Unfortunately, all five lack associated finds. A bimetallic dirk with bronze hilt and iron blade from the cemetery of Psar (Korça County, Albania) has a precise parallel in Calabria, and will be discussed in Chapter 10.1 together with the bimetallic swords from southern Italy.[104] The other swords come from the Sava near Krško (Slovenia), Batina (north-east Croatia) and Chauchitsa (central Macedonia), and there is an unprovenanced weapon in the Narodni muzej, Belgrade.[105] Although these weapons appear to be related to bronze solid-hilted swords of Flörsheim and Lipovka type, which might suggest a chronological position not long after the second half of the 10th century BC (Ha B2), the examples from the Sava at Krško, Chauchitsa and the Belgrade museum are similar to the bronze swords from Graves 136 and 165 at Brežec in Slovenia, indicating that they are probably somewhat later.[106] Mitja Guštin suggested a date in the first half of the 8th century BC for Brežec, Grave 165, but an earlier position, perhaps in the second half of the 9th century, seems more plausible today.[107] Judging from the known provenances and the relationship with the swords from Brežec, it seems most likely that these four swords were manufactured in workshops in the north-western Balkans (Slovenia, north Croatia). They are probably early examples of the use of iron for prestigious bimetallic weapons, before iron weaponry became common. For that reason, it would be interesting to know more precisely when they were made, but as they are all isolated finds this hardly seems possible.

As our discussion of the swords, dirks and daggers has revealed, the available evidence is often disappointing: the iron nails and rivets on bronze dirks and swords do not provide conclusive evidence for the use of iron much before the 10th century BC; the bimetallic dirks and short swords all lack associated finds; and the earliest iron swords in the Republic of North Macedonia can only be imprecisely dated to the 10th/9th century BC. The most interesting outcome of our discussion was the profound contrast between the evidence from the central Balkans (Serbia, Vojvodina) and the western Balkans (Bosnia-Hercevogina, Croatia, Slovenia). Whereas in the latter region, bronze swords, dirks and daggers continued to be manufactured throughout the 9th and into the 8th century BC, there is no evidence for such weapons from the central Balkans after the mid-10th century BC.[108] After a considerable gap, swords reappear in the central Balkans in the form of the iron Basarabi-Novi Sad type ca. 800 BC. This profound difference between the central and western Balkans was also revealed by our discussion of hoarding practices: in the central Balkans, bronze hoards ceased to be deposited at some time before the mid-10th century BC, and after an interruption of ca. 100-150 years, hoarding was resumed with iron tools

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[101] For the swords from Basilicata, see Bottini 2020: 96 table 6, with further literature. See especially Craco, Sant'Angelo, Tomb 6 (Bottini 1993: 39 fig.). — See also Bernalda, Incoronata-San Teodoro, Tomb 336 (Chiartano 1994: 136; pl. 80: A); Tursi, Valle Sorigliano, Tomb 102 (Frey 1991: 14 f.; pl. 12: 1; Bottini 1993: 33 fig.); Guardia Perticara, San Vito, Tomb 9 (Bottini 1993: 37 fig.).

[102] Čambal 2018: 130 pl. 1: 1.

[103] Note that the bimetallic sword from Črnomelj (Slovenia), Tumulus 8, Grave 2, is later; the associated finds, in particular the Apulian krater, indicate a date around 700 BC. — See: Harding 1995: 85 cat. no. 263A; pl. 35: 263A; Frelih 1992: 86 fig. 8: 2; 87 fig. 9: 2; Teržan 2014. — For the Apulian crater, compare Parzinger 1989: pl. 43: 2 (Reva near Dobrnič, Tumulus 22, Grave 1); see also Turk and Murgelj 2010: 170 fig. 12 (distribution map); Škvor Jernejčič 2011: 206 note 113; 209 f. (chronology).

[104] Aliu 1995: 139; 143 pl. 4: 31. — As suggested in Chapter 10.1, according to parallels for the form of the hilt on dirks from Crete, a date around the 9th century BC seems most likely for the similar hilts from Psar and 'Calabria'.

[105] Sava near Krško: Laharnar and Turk 2018: 33 fig. 24-25; Turk 2020: 565 f.; 559 fig. 3. — Batina: Harding 1995: 84 cat. no. 262; pl. 35: 262; Metzner-Nebelsick 2002: pl. 19: 1. — 'Unprovenanced' (Belgrade Museum): Harding 1995: 83 cat. no. 257; pl. 34: 257. — Chauchitsa: Kilian-Dirlmeier 1993: 129 cat. no. 448; pl. 58: 448.

[106] Flörsheim and Lipovka types: Müller-Karpe 1961: pl. 50: 4; 52: 1-5. — Brežec swords: Ruari Loseri 1977: 6 fig. 1-2; pl. 12; 33; Mizzan 1994; Harding 1995: 81 cat. no. 253-254; pl. 33: 253; Teržan et al. 2016: 102 fig. 33; 103 fig. 34.

[107] The grave furnishings include a pin of Sirolo-Numana type. — Guštin 1979: 62; 30 fig. 11 (Notranjska phase IIA).

[108] For the bronze swords, dirks and daggers in the western Balkans, see footnote 91.

and weapons.[109] By contrast, in the regions west of the Drina, hoards with utilitarian artefacts continued to be deposited during the 9th and 8th centuries BC. In summary, our study of the hoards and weapons has demonstrated the fundamental difference between the introduction of iron in the two areas: in the western Balkans, both bronze hoard deposition and the manufacture of bronze swords, dirks and daggers continued much longer than in the area east of the Drina.

8.7 Discussion and conclusions

It is difficult to summarise the fragmentary information from the central and western Balkans, particularly in view of the marked differences between the various regional cultural groups and the uneven state of research. However, some broad tendencies can be recognised.

After the first encounters with iron in the 11th century BC, the varied spectrum of artefacts found in the graves from Lofkënd (jewellery, a knife, an arrowhead and a spearhead) suggests that local iron production was already established in parts of southern Albania in the following century. It seems that the introduction of iron in Albania was comparable to the regions further south, such as Epirus (Liatovouni) or Aetolia (Stamna). Iron may have been introduced for utilitarian purposes at a similar date in the Republic of North Macedonia, considering that iron flange-hilted swords closely related to examples from the cemetery of Vergina were in use, and bronze swords seem no longer to have been manufactured after the 11th century BC. However, the iron swords from North Macedonia can only be imprecisely dated to the 10th or 9th century BC.

The earliest finds around the *Caput Adriae*, the knives and axes from Istria and the Karst/Soča region, were most likely imported; as mentioned above, this also seems likely in the case of the iron knife with bronze rivets from Kakavijë in Albania. Apparently, this contact – presumably with trading partners who sailed up the Adriatic coast – did not lead to a transfer of smelting technology, and there is no clear evidence for local production of iron at this time in Istria or western Slovenia.[110]

Iron remained rare in the western Balkans during the 9th century BC. In Slovenia, the most intensively researched region, iron seems to have been used chiefly for the manufacture of specific prestigious artefacts, including neck-rings, and perhaps bimetallic dirks and short swords. Iron became more widely used in Slovenia from the later 9th century BC onwards, in the so-called 'iron horizon'. This marked increase in the use of iron, implying that local iron production had been established, was probably stimulated by contact with the Basarabi culture.

From the 11th century BC onwards and reaching into the Hallstatt period, there is clear evidence for cultural continuity in the western Balkans. Large 'urnfield' cemeteries were used from Ha B1 onwards in Slovenia and northern Croatia (e.g. Tolmin, Ljubljana, Pobrežje, Ruše, Maribor, Dobova, Velika Gorica, Vukovar-Lijeva Bara, Dalj-Busija, Batina), and tumulus cemeteries with inhumation burials continued to be used during the Late Bronze and Early Iron Age in central and eastern Bosnia.[111] Ritual deposition of utilitarian bronze artefacts continued during the 10th, 9th and even 8th centuries BC in Slovenia, Bosnia and central and northern Croatia. Although iron tools and weapons were introduced during the 8th century BC, bronze examples were still manufactured and valued in the 8th century BC, and even later.[112]

[109] For this interruption in hoarding activity in the central Balkans, see e.g. Vasić 1994: 4 fig. 1.
[110] For ironworking in the 9th century BC at Ljubljana, Tribuna, see now Vojaković 2023.
[111] See, for example Teržan 1999: 111. — As an example for cultural continuity, see the development of pottery in the Dalj-Batina culture: Metzner-Nebelsick 2002: 167 ff. fig. 72-76.
[112] E.g. bronze winged axes, which are common in the area south-east of the Alps (Styria, Carinthia, Slovenia) and in the Este culture during the 8th and 7th century BC. See Stary 1982: 36 f. — For early graves with iron weapons (often associated with bronze weapons), see for example Frög, Tumulus 70 in Carinthia (Tomedi 2002: pl. 41-44: A); Ptuj, Ulica Viktorina Ptujskega in Slovenia (Dular and Lubšina Tušek 2014; Teržan 2017); Grepci in south-west Bosnia (Marijan 1995); Ilijak, Tumulus 20, Grave 1 in eastern Bosnia (Benac and Čović 1957: pl. 3: 1-11).

The situation in the central Balkans, where there was a profound disjunction around the Bronze/Iron transition, is very different. As explained above, the deposition of bronze hoards declined and came to a halt during Ha B1; bronze swords are also unknown after Ha B1. We must consider two explanations for the apparent decline in the production and deposition of utilitarian bronze artefacts around the first half of the 10th century BC. Firstly, it is evident that there was a radical transformation in the conceptualization of metals, and bronze artefacts were no longer considered suitable as votive offerings. Secondly, it is possible that bronze was no longer used for the manufacture of tools and weapons. This second eventuality seems to be supported by an important study in which Mario Gavranović analysed the occurrence of moulds for casting bronze artefacts in the central and western Balkans. According to Gavranović, in the later part of the Urnfield period (Ha B1-3), stone moulds are found in considerable quantities in settlements in the western Balkans, whereas they are absent in the regions east of the Drina.[113] Although it is conceivable that the metalworkers in the central Balkans changed their methods of bronze production in Ha B (e.g. changing to using sand or clay moulds and the lost-wax technique), it is more plausible that production of bronze utilitarian artefacts in the central Balkans declined sharply during Ha B1.

The deposition of hoards with bronze tools and weapons came to an end in the central and eastern Balkans at approximately the same time, probably by the first half of the 10th century BC. As there is evidence, especially in eastern Serbia, for contact with the Stamped Pottery cultures further to the east (Insula Banului and Pshenichevo pottery styles), it seems reasonable to link the decline in bronze production in Serbia with comparable developments in Bulgaria. In both regions, the Fluted Ware *koinè* disintegrated at the same time as the cessation of bronze hoarding, and this coincidence gives sustenance to the hypothesis that the Fluted Ware *koinè* corresponds to a communication network within an economic system based on the production, exchange, and display of bronze. According to the presently available evidence, the Fluted Ware *koinè* ended earlier in the central and eastern Balkans than in the Great Hungarian Plain (ca. 900 BC); while in parts of Transylvania and around the upper Dnister, pottery with fluted decoration of Gáva/Gáva-Holihrady type remained in use during the 9th century BC. The retreat of the Fluted Ware *koinè* is important as it seems to represent the demise of a cultural and economic network which was based on access to and exchange of bronze.

The Post-Fluted Ware cultures (Figure 43) represent a break with the past: the regional Stamped Pottery styles (Saharna, Cozia, Babadag, Insula Banului), the Bosut/Kalakača culture and, slightly later, the Mezőcsát culture in the Alföld. These cultures now stood under the influence of iron-using regions further to the south (Thrace) and east (the North Pontic steppe). In this new constellation, the Bosut culture in its Kalakača and Basarabi stages must have had a pivotal role in the transmission of new ideas from the eastern Balkans and the North Pontic steppe towards the Carpathian Basin.[114] It is abundantly clear from the Bâlvăneşti-Vinţ hoards and the swords of Basarabi-Novi Sad type that iron was fully established for the manufacture of tools and weapons by ca. 800 BC in the central Balkans, Oltenia, the Banat, and south-west Transylvania. Unfortunately, much less information is available on the introduction of iron further south in Serbia, Kosovo, and the Republic of North Macedonia.

[113] Gavranović 2013: 151 fig. 2.

[114] On the pivotal role of the Bosut culture, see Metzner-Nebelsick 2004: 283 ff.; 2010a: 137 ff.; 2010b: 215 f.; 2012b: "… the formation of the Basarabi-Cultural Complex, grounded in the tradition of older stamped ware pottery groups, can be seen as the emergence of a powerful political entity with wide ranging ties as far east as the Dnepr region and with exchange networks with the elites of the eastern Alpine Hallstatt culture between Carinthia and Lower Austria in the west."

Chapter 9
The Carpathian Basin and the wider European context of the introduction of iron

In the following pages the earliest iron artefacts in Central Europe will be the subject of a critical discussion (Chapter 9.1-3). In the second part (Chapter 9.4-6), the focus turns to the fundamental change in the conceptualization of bronze at the Bronze/Iron transition, with a special emphasis on the cessation of bronze hoard deposition.

The iron artefacts of the Late Bronze Age have recently been discussed by Florian Miketta in his important monograph published in 2017. A very useful review of the evidence from France, published in 2022, is another valuable contribution to our research topic.[1] Otherwise, there has been little systematic research on early iron in the past three decades. The discussion will begin with a detailed review of the evidence for early iron in Transylvania and the Banat, as it has often been claimed that the use of iron started earlier in these regions than elsewhere in Central Europe.

9.1 Notes on early iron in Transylvania and the Banat

In view of the results discussed in the previous chapters, the question of the start of iron production in Transylvania and the Romanian Banat is particularly intriguing. As thirty-five years have passed since the last major publications on the onset of iron use in Romania, it is high time to review the subject.[2] The question can best be introduced by a brief summary of the history of research.

The first significant study was published in 1964 by Kurt Horedt. Horedt believed that ironworking in Romania began in the 9th century BC, and he mentioned four sites with iron finds dating to Ha B (Bârlad, Hida, Şomartin, Tuşnad).[3] Ten years later, Mircea Rusu argued for a much earlier start for iron production, pushing the earliest finds back to the 12th or 11th century BC (Ha A).[4] As evidence, he named the iron socketed axe excavated in 1967 in the cemetery of Lăpuş (jud. Maramureş), the iron fragment from the Rozavlea III hoard (jud. Maramureş), found in 1971, and the iron objects found in the late 1950s in Bobda (jud. Timiş) and Gánovce (Slovakia). He also discussed three finds without precise provenances from the Banat, for which he again suggested an early chronological position (Ha A or Ha A2/B1).

In his valuable article published in 1977, Attila László assigned seven iron objects to Br D or Ha A, and he believed that a further two finds possibly date to Ha A.[5] László believed that the oldest iron artefacts come from the westernmost parts of Romania (Banat, Maramureş), and he suggested that they were obtained from an early ironworking centre located in the north-western Balkan Peninsula – possibly along with technological knowledge of iron production. By contrast, he believed that in the case of the Babadag culture (Dobrudja), iron technology was passed on from the Aegean via the west coast of the Black Sea.[6] Today we know that there was no such early iron production in the north-west Balkan or south-east Alpine regions, so that in this respect László's suggestion must be rejected.[7] László was able to assemble a large number of iron finds dating to Ha B.

[1] Miketta 2017; Jambon et al. 2022.
[2] See Boroffka 1987; 1991; Stoia 1989.
[3] Horedt 1964. — The iron finds from Bobda and Cernat were only mentioned in an addendum; see Horedt 1964: 132 note 58.
[4] Rusu 1974.
[5] László 1977.
[6] László 1977: 70 f.
[7] For the out-dated idea of an early centre of iron production in the area between the south-east Alps and the north-west Balkans, see Merhart 1952: 39; Kimmig 1964: 243 f.; Horedt 1964: 129.

After László's publication of 1977, a number of other authors proposed further evidence for the early onset of ironworking.[8] In 1989, Adriana Stoia listed a total of 18 iron artefacts from 13 sites dating to Ha A. Nikolaus Boroffka expressed his opinion on the origin of the new technology: he believed that the evidence indicated a transfer of the technology of iron production to Romania from Greece or Turkey at the latest during the 12th century BC, and very soon the establishment of a local iron industry.[9]

Finally, Valentin Vasiliev discussed the problem of the early iron finds in Romania in the publication of the excavations at the important defended settlement of Teleac in jud. Alba.[10] He drew attention to the 29 iron objects from stratified contexts at Teleac: while 25 came from phase III, only three were found in phase II.[11] And iron finds were completely absent in the earliest settlement (phase I). Vasiliev pointed out that the situation in Teleac was similar to that in the fortified site of Babadag. There too, iron finds were apparently absent in the earliest settlement (Babadag I). The first iron artefacts supposedly came from contexts of the second settlement phase (Babadag II), which, according to Vasiliev, began at the earliest in the mid-10th century BC. In view of this evidence, he pleaded for a more critical approach to the early iron finds from Transylvania and the Banat.[12] He noted the tendency in previous research to an early dating of iron finds, which was often unjustified, and emphasized the necessity of basing conclusions on stratified finds from reliable contexts. Although Vasiliev's critique of the previous research consensus was a very important contribution, note that his comments on the introduction of iron at Babadag should be treated with due caution, in view of the recent review of the settlement's chronology by Sorin-Cristian Ailincăi (see Chapter 5.1).

It is clear that there are different opinions on the introduction of iron and ironworking in Romania. On the one hand there is the view that iron was introduced early, in the 13th/12th century BC, with local iron production developing rapidly, and in the following centuries a constant increase in the use of iron. Different opinions about the inception of the new technology have been expressed: either an autochthonous development of iron production in Romania (Adriana Stoia), or the introduction from the west (Attila László), or from the Aegean/Anatolian area (Nikolaus Boroffka). In contrast to these views, Valentin Vasiliev argued that meaningful and regular local iron production and ironworking only started in Romania much later, around the second half of the 10th century BC in Dobrudja and even later in Transylvania, where he assigned Teleac II to the 8th century BC.[13] Vasiliev believed that before then iron objects only occurred sporadically.

Considering the relatively large number of iron finds of the 11th and 10th centuries BC in the area north of the Black Sea (see Chapter 6 and Figure 26), a corresponding level of iron production in contemporary Transylvania would not be at all surprising. However, a critical review of the find circumstances shows that iron objects in Romania reliably dated before the 9th century BC are surprisingly rare.[14]

Two finds are generally considered as evidence for the use of iron in the Maramureş region of north-west Romania already in the 13th century BC. In 1967, an iron socketed axe (9 cm in length) was discovered in Tumulus 1 at Lăpuş, which has been assigned to the first phase of the use of the cemetery.[15] The axe was found above a burnt layer at the base of the tumulus and beneath an accumulation of stones.[16] Sadly, the precise details of the excavation have not yet been published so it is impossible to be certain whether the axe truly belonged to the primary phase of use of the tumulus, even though this was explicitly stated by

[8] Boroffka 1987; 1991; Stoia 1989. — See also Muscă 1982 (especially for finds of slag).
[9] Boroffka 1991: 6.
[10] Vasiliev et al. 1991: 126-128.
[11] The 1991 publication assigned four iron objects to Teleac phase II, but now it seems that the stratigraphical context of one of these (the iron tongue-shaped billet) could, in fact, be dated to either phase II or III (see below).
[12] Among the examples discussed by Vasiliev, his scepticism is most justified in the case of the finds of iron slag. The pieces of slag listed in the publications of László, Muscă, Stoia, and Boroffka are mostly unstratified collections from settlements.
[13] Vasiliev et al. 1991: chronological table on p. 128.
[14] The author is very grateful to Dr Nikolaus Boroffka (Berlin) for his valuable help during research on the Transylvanian finds.
[15] Kacsó 2001: 234.
[16] Kacsó 1975: 50 fig. 1: 16; 67. — Kacsó 2001: 276 fig. 26: H1. — Kacsó 2011a: 217. — For a photograph of the axe, see Metzner-Nebelsick et al. 2010: 220; 229 fig. 2.

the excavator, Carol Kacsó. This is important because at Lăpuş, after the initial phase of activity, there followed a phase of ritual depositions in the vicinity of the cemetery in Ha B. Among other things, a bronze hoard, a bronze sword with bowl-shaped pommel, and various bronze socketed axes have been found in the surrounding area.[17] Owing to the paucity of published information on the stratigraphic context of the iron axe, it is impossible at present to exclude the possibility that it might derive from a later stage of ritual activity. This question is crucial because iron socketed axes are otherwise only known from later contexts, the earliest examples dating to the later 9th century BC.[18] Furthermore, as very similar iron axes with a round socket are frequently found in the Early Iron Age, it appears most likely that the axe was deposited in the tumulus much later than the primary phase of its use.[19]

The context of the second find from the Maramureş region is also not as straightforward as it might seem. In 1971 a collection of bronze objects, along with remains of two pottery vessels and a fragment of iron were discovered close to Rozavlea. The hoard ('hoard III') belongs to the Uriu-Ópályi series and can be reliably dated to Br D.[20] The iron object comprises a fragmentary flat tang (3.2 cm in length) with a copper alloy terminal, and most likely represents the remnant of an iron knife. But in subsequent publications, Carol Kacsó has been careful to explain that the iron fragment is not securely associated with the bronze hoard; because the tang fragment cannot be assigned to a known artefact type it can potentially date to any period – ancient, medieval, or modern.[21] Rozavlea cannot, therefore, be considered as reliable evidence for the early introduction of iron in Transylvania.

The other site often mentioned among the earliest iron finds from Romania is the cemetery of Bobda (jud. Timiş).[22] Although the cemetery was excavated in 1959/60, hardly any information has been published since then. In a single sentence published in 1964, Marius Moga mentioned "iron ornaments".[23] Many years later, Marian Gumă stated that Grave 10 contained an iron object that he referred to rather vaguely as a "link, bracelet or pendant".[24] As the grave belongs to the Cruceni-Belegiš II culture, dating approximately to the 13th/12th century BC, this could be one of the earliest iron artefacts in Central Europe. Unfortunately, according to information kindly provided by Alexandru Szentmiklosi and Andrei Georgescu (Timişoara), today there are no iron objects among the finds from Bobda in the Muzeul Național al Banatului, and they are not mentioned in the museum's inventory book. However, a photograph of an iron ring has recently been discovered in an old collection of photographs of finds from cemeteries of the Cruceni-Belegiš culture from the Banat, and it is possible that it is the piece from Bobda. Unfortunately, from the photograph it is not possible to determine its exact size; however, it seems to be small, and could be a finger ring or small bracelet; thus, without consulting the unpublished documentation of the excavation, it is impossible to reach a more definite conclusion about this iron object from Bobda.

Apart from these rather nebulous objects from Bobda, according to the available information, there are no further iron artefacts which can be reliably dated before the 10th century BC. Three finds without precise provenance from the Banat, which were first discussed in the article by Mircea Rusu in 1974, were already mentioned above. In my opinion, the two bronze objects cast over an iron core (a sword and a pin) were almost certainly not made in prehistoric times – this very demanding casting technology was impossible at such an early date.[25] The unprovenanced iron sword illustrated by Rusu does not belong to Ha A2/B1, in fact it belongs to the Basarabi-Novi Sad type discussed in Chapter 8.6, which seems to date mainly to the 8th century BC.[26]

[17] Kacsó 2009; Kacsó et al. 2011: 341 f.; 346; 351; Kacsó et al. 2012: 452 f.
[18] See e.g. Studeníková 2000: 63 fig. 1; Wanzek 1989: 169 ff.; Teržan 2017.
[19] See e.g. Gedl 2004: 60 ff.; Kłosińska 2019: 248 fig. 3: 5-6.
[20] Kacsó and Mitrea 1976: 539 fig. 1: 22. — For the chronology, see Kacsó 2001: 234.
[21] Kacsó 2011b: 455; 2015: 261.
[22] See for example László 1977: 54; Boroffka 1991: 7 no. 4.
[23] Moga 1964: 296.
[24] Gumă 1993: 171; 263; 264 note 81; 285 no. 12; 1995: 105. — According to information kindly provided by Dr Alexandru Szentmiklosi (Timişoara), Grave 10 belongs to the Cruceni-Belegiš II cultural group (13th/12th century BC).
[25] Rusu 1974: 352 fig. 1: 2-3.
[26] Rusu 1974: 352 fig. 1: 4. — See Bader 1991: 172 ff.; pl. 57: 469.

In fertile, densely populated landscapes like Transylvania and the Banat, unstratified finds from Bronze Age sites must be treated with due caution, as it is always possible that they derive from later periods.[27] This is especially true for the pieces of slag collected from the surface of Late Bronze Age settlements. But the same problem applies to typologically indeterminate iron artefacts. The tanged knife from Căuaş, 'Sighetiu' (jud. Satu Mare) can be taken as an example. Although it was found in the area of a settlement of the Gáva period, it could nevertheless stem from a later use of the site.[28] In other cases, the exact details of the location and context of the iron artefacts are unclear. For example, Carol Kacsó mentioned that an iron knife was found together with early Hallstatt pottery in a cave near Şuncuiuş (jud. Bihor).[29] But, to my knowledge, subsequently no further details about the context have been published. There are also difficulties in forming a judgement about some other settlement finds. In the course of building work in Deva (jud. Hunedoara), a settlement pit with pottery of the Wietenberg and Igriţa cultures was uncovered. According to Ioan Andriţoiu, the iron dagger blade was found above the settlement pit, so there is no unambiguous stratigraphical association between the iron blade and the contents of the pit.[30] In the course of excavations in the fortified settlement of Porumbeni Mari, 'Várfele' (jud. Harghita), an iron knife was discovered in a pit house. The problem in this case is that the finds from the context have not yet been published, so that it is impossible to judge the date of the house and its contents.[31]

Unfortunately, the find circumstances of an iron knife and an iron trunnion axe from a settlement pit on the Insula Banului have also not been published in any detail.[32] Insula Banului (Gura Văii, jud. Mehedinţi) is an island in the Danube, near the Iron Gates, on the border between Serbia and Oltenia. Although some authors have argued for a very early date for the axe, this is not convincing.[33] Based on the available information, the trunnion axe from the Insula Banului cannot be dated reliably, although a position in the 9th or 8th century BC would be most likely.[34]

A similarly unsatisfactory situation applies to some grave finds. For example, in the case of the grave with an iron knife from Mirăslău (jud. Alba), the finds are still not published.[35] And in the supposed grave from Oradea, 'Salca' (jud. Bihor), it is not unlikely that the Gáva pottery was mixed with later (La Tène, medieval?) iron objects and glass beads.[36]

These examples illustrate the fact that at present it is still difficult to form a clear picture of the occurrence of iron in Transylvania and the Banat before the 1st millennium BC. The situation changes in the 10th century BC, when the amount and the quality of evidence for the use of iron increases markedly. The excavations at the defended hill settlement of the Gáva culture at Teleac (jud. Alba) provide important information. As noted above, three iron objects have been reported from settlement phase II at Teleac: a fragment of a socketed axe and two indeterminate fragments.[37] In the excavation publication, a tongue-shaped iron billet was said also to come from a phase II context, but today a position in phase III seems equally possible.[38] The extensive new excavations in Teleac in recent years, conducted by Horia Ciugudean and Claes Uhnér, promise to provide crucial new evidence on early iron in Transylvania. As yet no information on the stratigraphic position of new iron finds has been made public, although in

[27] See the comments in Vasiliev 1983: 54. — Vasiliev et al. 1991: 126 ff.
[28] See Németi 1982: 48; 56; pl. 14: 3.
[29] Kacsó 1975: 67.
[30] Andriţoiu 1983: 46. — Boroffka 1991: 9 no. 14. — Vasiliev et al. 1991: 126 f.
[31] See László 1977: 55 and Boroffka 1991: 11 no. 29, with references to further literature.
[32] See László 1977: 55 no. 11; Boroffka 1991: 9 no. 20; Wesse 1990: pl. 23: 180. — For the chronology of the Insula Banului settlement, see for example the comments in Hänsel 1976: 151 ff.; Jevtić 1994: 129 ff.; Popović and Vukmanović 1998: 55.
[33] See, for example: Wesse 1990: 144 (transition from the 2nd to the 1st millennium BC); Boroffka 1991: 2; 9 f. cat. no. 20; 28 map 1 (11th/10th century BC).
[34] For similar axes from Greece, Bulgaria and Serbia, see for example Popham and Lemos 1996: pl. 48: 2; 128; 148: d (Lefkandi). — Wesse 1990: 149 f.; 166 ff. (Bulgaria and Serbia).
[35] See Boroffka 1991: 10 no. 25. — According to information kindly provided by Dr Nikolaus Boroffka (Berlin), the grave probably dates to Ha B.
[36] Emödi 1981. — Stoia 1989: 47. — Boroffka 1991: 10 no. 26.
[37] For the axe fragment, see Vasiliev et al. 1991: 212 fig. 16: 3.
[38] Vasiliev et al. 1991: 213 fig. 17: 5. — In a written communication (07.10.2018) Dr Horia Ciugudean (Alba Iulia) informed me that the iron billet cannot be reliably assigned to settlement phase II, it can equally well belong to either phase II or III.

his article on iron at Teleac, Svend Hansen confirms that iron objects were present at Teleac in the 10th century BC.[39] According to radiocarbon dates, the phase II settlement existed during the 10th century BC. The northern rampart and part of the phase II settlement were attacked and destroyed at some point during the second half of the 10th century BC; the following phase III settlement has small amounts of incised and stamped pottery of Kalakača and Basarabi type, along with typical late Gáva pottery. Horia Ciugudean has discussed the possibility that the destruction of the hillfort's defences took place in the context of pre-Scythian migrations and the emergence of the Mezőcsát culture.[40]

Excavations in 1963 at Cernat (jud. Covasna) in the defended settlement 'Vârful Ascuţit' uncovered a metalworker's workshop in 'pit-house 1'.[41] In the pit-house, near a hearth, the excavators found pottery, a spindle whorl and a casting ladle, and a number of metal objects: a bronze spearhead (Figure 45: 1), a bronze fibula (Figure 45: 2), an iron socketed chisel, an iron trunnion axe (Figure 45: 5), an iron double-axe (Figure 45: 6), an iron knife (Figure 45: 3), and 12 tongue-shaped iron billets (Figure 45: 4). This workshop represents one of the earliest reliable proofs of ironworking in Central Europe.

The bronze fibula and the iron knife are important for the chronology of the Cernat workshop. The fibula belongs to the rare Cernat variant, known from Romania and western Ukraine.[42] While an example in the hoard from Ghirişu Român indicates a date for the type in hoard horizon IV, the Cernat example could be slightly later.[43] Because the fibulae of the Bădeni variant seem to be the precursors of the Ruše type of saddle fibulae (dated to the 9th century BC), it is likely that they were in use until the end of the 10th century BC.[44] According to these considerations, the Cernat fibula can be dated with some confidence to the 10th century BC. The handle of the iron knife from the Cernat workshop broke off as it was being excavated (Figure 45: 3). Nevertheless, the profile of the blade, with a marked hump just before the handle, is very typical for knives of Ha B1b-B2, making an earlier date practically inconceivable.[45] Taken together, the evidence speaks for a date in the 10th century BC for the Cernat smithy.

The flat iron billets from the Cernat workshop are related to a well-known category of copper or bronze artefacts, with a long tongue-shape, a flat cross-section and rounded ends, which are frequently found in the Late Bronze Age in the Carpathian Basin and surrounding areas.[46] Compared with the examples made of copper or bronze, the iron pieces are very rare. Apart from Cernat, iron tongue-shaped billets are known from Teleac (jud. Alba), Lozna (jud. Botoşani) and perhaps Babadag (jud. Tulcea).[47] They only weigh ca. 50 g and would have been suited for making small objects, such as knife blades.[48]

[39] Hansen 2019: 218.

[40] For information on the new excavations at Teleac, see Uhnér et al. 2019; for the destruction of the rampart by pre-Scythian invaders, see Ciugudean 2021: 70 ff.

[41] Székely 1966. — Bader 1983: 16 ff.; pl. 55: B (with references to further literature). — For a reconstruction of the find circumstances, see Soroceanu 1995: 61; 51 fig. 15. — According to Nikolaus Boroffka (1991: 8 no. 8) in 1980 excavations in a second pit-house uncovered a hearth, an iron double-axe, a casting ladle, a fragmentary casting mould, a piece or raw iron, slag, and pottery. — For the most recent metal finds from Cernat, see Szabó 2011: 339.

[42] There are two related fibula variants characterised by an external spiral: the Cernat and Bădeni variants. Because the spiral construction is so characteristic, the two variants are probably contemporary. — For the chronology of these fibulae, see the illustration in Ciugudean 2011: 77 fig. 2. — Examples of the Cernat variant are known from Augustin(?), Cernat, Ghirişu Român, Porumbenii Mare and Lysychnyky (Ternopil Oblast). — Apart from Bădeni, the Bădeni type is known from Ormeniş, 'Tipia Ormenişului' and probably from a phase II context at Teleac. — See Vasiliev et al. 1991: 215 fig. 19: 7. — Marta 2003: 358 pl. 1: A. — Teržan 2010. — Costea 2011: pl. 1: a.d. — Médér 2015: 42 pl. 2: 1.2.3.5.12.

[43] For the developed character of the Cernat fibula, see Pabst 2011: 200 note 14.

[44] For the saddle fibulae of Ruše type, see e.g. Pare 1998: 340 note 70. — Pabst 2011: 448 map 34 (more fibulae from Romania and the Ukraine could be added to the distribution map). — For a newly discovered example from Racoş, 'Piatra Detunată' (jud. Braşov), see Costea 2011: pl. 1: c.

[45] See for example Sperber 2017: 32 ff.; 169-171.

[46] For distribution maps, see Dergačev 2002: 179; pl. 131 ("saws"). — Nessel 2009: 257 fig. 5. — For the question of the function of the flat bars (knives, saws or ingots), see Nessel 2009.

[47] Teleac, Phase II-III: see above. — Lozna, from a settlement context of the Corlăteni-Chişinău culture, dated to Ha B: Teodor and Şadurschi 1981: fig. 10: 4. — Babadag, Phase II or III: László 1977: 53; 65; Jugănaru 2005: 69 f.; 137 fig. 43: 7.

[48] László 1977: 65.

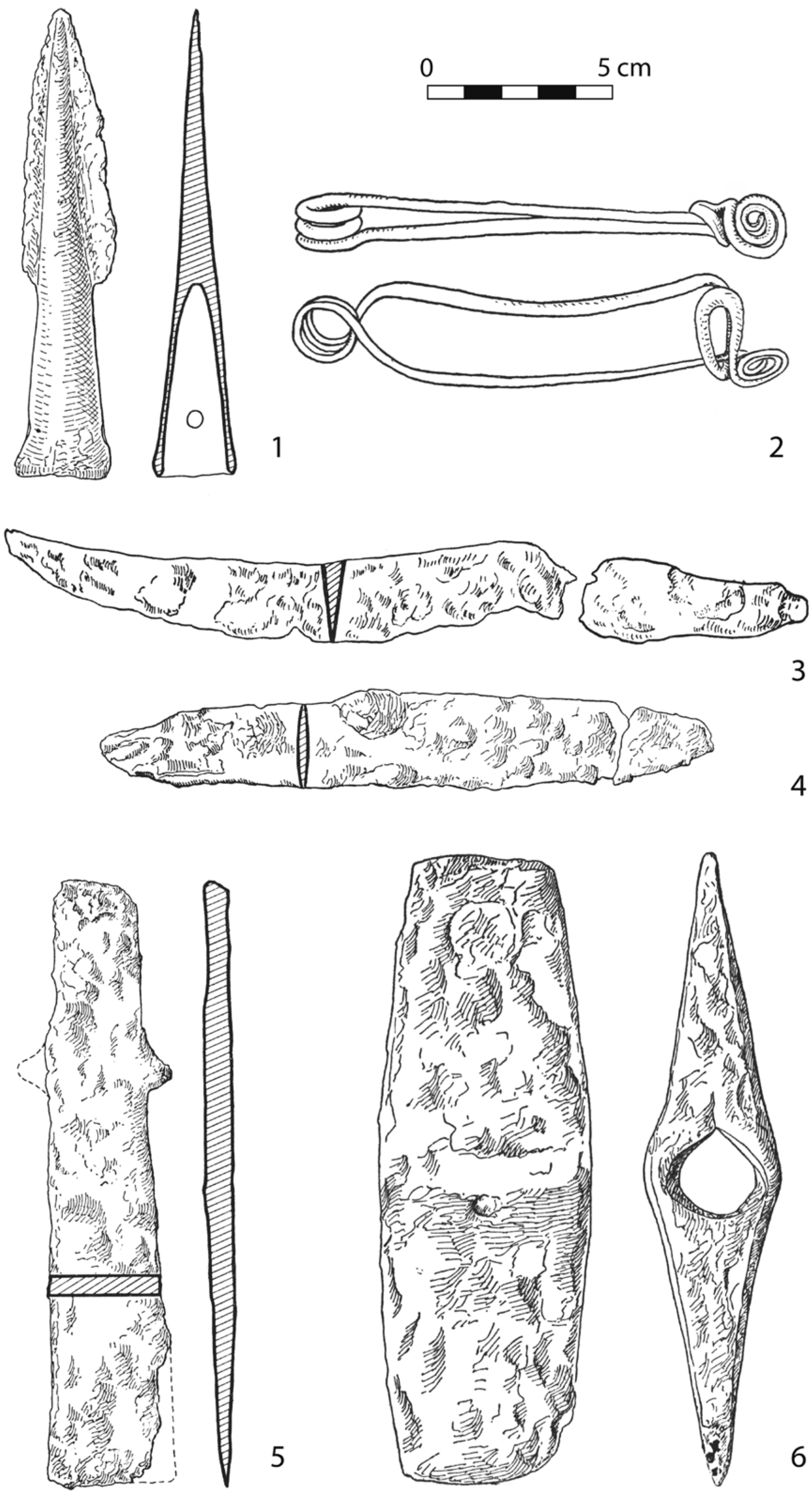


Figure 45. Metal finds from the smith's workshop at Cernat (jud. Covasna), Transylvania. — After Székely 1966: 213 fig. 4; 214 fig. 5. — 1-2 bronze, otherwise iron. — Scale 1:2.

The axes from Cernat are especially interesting: a trunnion axe 16.6 cm long (Figure 45: 5) and a double-axe 17 cm long and 5 cm wide with a round shaft-hole (Figure 45: 6). The importance of the axes lies in the fact that these particular types, in iron, were completely alien to Central Europe in the 10th century BC. For this reason, they give us a valuable clue to the source of the impulses in the introduction of ironworking.

The round shaft-hole of the double-axe is unusual. Among bronze double-axes, the round shaft-hole is a characteristic feature of Cyprus and Crete, whereas the shaft-holes of Mycenaean double-axes were generally oval.[49] The narrow cutting edge of the Cernat example is also unfamiliar. Most double-axes are shaped curving outwards from the shaft-hole, to create longer convex cutting edges. Bronze examples with narrow cutting edges, having a sub-rectangular outline, are known from Cyprus, for example in the Foundry Hoard from Enkomi.[50] There is therefore some evidence that the 'ancestry' of the Cernat type might lie in Cyprus or Crete. But the best parallel in iron, of similar size and shape, came to light at Assiros Toumba in Greek Macedonia, belonging to a settlement layer which corresponds roughly to the Protogeometric period.[51] Otherwise, iron double-axes appear in graves at Lefkandi in the 9th century BC, at Argos in the 8th century BC, and in Crete from the 10th to the 8th centuries BC at Vrokastro-Karakovilia, Knossos, Fortetsa, Agios Georgios Papoura, and Kavousi.[52]

Further north, early iron double-axes are less common, and – apart from Cernat – seem to date from the 9th/8th century BC onwards. Examples can be mentioned from the defended settlement of Teleac and from the hoard of Bâlvăneşti (jud. Mehedinţi).[53] According to the evidence reviewed above, it is most likely that the iron double-axe was introduced to Romania from the Aegean. However, at first the new axe type did not gain wide popularity. Iron double-axes only became more frequent in later centuries, for example in Ferigile (jud. VâIcea) and related cemeteries.[54]

Finally, the iron trunnion axe from the Cernat smithy also deserves special attention (Figure 45: 5). According to Anke Wesse's classification, the Cernat example can be assigned to type III1C.[55] This is a fairly common type with a trapezoidal blade and a pair of vestigial arms. As Wesse showed, the iron type is related to bronze predecessors found in the Aegean at the end of the Bronze Age and the start of the Iron Age (see Figure 19: 5.6). Iron examples appear in the second half of the 10th and the first half of the 9th century BC, for example in Athens and Lefkandi (Figure 19: 12.13).[56]

It is difficult to escape the conclusion that the Cernat blacksmith was producing new types of axes originating in the Protogeometric Aegean. The remaining iron artefacts from Cernat, the iron knife, socketed chisel, and tongue-shaped billets belong to local Transylvanian types, and indicate that iron artefacts were produced in the Cernat workshop, presumably from iron smelted from local iron ores. Most likely this can be explained by a transfer of technology, ultimately from the Aegean.

The bimetallic knife from the hoard of Hida (jud. Sălaj) illustrates another aspect of the early use of the new metal. There is a general consensus in the literature that the hoard dates to the phase Ha B2.[57] The

[49] Catling 1964: 88 f. - And see Chaper 4.4.
[50] Matthäus 1985: pl. 124: 4. — See also Lo Schiavo et al. 1985: 21 fig. 8: 6.8.
[51] Wardle 1987: pl. 51: b; see also Weninger and Jung 2009: 388 (layer 2 or 3).
[52] Lefkandi, Toumba, Pyre 13: Popham and Lemos 1996: pl. 128 (the tomb is assigned to Subprotogeometric II). — Argos: Courbin 1957: 369 fig. 50-51; 1974: 135. — Vrokastro, Chamber-tomb I: Hall 1914: 138 no. 10. — Knossos, North Cemetery, Tombs 219 and 285: Coldstream and Catling 1996: fig. 178. — Fortetsa, Tomb P: Brock 1957: pl. 172: 1641. — Agios Georgios Papoura: Watrous 1980: pl. 29: 23. — Kavousi: Boardman 1971: 6; pl. Δ.
[53] Teleac: Vasiliev et al. 1991: 53; pl. 16: 8.9. — Bâlvăneşti: Petrescu-Dîmboviţa 1977: pl. 398: 12.
[54] Vulpe 1967.
[55] Wesse 1990.
[56] Athens, PG Tomb 40 (Late Protogeometric): Kübler 1943: 42; pl. 38; Müller-Karpe 1962: 93 fig. 11: 1. — Athens, Agora, Tomb 13 (Early Geometric I): Papadopoulos and Smithson 2017: 115 fig. 2.63: 13. — Lefkandi, Palia Perivolia, Tomb 13 (Subprotogeometric I): Popham et al. 1980: 147 no. 22; pl. 133: 22; 215: b; 244: F. — Lefkandi, Toumba, Tomb 54 (Late Protogeometric): Popham and Lemos 1996: pl. 148: e.
[57] Petrescu-Dîmboviţa 1978: 149 no. 261; pl. 259: C; 260: A; Bader 1991: 112 ff. — For the chronology, see for example Müller-Karpe 1959: 209; Pare 1998: 361; 364; 381; Ciugudean et al. 2008: 16 f.; 20; 49.

iron blade of the knife has not been preserved, but traces survive in the bronze handle, which has an antenna-shaped pommel. The knife can be compared to a number of bimetallic examples in Central and northern Europe dating from the 10th and 9th century BC, in which iron was used to make prestigious, and not merely functional implements (see Chapter 9.3). Finally, the strange case of the sword in the hoard from Câţcău (jud. Cluj) must be mentioned.[58] The tang of the sword blade inside the solid-cast hilt is supposedly fixed to the hilt by a piece of iron; however, it is impossible to judge the relevance of this possible use of iron without further chemical and x-ray analyses.

Our review of the available information on early iron in Transylvania is sobering. It transpires that there is no reliable evidence for iron artefacts before the 10th century BC. The possible iron ring from Bobda, in the Banat, could be an exception, but even in this case, the context has not been published and the 'iron ornaments' (or ring) have been lost.

According to the present state of research, in the 11th/10th century BC iron was less common in Transylvania than in the regions further east, between the Carpathian Mountains and the Dnipro (compare Figure 26). The paucity of iron finds dating before the 9th century BC in Transylvania and the Banat could partly be explained by the fact that some potentially important contexts have still not been published, many years after the excavations. On the other hand, as the discussion in the next section will demonstrate, iron was still a rare commodity throughout Central Europe at this time, and it is perfectly possible that the new metal only started to be used in Transylvania at some point during the 10th century BC (see Figure 46).

9.2 The earliest iron in the Carpathian Basin and the area north of the Alps

Thanks to the fundamental monograph by Florian Miketta, it is now possible to review the earliest iron artefacts in Central Europe comprehensively.[59] Nevertheless, the question of the onset of iron metallurgy in the Carpathian Basin and the area north of the Alps is not trivial. It is necessary to analyse the published evidence carefully, with the following questions in mind: Does the object consist of metallic iron? Does it come from a reliable archaeological context? Has the chronology of the context been interpreted correctly? Is the iron object a later (e.g. medieval, modern) intrusion?

As anyone who has used a metal detector knows, in densely populated, fertile regions of Central Europe, the topsoil often contains surprisingly large amounts of iron objects. While these are often recognizably modern, there are also many iron objects and fragments which are difficult, if not impossible, to date – such as corroded blade fragments, rings, broken nails etc. For this reason, it is quite likely that some of the more rudimentary iron objects found on Bronze Age sites are, in fact, later intrusions. The iron object may have entered the archaeological context through an animal burrow, or the grave, hoard or settlement context might simply have been carelessly excavated. These problems are particularly severe in the case of early excavations, where documentation is often practically non-existent.

The find-circumstances of the hoard from Červené Poříčí (okr. Klatovy) in south-west Bohemia provide an illustrative example of this problem. The Viennese archaeologist Josef Szombathy describes his systematic excavation of the site of the hoard, after the first bronze finds came to light in 1887:

"After the freshly fallen snow had melted, on April 13th [1888], careful excavation yielded the following pieces. Of bronze: eight palstaves or winged axes, a socketed axe, a conical socket and six small fragments of sheet metal; of iron: a ring with a diameter of 5 cm, a 6 cm long nail with a square rivet plate, and a 5.5 cm long piece of a 0.7/1.0 cm. thick rod. All these finds were scattered close to the surface in the topsoil,

[58] Bader 1991: 163 f. no. 382; pl. 55: 382. — Soroceanu 1995: 62; 79; 36 fig. 10: 4 (p. 62: „Die Laboranalyse ... bestätigte, daß die Griffstange mit Eisen im Inneren des Vollgriffes befestigt wurde"). — For the chronology of the Câţcău hoard (Ha B2, hoard phase IV/V), see Pare 1998: 361; 364; 367 fig. 33: 3; see also Sperber 2017: 172 with note 629.

[59] For distribution maps and lists of iron artefacts dating before the 9th century BC, see Miketta 2017: 170 fig. 76; 172 fig. 77; 228 list 5a.b.

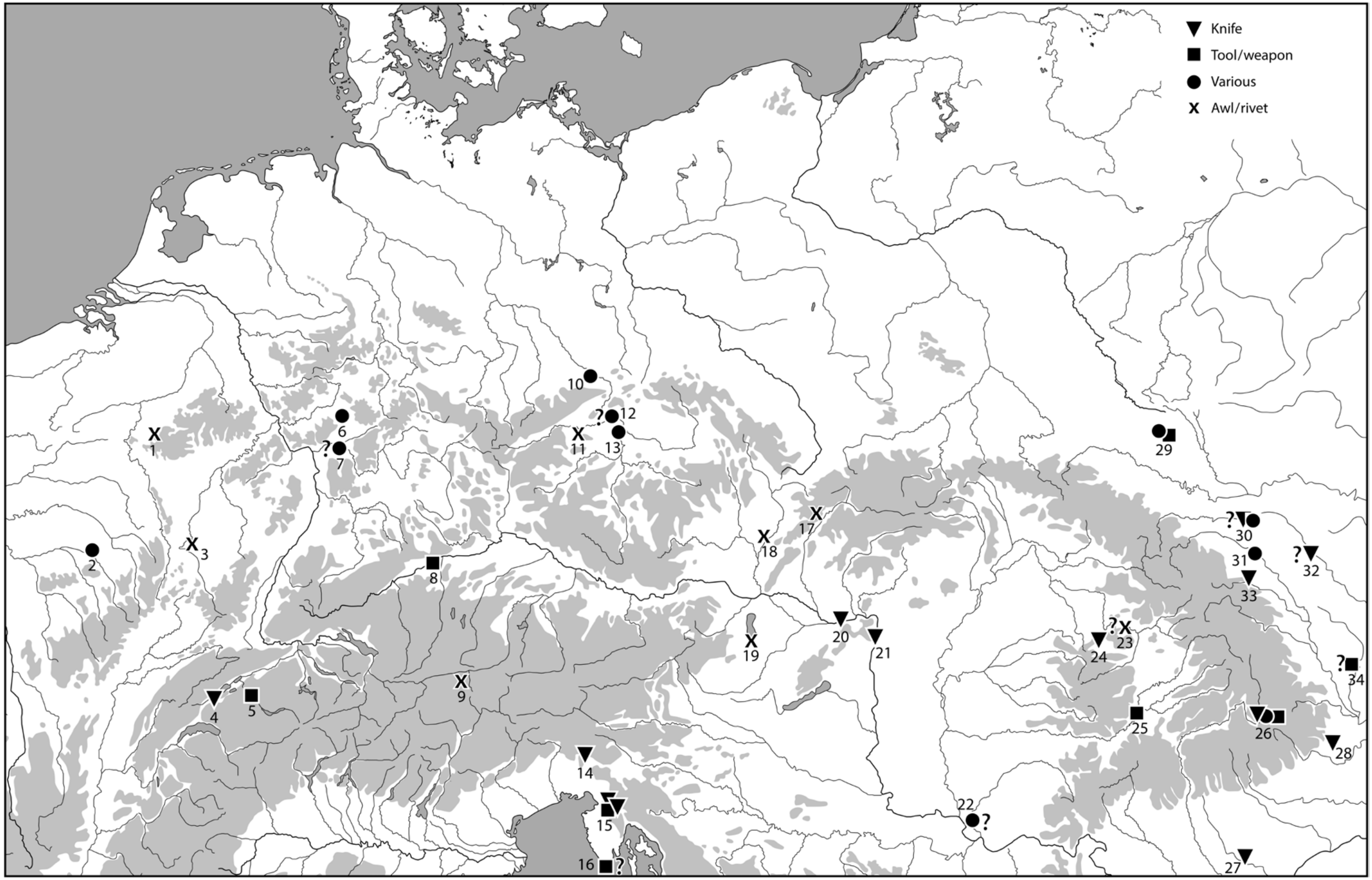


Figure 46. Distribution map of iron finds dating to the 11th-10th century BC in the area between eastern France and Moldavia (see List 9.1). — 1 Han-sur-Lesse. — 2 Champigny. — 3 Custines. — 4 Saint-Aubin-Sauges. — 5 Nidau. — 6 Bad Nauheim. — 7 Babenhausen. — 8 Neudegg. — 9 Völs. — 10 Dresden-Coschütz. — 11 Staňkovice. — 12 Maškovice. — 13 Jenišovice. — 14 Tolmin. — 15 Brežec, Škocjan. — 16 Pećina na Gradini. — 17 Horní Lideč. — 18 Buchlovice. — 19 Sopron-Krautacker. — 20 Chotín. — 21 Budapest-Békásmegyer. — 22 Bobda. — 23 Câţcău. — 24 Hida. — 25 Teleac. — 26 Cernat. — 27 Meri. — 28 Cândeşti. — 29 Nedilyska. — 30 Mahala. — 31 Lozna. — 32 Truşeşti. — 33 Grăniceşti. — 34 Bârlad.

which was on average 30 cm thick, over an area of almost 4 square metres, without any traces visible in the underlying layer of yellow and grey alluvial sand. There were no remnants of a smashed pottery container or anything similar, in which the items might have been stored. ... Twenty paces north-east of this site, I found a round pit under the topsoil, 55 cm in diameter and reaching up to 70 cm below the surface, which was filled with ash, mixed with very few charcoal particles, and a few red and grey sherds of wheel-turned pottery. There is nothing to suggest that there is a connection between this ash pit, which obviously belongs to a later period, and the bronze finds. However, this shows us that the site was also inhabited by people in later periods, and gives us a clue for the interpretation of the three iron objects found near the bronzes, which do not fit with the palstaves; furthermore, although oxidised to the core, the iron objects have not left any trace (which would otherwise certainly be betrayed by the rust) of an earlier contact with any of the bronze pieces. For these reasons, and even more so for the reasons that emerged later, I believe that these pieces of iron do not belong to the bronze finds, but only found their way to the same place at a later date."[60]

For the time, Szombathy was an exceptionally competent and experienced archaeologist, and so he was able to make the well-informed and probably correct judgement that the iron objects did not originally belong to the bronze hoard. Unfortunately, in many cases the early graves and hoards with iron artefacts were discovered by chance, by laymen or amateurs, and in these cases, the contexts must be treated with due caution.[61]

A cautious, critical approach is especially important for the earliest potential evidence for the use of iron. To be more specific: while there is sufficient evidence that iron artefacts were in use from Ha B1 onwards, the earlier evidence is much less convincing.

In some cases, it is very likely that the iron objects are much later intrusions, for example the fragmentary iron 'pin' from Szentkirályszabadja (Kom. Veszprém), the iron wire with a barbed end from Kelheim, Grave 58 (Kr. Kelheim), and the iron fragment found in a disturbed cist-grave at Mühlheim-Lämmerspiel (Kr. Offenbach).[62] There are two examples (an 'iron rod' and an 'iron rivet') in which it is doubtful whether metallic iron was present at all: the copper casting cake from the hoard of Praha-Suchdol (Bohemia), and the bronze knife from Groß-Gerau (Hessen).[63] Two iron knives, from Konstanz-Rauenegg in Baden-Württemberg and Marianka (okr. Malacky, Slovakia), do not come from reliable archaeological contexts, and the early dates suggested by Florian Miketta seem very uncertain.[64]

Some artefacts have often been discussed, and have previously been claimed as evidence for the very early introduction of iron in Central Europe. However, as they are each quite isolated in their respective regional contexts, it is difficult to imagine how the innovation process could have functioned. Is it plausible that the technology of iron production was invented and then immediately forgotten? The most famous case is the rivetted object found in a well at Gánovce, 'Hrádok' (okr. Poprad) in Slovakia. Unfortunately, the archaeological context has only been described in a preliminary report, published in 1963. Zoja Benkovsky-Pivovarová has argued that the iron object does not belong to the original well of the Otomani culture (17th/16th century BC), but is instead most probably the handle of a knife of the Early Iron Age.[65] Since the preliminary report mentions the presence of pottery sherds of the Hallstatt

[60] Szombathy 1888: 90 f. (my translation); for the hoard, see now Kytlicová 2007: 257 cat. no. 19.
[61] The hoard from Maškovice in north Bohemia, discovered in 1853, is a good example (see List 9.1). It seems doubtful whether the fragmentary iron chain belonged to the original hoard deposition; however, as there is no detailed documentation on the find circumstances, the question will probably never be resolved.
[62] Szentkirályszabadja: in a personal communication (03.12.2019), Gábor Ilon (Budapest) agreed that it is doubtful that the 'pin' was originally associated with the hoard. See Ilon 1998; Miketta 2017: 271 cat. no. HU-5. — Kelheim, Grave 58: Miketta 2017: 254 f. cat. no. DE-25A. — Mühlheim-Lämmerspiel: Ebel-Zepezauer 1992: 29 no. 20; fig. 9: 3.
[63] For Praha-Suchdol, see Miketta 2017, 243 f. cat. no. CZ-7; and particularly the comments in Lehnhardt 2021: 21. — The knife from Groß-Gerau has been lost, a tiny 'iron rivet' was supposedly visible in the tang; see Kubach 1980: 221; 280 no. 80; 308 fig. 17: 6 (Moorpatina); Hohlbein 2016: 256 cat. no. 852; pl. 69: 852; Miketta 2017: 253 f. cat. no. DE-22.
[64] Konstanz-Rauenegg, iron knife found in 1872: Schöbel 1996: 153 f.; 114 note 343; 117 Tab. 6 (Nr. 13); Miketta 2017: 255 f. cat. no. DE-26. — Marianka, iron knife from a settlement, unstratified: Hlavenková 2010: 42; 41 pl. 4: 2; Miketta 2017: 276 cat. no. SK-3.
[65] Benkovsky-Pivovarová 2002; Miketta 2017: 39 ff.

period in the well, and the iron fragment resembles a rivetted knife handle rather than a sickle or a dagger hilt, it is difficult not to agree with Benkovsky-Pivovarová's arguments.[66] The iron 'awl' or 'chisel' from Bargeroosterveld (Prov. Drenthe) was found on a wooden trackway which has a dendro-date in the 14th century BC.[67] As iron finds are otherwise completely absent in the Netherlands until the Hallstatt period, we must compare three different eventualities: 1) the 'awl' was a one-off technological achievement, the technological expertise was then immediately forgotten; 2) the 'awl' was imported from an unknown iron-producing centre; 3) the 'awl' is simply a later intrusion, perhaps the remains of a nail from a horseshoe, or something similar. The third eventuality appears to be the most plausible explanation.

A pin with a bronze head and seven bronze collars was discovered somewhere in the vicinity of Chalon-sur-Saône (Dép. Saône-et-Loire), probably from the bed of the Saône. The bronze elements of the pin belong to a distinctive variety ('Vernaison' type) belonging to the start of the Late Bronze Age (*Bronze final* 1).[68] The pin is unique, however, because it is provided with an iron shaft. While this seems to be solid evidence for the use of iron in the 13th century BC, the lack of a clear provenance makes the pin difficult to interpret, particularly since it has been lost and it is no longer available for study. The careful archival research of Albert Jambon and his colleagues has brought to light cases in which iron components were fitted to Bronze Age artefacts during the 19th century, and this could conceivably be another example of this practice.[69]

Finally, in view of the early date, the iron awl or pin fragment from Kitzbühel, Grave 1 should be considered with caution.[70] This fragment, 3.1 cm long, is the only iron artefact in the area north of the Alps dating to the 13th century BC. In view of its position outside the urn, and the above comments about potential contamination by modern intrusions, the iron fragment does not justify the conclusion that iron was already manufactured in the region at this early date.

As already mentioned above, iron entered the archaeological record in the Carpathian Basin and the area north of the Alps in Ha B1. However, two iron rings have been reported from graves in Hessen, which could suggest an even earlier date (Ha A2), if the rings truly belonged to the original grave furnishings.[71] Another possible early object is the iron pin with a profiled biconical head from the defended hill settlement of Dresden-Coschütz (Figure 47).[72] The shape of the pin-head seems to be characteristic for the phases Ha A2-B1.[73] Otherwise, the earliest iron artefacts all belong to Ha B1-B2 (ca. mid-11th to 10th century BC; see Figure 46 and List 9.1). Iron was obviously still a rare commodity at this time, and there is a light scatter of mainly small artefacts between eastern France and Transylvania. The rare iron objects appear sporadically in a fully 'Bronze Age', bronze-dominated landscape. As the iron objects were often found accidently, it is possible that some of them do not belong to the original archaeological contexts, and this is particularly true in the case of early discoveries, such as Maškovice (1853), Champigny (1879), Bad Nauheim (1878) or Babenhausen (1880). As there are no significant regional concentrations, it is possible that the iron was not smelted locally, but imported – as finished products or perhaps in the form of tongue-shaped iron billets like those found at Cernat, Teleac and Lozna (see above).

Jan Bouzek introduced an interesting idea based on a fragmentary iron object from a cremation burial in Bohemia (Staňkovice, okr. Žatec, Grave 7).[74] Bouzek interpreted the two iron fragments from the urn-

[66] For the presence of pottery sherds of the Hallstatt period, see Benkovsky-Pivovarová 2002: 231.
[67] Miketta 2017: 272 cat. no. NL-1.
[68] Miketta 2017: 266 f. cat. no. FR-9; Jambon et al. 2022: 510 fig. 4; 511 cat. no. 1; 521 note 2.
[69] For the Middle Bronze Age flanged axe from Ygos-Saint-Saturnin and the Late Bronze Age sword-hilt from the Gué de Velluire, see Jambon et al. 2022: 502 ff.; 510.
[70] Miketta 2017: 140 f.; 232 cat. no. AT-3.
[71] The graves were uncovered in 1878 (Bad Nauheim) and 1880 (Babenhausen). Whereas the piece from Babenhausen could have been a finger ring, the fragment from Bad Nauheim is from a ring with a diameter of ca. 4.2 cm. Neither of the rings survives today.
[72] In a personal communication (13.07.2017), Dr Ronald Heynowski (Dresden) confirmed that the pin is made of metallic iron.
[73] Compare the shape of the following bronze pins which date to Ha A2 or B1: Hessen and Rheinhessen (Kubach 1977: pl. 75: 1157-1185); Niederkaina, grave 8/1950 (Heyd 1998: pl. 40: 4); Herrnwahlthann, grave 2 (Pare 1999: 225 fig. 67: 2).
[74] Bouzek 1978. — The pottery from the grave suggests a date in Ha B1.

Figure 47. Iron dress pin from Dresden-Coschütz, Saxony. — Copyright Landesamt für Archäologie Sachsen; photograph: S. Müller. — Scale 1:1.

grave (lengths 3.8 cm and 4.0 cm) as the remains of a chisel or burin. He argued that the fine decoration on some bronze sheet artefacts, such as fibulae, could only have been produced using steel tools. According to Bouzek, the earliest traces of this fine engraved decoration date to Ha A2, but the technique became more common in Ha B1. However, in a subsequent publication, Olga Kytlicová argued that traces of steel tools first appear on bronze artefacts dating to Ha B3.[75] It is also worth mentioning that the two iron fragments from the Staňkovice grave have a rather unspecific shape, and the interpretation as a chisel seems rather doubtful.

A possible alternative explanation for the origin of some of the earliest iron artefacts, which are mainly small in size, is suggested by new scientific analyses of an iron arrowhead from the lake-side settlement at Mörigen in Canton Bern.[76] The authors of the study, published in 2023, demonstrate that the arrowhead was made from meteoritic iron. Since its simple, flat shape is similar to a number of bronze arrowheads from the same settlement, the iron example was presumably manufactured locally.[77] The only other artefacts made from meteoritic iron in Central Europe comprise two bracelets from Wietrzno and an axe from Czestochowa-Rakowa in Poland.[78] Although the arrowhead from Mörigen dates to the late Urnfield period (Ha B3), and the Polish bracelets and axe belong to the Hallstatt period, it is quite possible that some of the earlier iron objects (rings, rivets, etc.) were made from meteoritic rather than smelted iron. However, in the absence of relevant scientific analyses, this remains speculative. The use of telluric iron (terrestrial, naturally occurring metallic iron) in the Bronze Age is another potential source of iron, although it is admittedly very unlikely that it ever played a significant role in Europe. Telluric iron, which has less nickel than meteoritic iron (typically ca. 3-4% Ni), is extremely rare and its use for making artefacts has only been reported for the Inuits in the vicinity of the massive outcrop in Disko Bay in Greenland. A smaller occurrence of telluric iron is known at Bühl near Ahnatal (Lkr. Kassel) in Hessen. In the first decades of the 20th century, workers in the Basalt quarry collected lumps of telluric iron and sold them to collectors. Apparently, the iron is malleable and could be made into artefacts by cold-hammering.[79] It is an open question whether telluric iron was ever used in Bronze Age Europe.

It is remarkable that iron seems to have appeared in Central Europe at roughly the same time as in the eastern Balkan Peninsula, the area north of the Black Sea, and western Slovenia. Owing to the fragmentary information available from each of these areas, it is not certain exactly where iron was introduced first, although it seems most plausible that iron initially reached coastal areas and later penetrated inland. Assuming that, at first, the iron in Central Europe was imported, potentially it could have reached the Middle Danubian and North Alpine Urnfield cultures either from the *Caput Adriae*, from the eastern Balkans, or from the regions to the east of the Carpathian Mountains.

75 See Miketta 2017: 144.
76 Hofmann et al. 2023. — For the arrowhead, see Bernatzky-Goetze 1987: 191; pl. 152: 23.
77 Compare Bernatzky-Goetze 1987: pl. 152: 15-24.
78 See Kotowiecki 2004. — For the results of new pXRF analyses of iron artefacts from Czestochowa, see Jambon et al. (in press).
79 For '*Bühleisen*', see Irmer 1920; Ramdohr 1953; Schlitzberger 2014.

The relative paucity of finds in the eastern half of the Carpathian Basin, specifically the Great Hungarian Plain, does not necessarily reflect the true quantities of iron in circulation. The fact that cemeteries are very uncommon in the Gáva culture is one possible explanation for the rarity of iron artefacts, and our discussion of the Transylvanian evidence showed that the state of research and publication hardly allows reliable conclusions at present.[80] Considering the small number of iron artefacts in Ha B1-2, the absence of iron finds of a similar early date in areas such as the southern part of the Carpathian Basin could simply be explained by coincidence or a lack of excavation of sites of this date.

On the other hand, the almost complete absence of iron in France and the Low Countries is significant, and shows that the new metal reached these regions with some delay compared with Central Europe.[81] Iron was also still unknown in the British Isles during the 10th century BC. Early ironworking was claimed for a settlement at Hartshill Copse (Berkshire), but subsequent research by Tim Young has shown that the microscopic residues of hammerscale slag very likely came from a later phase of activity at the site ('phase 3'), dating to the Iron Age.[82] Iron also arrived late in southern Scandinavia; for example the first iron artefacts from Denmark date around the 7th century BC.[83]

The scatter of rings, 'awls' and rivets supposedly dating to the 11th/10th century BC (Figure 46) do not constitute a very convincing innovation horizon. The objects sometimes come from unsystematic, 19th-century discoveries, making their reported contexts suspect. It is also possible that some of the objects, such as the 'rivets', are not made of smelted iron, but from some other alloy. Hopefully, further research will help clarify the interpretation of these early iron finds.[84] In my opinion, considering their questionable reliability, these scattered early finds are not sufficient to justify a 'gradualist' account of the introduction of iron.[85]

The larger artefacts are more reliably dated to the 10th century BC, and there are some noticeable regional differences (see Figure 46). Iron knives are relatively common in the east, coming from Chotín, Budapest-Békásmegyer, Hida, Cernat, and the Karst/Soča region of western Slovenia. By contrast, further to the west there are three high-status bimetallic objects: a sword from Neudegg in Bavaria, a spearhead from Nidau, and a knife from Saint-Aubin-Sauges in Switzerland. Although all three objects are isolated finds discovered in the 19th century, they are related to specific types of bronze artefacts, showing that all three were very likely manufactured in the 10th century BC (Ha B1b-B2). These regional variations in the use of iron suggest that the new metal was adopted in different ways in different cultural milieux. These few iron implements (mainly knives) and weapons, possibly all dating to the 10th century BC, are the first evidence for a more consistent adoption of iron in local cultural contexts between Transylvania and the area north of the Alps.

9.3 Iron in the late Urnfield period: utilitarian implements and status symbols

As we have seen, during the 10th century BC iron was still rare in Central Europe and it is difficult to detect significant regional differences in the use of the new metal. The situation changed radically in the 9th century BC (Ha B3), when clear regional preferences in the use of iron can be observed (see Figure 48). For example, a fairly dense scatter of iron knives is visible on the distribution map around the eastern

[80] For a good discussion of the few cemeteries of the Gáva culture, see Király 2012.

[81] See Jambon et al. 2022. — In Mediterranean France, iron artefacts only appear in graves towards the end of the 8th century BC; see Beylier 2020: 96-99.

[82] See Collard et al. 2006; Tubb 2011: 32 ff.; Young 2020: 11.

[83] Lyngstrøm and Jouttijärvi 2018; Lyngstrøm 2020: 52 f. — Despite the recent publication of an article on the subject, the question of the introduction of iron in Sweden remains very opaque as the find circumstances of many numerous iron artefacts supposedly from Bronze Age contexts have not yet been analysed critically. See Sörman and Ojala 2022.

[84] See also the comments at the end of Chapter 12.1.

[85] For a 'gradualist' view of the introduction of iron in the Near East and the Aegean, see comments on the work of Jane Waldbaum, Radomír Pleiner and Joanna Palermo in the introduction to Chapter 2. – A gradual and widespread introduction of iron during the 2nd millennium BC has also been proposed for Central and northern Europe, for example in the publications of Claudia Derrix (2001: 23 ff.; 58; 167; 170) and Florian Miketta (2017: 188 f.; 210 f.).

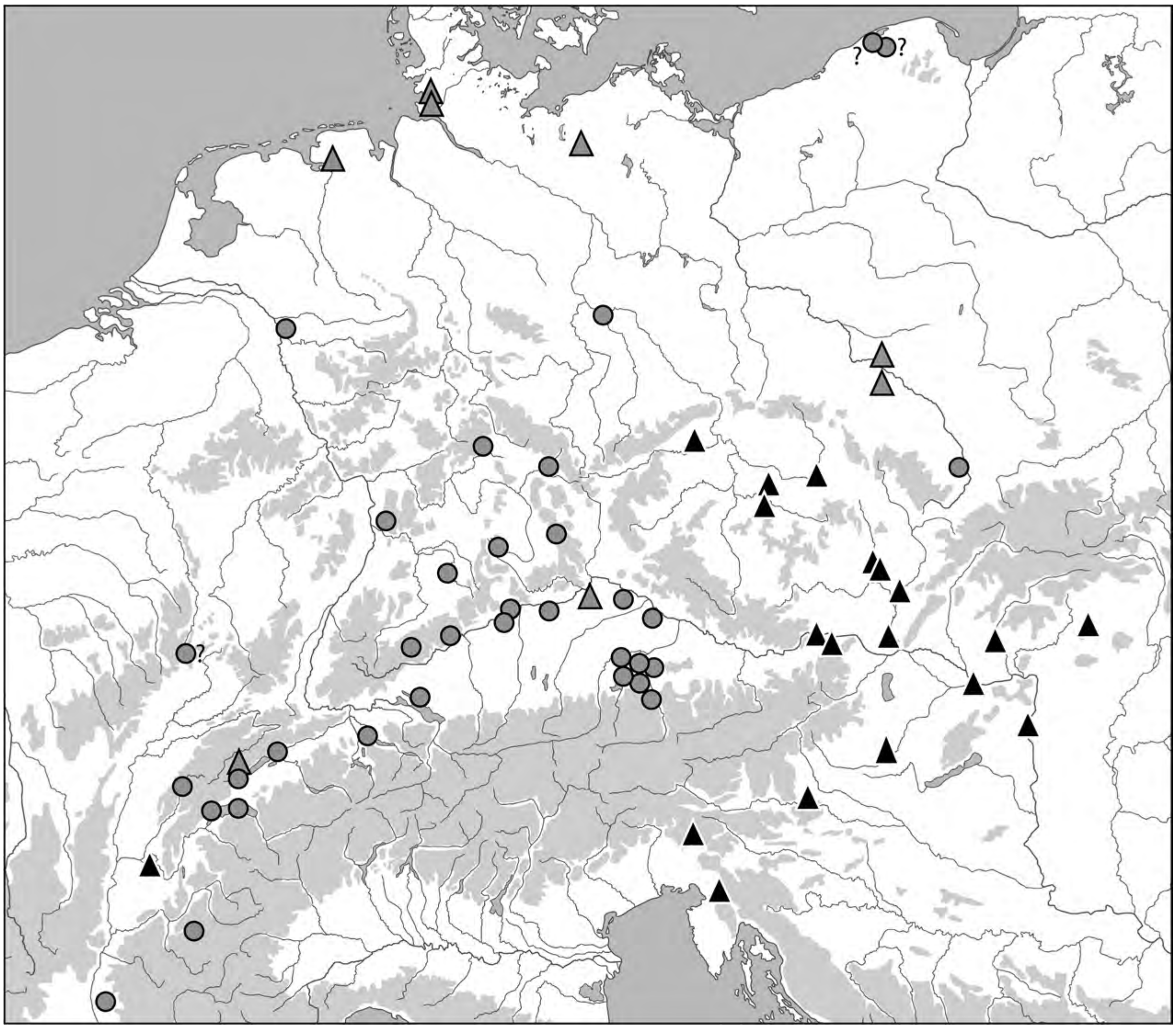


Figure 48. Distribution map showing the use of iron in Ha B. — Black triangles: iron knives. — Grey triangles: bimetallic knives. — Grey circles: iron used on bronze artefacts as a decorative metal. — See Lists 9.2 and 9.3.

Alps, reaching the middle Danube, and extending into Moravia and Bohemia (see List 9.2).[86] No less than five iron knives were found in the cemetery of Franzhausen 'Kokoron', in Lower Austria. A total of 403 graves were excavated at Franzhausen, reaching from the mid-11th to the end of the 9th century BC (Ha A1/B1-Ha B3).[87] The knives are found in the extreme south-west of the cemetery in graves belonging to the latest phase of use. In the case of Franzhausen, iron seems to have replaced bronze for making knives during the 9th century BC and it is likely that they were used in daily life.

[86] Further iron knives from Slovakia could belong to the Late Bronze Age (Jasov, Mužla, Prešov, Rosina, Terňa, Lysá stráž); however, none of these examples seems to be reliably dated. See Furmánek 1988. — The iron knives from Henfstädt, Lkr. Hildburghausen and Sulzbach am Main, Lkr. Miltenberg, grave 2/1965 do not seem reliably dated to the late Urnfield period. In the case of Henfstädt, the associated pottery could belong to the early Hallstatt period; in the case of Sulzbach, the iron fragments might not belong to the original grave assemblage. See Labitzke 2013: 147 f.; 185 pl. 4: 23; Marquart 2017: 553; pl. 70; Miketta 2017: 261 cat. no. DE-37. — Sperber (2017: 20 f.) mentions iron knives known from lake-side settlements on the north bank of Lake Constance, but it is not clear which, if any, of the knives derive from Late Bronze Age contexts; see Schöbel 1996: pl. 6: 24; 47: 7.10-12; 83: 12; 102: 11-13. Sperber also mentions two examples from Zürich-Alpenquai; however, according to information kindly supplied by Samuel van Willigen (Landesmuseum Zürich), these knives are in fact made of bronze. See Sperber 2017: 21.
[87] Lochner and Hellerschmid 2016.

Bimetallic knives, with an iron blade and bronze hilt, require a different explanation. They have a curious distribution, with examples in Transylvania, Bavaria, Switzerland, Lower Silesia, Mecklenburg, Holstein and Ostfriesland (Figure 48; List 9.2). Almost all the bimetallic examples are located outside the main distribution area of the iron knives. With their elaborate bronze handles, they were presumably valued as prestige goods. The remarkable iron solid-hilted knife with inlaid bronze ornamentation from the rich 'Tumulus Géraud' at Saint-Romain-de-Jalionas (Dép. Isère), an exceptional feat of craftsmanship, must also have been a valued status symbol.[88] In contrast, the simple iron knife blades with a tang to hold an organic handle could have been used as cutting implements in day-to-day life.

In upper Austria, Salzburg, southern Germany, Switzerland, and eastern France, iron was chiefly used as decoration on bronze artefacts (see Figure 48 and List 9.3).[89] The most common objects are bronze solid-hilted swords and spearheads with inlaid iron ornamentation, but bronze bracelets inlaid with iron and bronze pins with iron applications are also known. Items of iron jewellery, especially pins, are also relatively frequent.[90] Perhaps we can conclude that iron was only available in small quantities and treated almost like a precious metal in these areas.

In summary, while iron was used for utilitarian implements in the area east and north-east of the Alps, the bimetallic artefacts and the inlays and applications on bronzes from eastern France, Switzerland, Germany, Upper Austria, and Poland show that iron was treated as a rare and valuable metal during the 10th and 9th centuries BC, and was used to manufacture high-status weapons and implements; for example:[91]

- Eastern France: iron solid-hilted knife with bronze inlay from Saint-Romain-de-Jalionas (Dép. Isère).
- Switzerland: bimetallic sword from Mörigen (Ct. Bern), bimetallic knife from Saint-Aubin-Sauges (Ct. Neuchâtel), bimetallic spear from Nidau (Ct. Bern).
- Southern Germany (Baden-Württemberg, Bavaria): bimetallic sword from Neudegg (Lkr. Donau-Ries), iron sword blade from Singen (Lkr. Konstanz), bimetallic knife from Teugn/Thronhofen (Lkr. Kelheim), bimetallic spears from Künzing (Lkr. Deggendorf).
- Northern Germany (Niedersachsen, Schleswig-Holstein, Mecklenburg): bimetallic sword from Schwaan (Lkr. Rostock), bimetallic knives from Albersdorf (Kr. Dithmarschen), Aurich (Lkr. Aurich), Tellingstedt (Kr. Dithmarschen) and Zülow (Kr. Ludwigslust-Parchim).
- Silesia: bimetallic knives from Wrocław-Grabiszyn and Pawłow Trzebnicki (both woj. Dolnośląskie).

The bimetallic construction is a characteristic feature in the early stages of iron use in many regions when the new metal was still unfamiliar and valuable. The impulse to make bimetallic artefacts might have reached the area north of the Alps from the Carpathian Basin (bimetallic knife from Hida; pre-Scythian swords and daggers), from the central and western Balkan Peninsula (axe from Brežec; bimetallic swords and dirks), or southern Italy (bimetallic short swords, dirks, and spearheads).

This clear regional zonation, evident on Figure 48, shows that a massive change took place at around 900 BC. The most important innovation is the use of iron for utilitarian artefacts (especially knives, but also weapons) around the eastern Alps, in Moravia and in Bohemia. In the next century, during the Early Hallstatt period, ironworking spread quickly throughout the area north of the Alps. For example,

[88] See Jambon et al. 2022: 511 cat. no. 10; 513 fig. 9.
[89] The swords with iron inlay (Auvernier, Mörigen and Riedlingen types) from Wesel, Dessau-Kühnau and Gamów were probably imported from southern Germany. The same could be true for the swords of Auvernier and Mörigen type from Czysta and Witkowo, on which the presence of iron inlaid decoration is uncertain.
[90] For the iron pins, see Miketta 2017: pl. 2: 2-15; 4: B9; 7: 3. — For the iron bracelet from Ivry-en-Montagne, Dép. Côte-d'Or, see Olivier and Triboulot 1999: 126 fig. 3: B3; Miketta 2017: 267 cat. no. FR-12.
[91] For all these artefacts, see Miketta 2017. — According to information kindly provided by Samuel van Willigen (08.11.2018), the blade of the Mörigen sword is indeed made of iron; in the earlier literature there has been some confusion about this question. See Miketta 2017: 116; 237 cat. no. CH-4Ab; pl. 44: D4; Willigen 2018: 125 fig. 3b.

as Martin Hohlbein states, in south and west Germany production of bronze knives ceased abruptly at the end of Ha B3; during the Hallstatt period almost all the knives were then made of iron.[92] The rapid development of blacksmithing is demonstrated, for example, by the use of iron tyres on wheeled vehicles, starting in the late 8th century BC (Ha C1b).[93]

To approach an explanation for the fundamental change around 900 BC, and particularly the adoption of iron for utilitarian artefacts in the Carpathian Basin, it is helpful to review the evidence for bronze and iron in hoard depositions at the end of the Bronze Age. The following analysis will focus on the use of bronze versus iron for manufacturing utilitarian artefacts (tools and weapons) – the fundamental breakthrough at the transition to the Iron Age.

9.4 Hoard deposition in the Carpathian Basin and the Bronze/Iron transition

The hoards in the central and western Balkan Peninsula have already been discussed in Chapter 8.5. Whereas in the area to the west of the Drina, hoards with bronze utilitarian artefacts continued to be deposited during the 10th, 9th and 8th centuries BC, further east, in Serbia and Bulgaria, the deposition of bronze tools and weapons ceased sometime around 1000 BC or during the first half of the 10th century BC. In Figure 49 the contrast between the praxis of hoard deposition in the central, as compared to the western Balkans is placed in a wider context. The map shows the distribution of hoards with utilitarian artefacts dating to the 9th and 8th centuries BC (hoard phases V and VI), distinguishing between hoards in which the tools and weapons are made of bronze or iron.[94] The map shows four major regional tendencies in the deposition of bronze and iron, indicating distinct differences in the conceptualization of the two metals.

i) The first regional group, reaching from the south-east Alps (Carinthia, Styria) to Slovenia, central Croatia and Bosnia, has already been discussed in Chapter 8.5 (see Figure 49: 23-26.59-70). The hoards show that in this area, tools (e.g. socketed axes) and weapons (e.g. solid-hilted swords, dirks, facetted spearheads) were still being made of bronze in the 9th and 8th century BC.[95] Indeed, in the area south-east of the Alps, bronze was still sometimes used for tools and weapons during the Early Iron Age.[96] As in northern Italy, bronze was only gradually replaced by iron. High-status artefacts were still manufactured in bronze during the 8th and 7th century BC, as numerous bronze tools and weapons in élite graves demonstrate.[97] Bronze retained its value after the introduction of iron metallurgy and, for a time, both metals were used in parallel for utilitarian artefacts.

ii) In the second region, hoards with bronze utilitarian implements dating to the 9th and 8th century BC are absent (Figure 49). The practice of hoard deposition had clearly ceased or it became very rare: this is clearest in the Great Hungarian Plain. Whereas bronze hoards of the 9th-8th century BC are still

[92] Hohlbein 2016, 392: „Mit den Typen der späten Urnenfelderzeit nimmt die Entwicklung der Bronzemesser im Gebiet nördlich der Alpen ein abruptes Ende. Bronzemesser sind bereits am Anfang der Stufe Ha C nicht mehr vertreten."

[93] See Pare 1992.

[94] References for the hoards of the 9th/8th century BC with tools and weapons: General studies: Pare 1998; Metzner-Nebelsick 2002; Kemenczei 2005. — Lower Austria: Lauermann and Rammer 2013. — Moravia: Salaš 2005. — Hungary: Mozsolics 2000. — Romania: Metzner-Nebelsick 2005b; Soroceanu 2008; Dietrich 2021. — For individual hoards, see: Bartík et al. 2019 (Plavecký Mikuláš). — Boroffka et al. 2023 (Teleac). — Borş 2015; Borş et al. 2013; Borş et al. 2017; Borş and Rădvan 2019 (Tărtăria). — Ciugudean et al. 2008 (Şomartin). — Jevtić 2016 (Miroč). — Kobal' 2000 (Olešnik, Tekovo). — Nikolov 1970 (Krivodol). — Ondrkál 2020b (Strání). — Ožďani 2009 (Nemecká III). — Ožďani 2018 (Nitrianska Blatnica I). — Ožďani and Žebrák 2017 (Počúvadlo-Sitno). — Popa 2020 (Blandiana I). — Rezi 2012 (Sâmbriaş). — Rezi 2017 (Sângeorgiu de Pădure). — Szabó 2019 (Tállya-Óvár, Parád-Várhegy, Bükkszentlászló-Nagysánc IV). — Note that some of the Transylvanian hoards with socketed axes listed here have been assigned by Carola Metzner-Nebelsick to hoard phase IV (Metzner-Nebelsick 2002: 62 ff.; 2005b). In contrast to Metzner-Nebelsick, hoards containing axes cast with an asymmetrical outline (e.g. Blăjenii de Jos, Cămin, Delniţa, Târgu Secuiesc I, etc.), are considered to date later than hoard phase IV. This is in agreement with scholars, including Mircea Rusu, Wilhelm Albert von Brunn and Mircea Petrescu-Dîmboviţa. See Rusu 1963; von Brunn 1968: 31; Petrescu-Dîmboviţa 1978.

[95] For the weapons, see e.g. the hoard depositions from Matijevići (Croatia), Grapska, Lučica, Ometala, Tešanj, Veliki Mošunj (Bosnia) and Škocjan, Mušja jama (Slovenia).

[96] See e.g. the winged and socketed axes (Stary 1982) and the solid-hilted swords (Harding 1995: 80 ff.; 86 f.).

[97] See e.g. Pécs-Jakabhegy, Tumulus 75 (Metzner-Nebelsick 2002: 385 f.; pl. 124: 2); Kaptol, Tumulus 6 (Potrebica 2013: 100 fig. 46); Strettweg (Egg 1996: 150 fig. 87: 1).

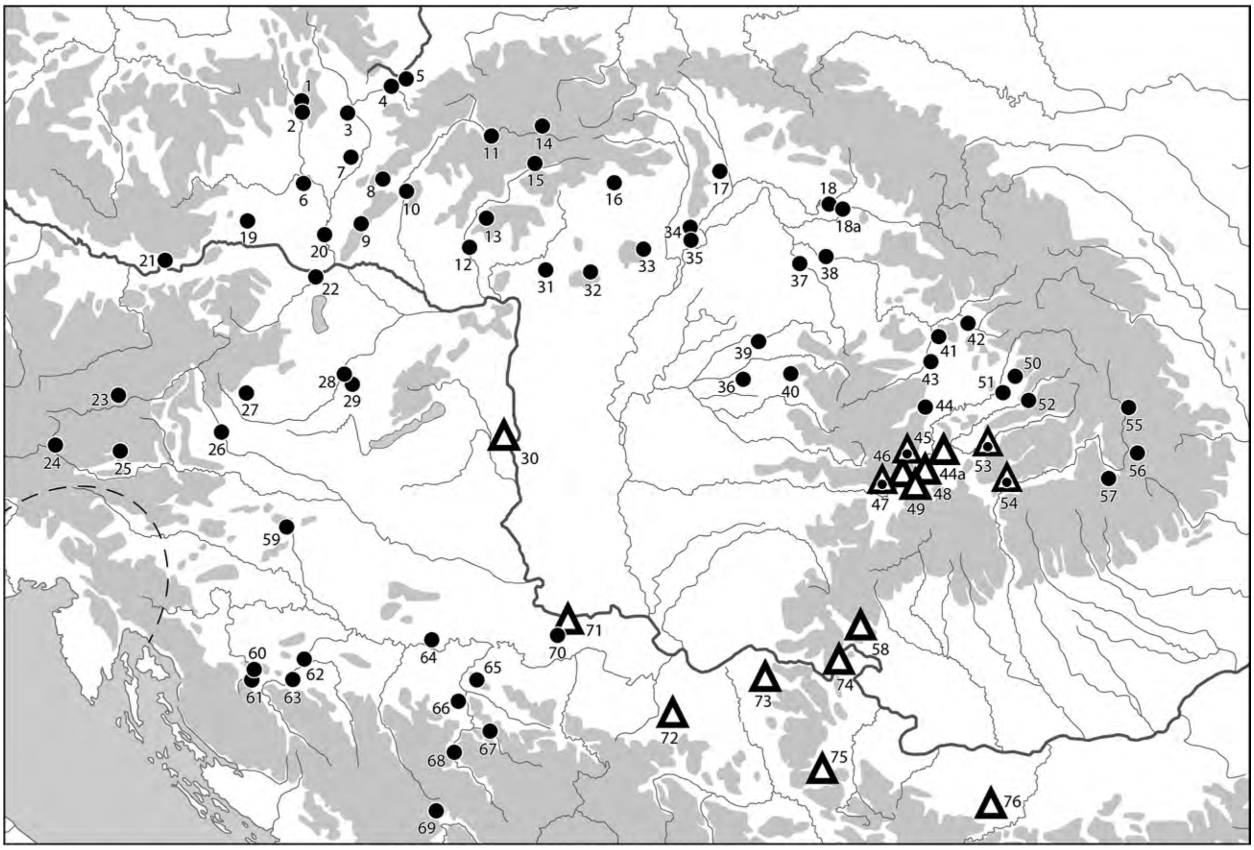


Figure 49. Hoards of the 9th-8th centuries BC (hoard phases V and VI) containing weapons and tools. — Black circles: weapons/tools made of bronze. — White triangles: weapons/tools made of iron. — White triangles containing a black circle: weapons/tools made of iron and bronze. — 1 Boskovice I. — 2 Rájec-Jestřebí. — 3 Polkovice. — 4 Černotín. — 5 Štramberk. — 6 Klentnice. — 7 Syrovín. — 8 Strání. — 9 Plavecký Mikuláš. — 10 Nitrianska Blatnica I. — 11 Blatnica. — 12 Santovka/1924. — 13 Počúvadlo Sitno. — 14 Liptovský Mikuláš. — 15 Nemecká III. — 16 Plešivec. — 17 Svätuše (Plešany). — 18 Tekovo. — 18a Olešnik I. — 19 Großweikersdorf. — 20 Stillfried II. — 21 Neustadtl II. — 22 Haslau-Regelsbrunn. — 23 Schönberg. — 24 Seeboden. — 25 Treffelsdorf. — 26 Wildon. — 27 Pischelsdorf-Kulm. — 28 Celldömölk-Nagyság. — 29 Celldömölk V. — 30 Dunakömlőd. — 31 Szanda. — 32 Parád-Várhegy. — 33 Bükkszentlászló Nagysánc. — 34 Tállya-Óvár. — 35 Prügy. — 36 Biharugra/1907. — 37 Cămin. — 38 Vetiş. — 39 Sântimreu. — 40 Josani. — 41 Fizeşu Gherlii II. — 42 Blăjenii de Jos. — 43 Unguraş. — 44 Buru. — 44a Teleac. — 45 Tărtăria I. — 46 Tărtăria II. — 47 Blandiana I. — 48 Vinţu de Jos I. — 49 Vinţu de Jos III. — 50 Sâmbriaş. — 51 Târgu Mureş. — 52 Sângeorgiu de Pădure I. — 53 Şmig. — 54 Şomartin. — 55 Delniţa. — 56 Târgu Secuiesc I. — 57 Crizbav. — 58 Bâlvăneşti. — 59 Kamena Gorica. — 60 Vranjkova pećina/Drežnik II. — 61 Gajina pećina. — 62 Matijevići. — 63 Osredak. — 64 Ciglenik. — 65 Grapska. — 66 Tešanj. — 67 Lučica (Hrge). — 68 Veliki Mošunj. — 69 Ometala. — 70 Adaševci. — 71 Šarengrad. — 72 Rudovci. — 73 Aljudovo. — 74 Miroč Mountain. — 75 Rujište. — 76 Krivodol.

found in the North Hungarian Mountains (Mátra, Bükk, Zemplén), they are almost completely absent in the Alföld.[98] The cessation of hoard deposition is most striking in areas in which hoarding activity had previously been intense, particularly in north-east Hungary, where many hoards of phase IV are known, such as Hajdúböszörmény, Rohod, etc. Similarly, hoard deposition petered out in Carpatho-Ukraine.[99] South-east Hungary also had prominent hoards in the 11th and 10th centuries BC, including Szentes-

[98] The find from Biharugra is the only exception in eastern Hungary. — In the region between the Tisza in north-east Hungary and the Crasna River in north-west Romania, where hoards were common in the 11th/10th century, examples of the 9th/8th century BC are absent. — The hoard from Kecel in Kom. Bács-Kiskun is not shown on the map; as the bronze socketed axe deposited in the hoard was an antique (manufactured in Ha A1), it is not evidence for the manufacture of bronze axes during the 9th/8th century BC. For Kecel, see Mozsolics 2000: 52 f.; pl. 47: 13; for the axes, see Dietrich 2021 (Type D2).

[99] See Kobal' 2000: pl. 108: B.

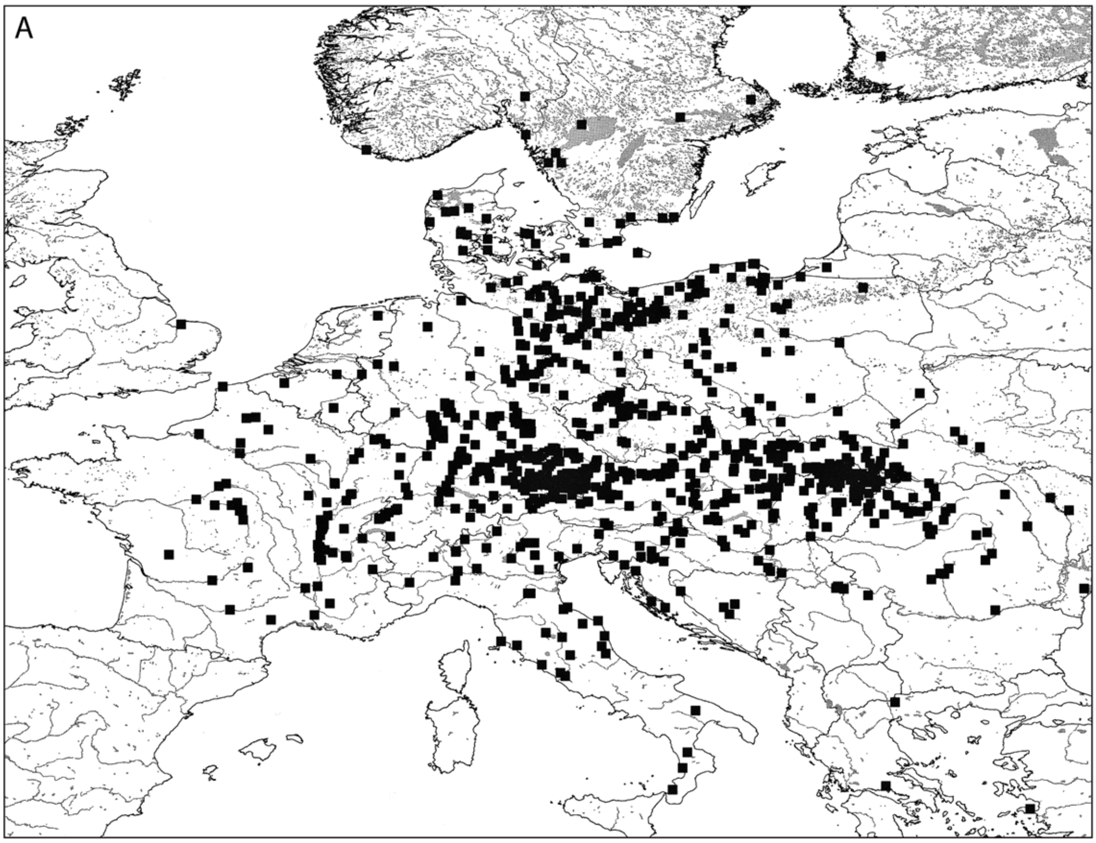
Nagyhegy or Baks-Temető-part, and once again hoards with bronze tools and weapons are absent in the following centuries.[100] In Transdanubia, hoards of Ha B1-B2 (hoard phase IV and IV/V) include well-known examples from Jobaháza, Velem-Szentvid, Celldömölk-Sághegy, and Románd; in hoard phase V (Ha B3), only two small hoard depositions with bronze implements remain – from the vicinity of Celldömölk; both hoards contain a single utilitarian artefact, in both cases a socketed axe (Figure 49: 28.29).[101] In southern Transylvania hoards are also well represented in hoard horizon IV (e.g. Corneşti, Şpălnaca I, etc.) but, once again, the practice came to an end during the second half of the 10th century BC (Ha B2, hoard phase IV/V).[102] Hoard deposition with utilitarian bronze artefacts also ceased after the 10th century BC in the vicinity of Bratislava and in the northernmost part of Croatia.

iii) In the third region, deposition of hoards with bronze tools and weapons continued during the 9th/8th century BC. The region includes Lower Austria, Moravia, Slovakia, the North Hungarian Mountains, the upper Tisza Valley in Carpatho-Ukraine, and the northern parts of Transylvania between jud. Satu Mare and jud. Braşov (Figure 49: 1-22.27-29.31-44.50-52.55-57). Compared with previous centuries, the number of hoards is now smaller, and they contain fewer bronzes. The hoards mainly have a rather monotonous assortment of objects dominated by socketed axes, but some contain in addition (in descending order of frequency) sickles, spears, chisels, and knives. Large hoards with mixed composition and a relatively high proportion of fragmentary objects (scrap) were not deposited after the 10th century BC; cast ingots are also absent now. The same is true for bronzes associated with the élite, such as solid-hilted swords, helmets, and wagon components, although bronze vessels are still found. In summary, the hoards in the third region contain a restricted spectrum of artefacts and they make an impoverished impression compared with earlier periods.

The hoards described above show that bronze was still used for making utilitarian implements during the 9th/8th century in the third region. Furthermore, comparable hoards were also deposited at this time around the upper Dnister, in Galicia.[103] This is interesting, because early iron objects dating to the mid- or second half of the 10th century BC have been found in the same area in the hoard from Nedilyska (see Chapter 6.3). A comparable situation is seen in south-east Transylvania, where iron artefacts were manufactured during the second half of the 10th century BC at Cernat. In both areas, although iron was already known and occasionally worked by smiths in the 10th century BC, bronze was nevertheless still used for utilitarian artefacts, and hoards with bronze tools and weapons continued to be deposited during the 9th/8th century BC.

The absence of swords in hoards in the third area, noted above, requires further comment. In fact, bronze sword production seems to have come to an end in both areas ii and iii at the end of the 10th century BC. This can be illustrated by comparing two maps published by Philipp Stockhammer (Figure 50).[104] Map A shows all the solid-hilted swords of the Late Bronze Age and the start of the Iron Age (Br D-Ha C), while in Map B only those examples dated to the late Urnfield period (Ha B3) are included. In Central Europe the main distribution in Ha B3 reaches as far east as Bohemia and Upper Austria; bronze solid-hilted swords also remained in use during the 9th century BC in northern Europe, in central and northern Italy and in the western Balkan Peninsula. By contrast, the manufacture of solid-hilted swords in eastern

[100] For the Hungarian hoards, see Mozsolics 2000; Szabó 2019.
[101] See Mozsolics 2000: 39; 74 ('Simaság').
[102] See, for example: Brad, jud. Hunedoara (hoard phase IV/V, Ha B2): Petrescu-Dîmboviţa 1978: pl. 226: C; Müller-Karpe 1959: 128 note 3; 209 (Bród). — In my opinion, the 'hoard' from Ruşi (jud. Sibiu) cannot be dated precisely; see Pare 1998: 382 f. notes 222-223; Ciugudean et al. 2008: 22 ff.; pl. 5; Dietrich 2021: 491 cat. no. 1643; 2697; (2698?).
[103] For example, Mošanec, Ruda and Vorona. See Pare 1998: 368 f. and 369 fig. 34.
[104] Stockhammer 2004: 92 f., maps 2 and 40. — In Figure 50 some corrections have been made to Stockhammer's map, and these require comment. — The most important solid-hilted swords in the east come from the hoard of Gamów, pow. Racibórz, and it is significant that they were very likely imported, probably from southern Germany (Müller-Karpe 1961: pl. 61: 1-5). By contrast, the hoard from Wojciechowice, pow. Jędrzejów, indicates local production of bronze daggers and short swords in the late Urnfield period (Gedl 1980: pl. 42: C). The provenance of the Tarquinia sword from Nieczajna, pow. Dąbrowa Tarnowska, seems doubtful; the repairs to the sword appear to be recent (hilt filled with lead?), suggesting that it might have been obtained on the antiquities market (Bugaj 2005: 96 fig. 3). The provenance of the sword from the 'Debrecen area' is also unlikely (Kemenczei 1991: 49).



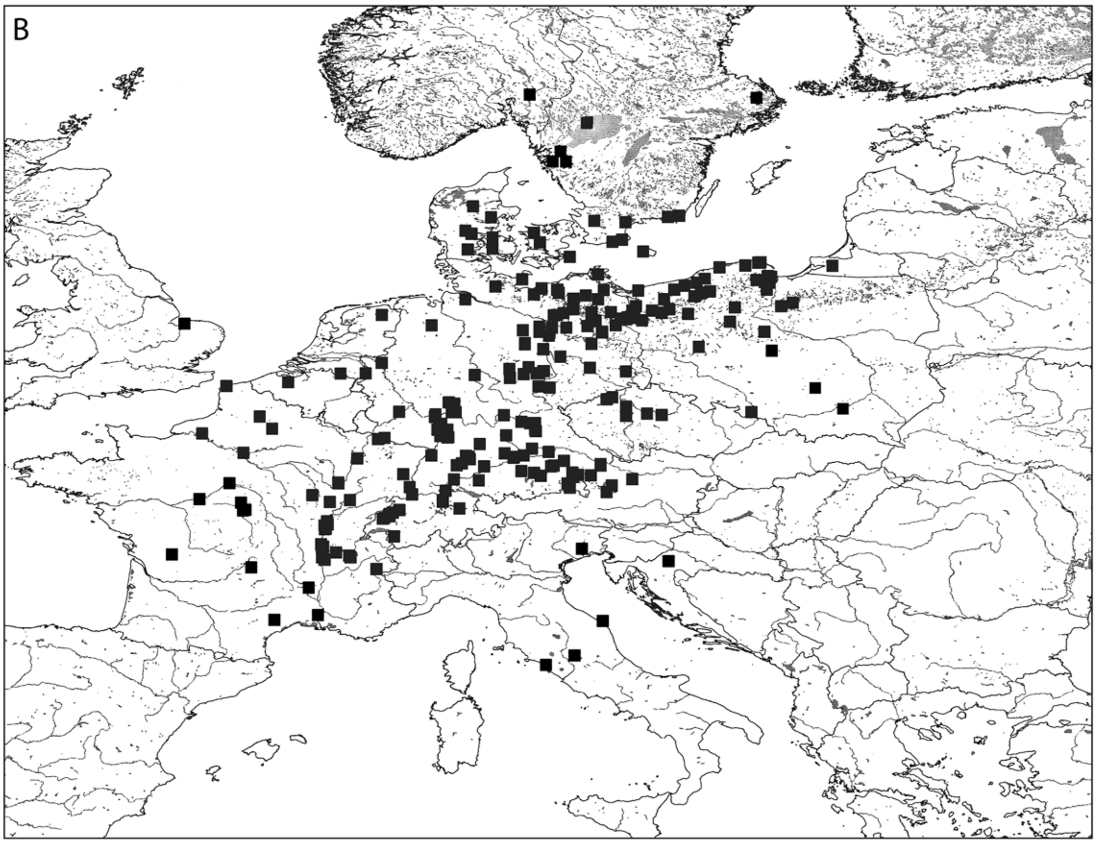


Figure 50. Distribution maps of bronze solid-hilted swords of the Late Bronze Age and the start of the Iron Age. — A: all swords dating from Br D to Ha C. — B: only swords dating to the late Urnfield period (Ha B3). — After Stockhammer (2004), with corrections.

Central Europe evidently ceased before the start of Ha B3.[105] The latest solid-hilted swords (late swords with bowl-shaped pommels and early antenna swords) can be assigned to the Romând phase (Ha B2).[106] Stockhammer also states that flange-hilted swords are almost completely absent in eastern Central Europe in the late Urnfield period although, following Peter Schauer, he believed that some long, richly decorated swords (Großauheim/Curteni types) might date to the late Urnfield period.[107] However, this has been refuted by Lothar Sperber, who recently discussed the most important late flange-hilted swords from the Carpathian Basin.[108] Accordingly, by the start of the 9th century BC, the proud tradition of bronze sword production, both solid-hilted and flange-hilted, had vanished in the Carpathian Basin. The situation is very different in western Central Europe, where production of solid-hilted swords (Mörigen, Auvernier, Tachlovice, Weltenburg, Tarquinia, and other types) remained strong until the end of the late Urnfield period (Ha B3). Bronze flange-hilted and solid-hilted swords, dirks and daggers were also still manufactured in the western Balkan Peninsula and the south-east Alpine area during the 9th and 8th century BC (for details, see Chapter 8.6).

iv) The fourth regional group comprises the hoards with tools and weapons made of iron (Figure 49: 45-49.53-54.58.71-76). These mainly belong to the Bâlvăneşti-Vinţ hoards, which were already discussed in Chapter 8.5.[109] The Bâlvăneşti-Vinţ hoards are quite unlike the bronze hoards from previous centuries; they contain specific artefact sets which seem to pertain to male (iron tools and weapons, bronze and iron horse-gear) and female (bronze and iron jewellery) individuals. The Bâlvăneşti-Vinţ hoards correspond chronologically and spatially with the Basarabi culture. They contain a wide range of iron tools and implements, including daggers, arrowheads, knives, chisels, trunnion axes and double-axes, demonstrating that iron was produced (smelted and manufactured) on a large scale in the region. The recently excavated hoards from Tărtăria are especially important: together, Hoards I and II contained ca. 450 metal objects; the iron artefacts include dagger blades, spears, socketed axes, double-axes, trunnion axes, knives, and chisels.[110] As explained in Chapter 8.4, a radiocarbon date from Hoard I from Tărtăria shows that massive quantities of iron were in circulation by the late 9th or early 8th century BC.

It is very noticeable that the hoards with iron utilitarian artefacts occur in regions in which hoards with weapons and tools exclusively made of bronze are absent during the 9th and 8th centuries BC (i.e. area iv is a subset of area ii). However, in southern Transylvania there is an area of overlap. Four hoards contain both iron and bronze utilitarian artefacts (Figure 49: 45.47.53.54):

- Tărtăria (jud. Alba): apart from the numerous iron weapons and implements, Hoards I and II also contain one bronze spearhead and one bronze knife.[111]
- Blandiana I (jud. Alba): the objects in the hoard comprise iron tools and weapons (including a sword, a fragmentary knife, chisels, spearheads), one small bronze socketed axe, bronze jewellery, and a bronze vessel.[112]

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105 See Stockhammer 2004: 92 f.

106 Müller-Karpe 1961: 88; Kemenczei 1988: 73 f.; Bader 1991: 8. — Ha B2 corresponds to hoard horizon IV/V in the Carpathian Basin (see Pare 1998; Sperber 2017: 172 note 629). — Bronze solid-hilted swords dating to Ha B2 include examples from Horní Lideč, okr. Vsetín, in Moravia (see List 9.1); Baks-Temető-part, Kom. Csongrád (Szabó 2019: 84 fig. 75); Tállya-Óvár, Kom. Borsod-Abaúj-zemplén (Szabó 2019: 106 fig. 95); Yazlovets, Ternopil Oblast, (Bugaj 2005: 94 fig. 1; compare Garching an der Alz [Sperber 2017: 54 fig. 26: 2]) and Chornyi Potik, Zakarpattia Oblast (Popovich 1999: 152 pl. 1) in Ukraine; and probably Valea Rusului in Moldavia (Dergačev 2002: pl. 48: 6; Bader 1991: 161; Pare 1998: 364; 368). — For comments on the swords from Şimleu Silvaniei (Transylvania), Romând (Hungary) and Vel'ká (Slovakia), see Sperber 2017: 54; 73-75; 173.

107 Stockhammer 2004: 93; Schauer 1971: 183; 185. — See also Bader 1991: 8; Kemenczei 1988: 73 f.

108 See Sperber 2017: 53 f.; 58; 66; 71; 166; lists 10, 13A, 13B, 14A and 15. — Sperber assigns the following swords with long and wide leaf-shaped blades to his phase SB IIIa1: Klentnice (Novák 1975: cat. no. 122); Tiszalök, Vác/Budapest, Nagymaros, Podhořany (Kemenczei 1988: cat. no. 398, 399, 400, 467 and 469); Arad, Curteni, 'Transylvania' (Bader 1991: cat. no. 277, 278 and 279); Dalj, Velika Gorica (Harding 1995: cat. no. 206 and 207).

109 Note that the hoard from Dunakömlöd (Figure 49: 30) does not belong to the Bâlvăneşti-Vinţ series of hoards, instead it has a 'pre-Scythian' composition, containing bronze horse-gear and iron spearheads. See Metzner-Nebelsick 2002: 707; pl. 129; 130; 131:1-3. — For Şomartin and Şmig (Figure 49: 53.54), see below.

110 See Borş and Rădvan 2019.

111 Borş and Rădvan 2019: 41; 100.

112 Popa 2020.

- Şomartin (jud. Sibiu): the hoard consists of three bronze socketed axes, four bronze bowls, and iron fragments probably from a double-axe, all found in a pottery vessel.[113]
- Şmig (jud. Sibiu): the hoard comprises a miniature bronze socketed axe, six bronze bowls, and one iron spearhead, all found in a pottery vessel.[114]

The Tărtăria and Blandiana hoards belong to the Bâlvăneşti-Vinţ series; they are only exceptional because they include a small number of bronze utilitarian artefacts. The brief summary of the contents of the hoards from Şomartin and Şmig show that they are different, and represent an idiosyncratic deposition practice specific to jud. Sibiu. These four hoards show that at the time when iron was being produced on a large scale in the area of the Basarabi culture, bronze tools and weapons still played a minor role in southern Transylvania (jud. Alba and Sibiu). Presumably, these bronze utilitarian artefacts were obtained from areas further north in Transylvania (area iii), where bronze remained predominant in the manufacture of tools and weapons.[115]

The socketed axes from Şomartin and Şmig belong to the latest bronze axe variants produced in Transylvania. The first variant comprises miniature socketed axes, which were specially manufactured as non-functional votives.[116] The second variant consists of axes with three or four ribs of equal size around the top of the socket.[117] These two axe varieties seem to be characteristic for the latest stage of bronze socketed axe production in area iii (hoard phase VI). After hoard phase VI, bronze socketed axes were no longer manufactured in Transylvania.

Our discussion of hoards with tools and weapons, and the different regional hoarding practices (areas i-iv), allows the formulation of the following propositions:

1. The cessation of utilitarian bronze hoard deposition spread from the eastern Balkan Peninsula to the central Balkans and then to the lowland plains of the Carpathian Basin (area ii) in the period between ca. 1000 BC and ca. 900 BC (Figure 54, and see Chapters 5.1 and 8.5).
2. In area ii, the change from bronze to iron does not seem to be a matter of the gradual displacement of one metal by the other, instead the transition at ca. 900 BC seems to have been abrupt. This is suggested by the cessation of bronze hoarding and the disappearance of important bronze élite accoutrements, such as bronze swords, at the Ha B2/B3 transition.
3. The impoverishment of bronze hoards in area iii and the termination of bronze sword production are linked to the abrupt decline in the circulation and consumption of bronze in area ii.
4. Thanks to specific ritual practices in the area of the Basarabi culture, resulting in the deposition of the Bâlvăneşti-Vinţ series of hoards, we are able to appreciate that in this area iron had fully replaced bronze in the production of utilitarian artefacts by the end of the 9th century BC. But a high level of iron technology could already have been achieved in this area long before the Bâlvăneşti-Vinţ deposition practice began; and the same could be true for the whole of area ii. Indeed, the decline in evidence for the use of bronze for utilitarian purposes in the Hungarian Plain after ca. 900 BC makes this a plausible scenario.
5. As explained above, iron use was transformed in the area north-east of the Alps around the transition from Ha B2 to B3: in the 9th century BC, iron utilitarian artefacts were in widespread use – particularly knives (Figure 48), but also weapons such as daggers and spears (see, for example,

[113] Ciugudean et al. 2008: 34-38; Dietrich 2021: 507 f. cat. no. 1740.
[114] The hoard, recently found, has not yet been published. I am very grateful to Horia Ciugudean (Alba Iulia) for information on this new find.
[115] This corresponds to hoard phase VI in the chronological scheme published in Pare 1998: 369 ff.
[116] For miniature socketed axes (length ≤ 5.5 cm) in Transylvania, see Dietrich 2021: 531; 756; 771. Apart from Transylvania, similar miniature axes are also known from northern Hungary and Slovakia. — See, for example: Şomartin (Ciugudean et al. 2008: 35 no. 3; pl. 14: 1); Şmig (pers. comm. H. Ciugudean); Crizbav (Petrescu-Dîmboviţa 1978: 151; pl. 265: E4; Dietrich 2021: 530 cat. no. 1901; pl. 421: 1901); Blatnica (Kemenczei 2005: 146; pl. 54: A4); Nemecká III (Oždʼani 2009: 11 no. 1-3; pl. 13: 1-3); Párad-Várhegy (Szabó 2019: 134 fig. 123); Prügy (Kemenczei 2005: 135 no. 40-41; pl. 29: 40-41); Szanda (Kemenczei 2005: 135 no. 17; pl. 32: 17; Metzner-Nebelsick 2002: pl. 134: 4).
[117] See Pare 1998: 372; see also 363 fig. 31: 24-25; 365 fig. 32: 26-28.30-32-33. — For further illustrations, see e.g. Şomartin (Ciugudean et al. 2008: pl. 14: 6); Nemecká III (Oždʼani 2009: pl. 13: 4; 14: 1.3; 15: 2).

Figures 51 and 52). According to the scenario generated by the above propositions, it is most likely that ironworking was introduced to the north-east Alpine regions from area ii (specifically the Great and Little Hungarian Plains).

9.5 Crisis and system collapse in the Carpathian Basin

In the previous pages, the critical cultural changes which took place in the Carpathian Basin after ca. 900 BC have hardly been mentioned, as the discussion focused almost exclusively on the presence or absence of bronze and iron in hoards and other contexts. The clearest evidence for this cultural disjunction is provided by the appearance of the inhumation cemeteries of the Mezőcsát culture, which were in use during the 9th and 8th century BC. This subject, along with the broader question of pre-Scythian contacts between the Carpathian Basin, the North Pontic steppe and the northern Caucasus, has been studied in a number of fundamental publications by Carola Metzner-Nebelsick, and the following paragraphs are an attempt to summarize some of her more important conclusions.[118]

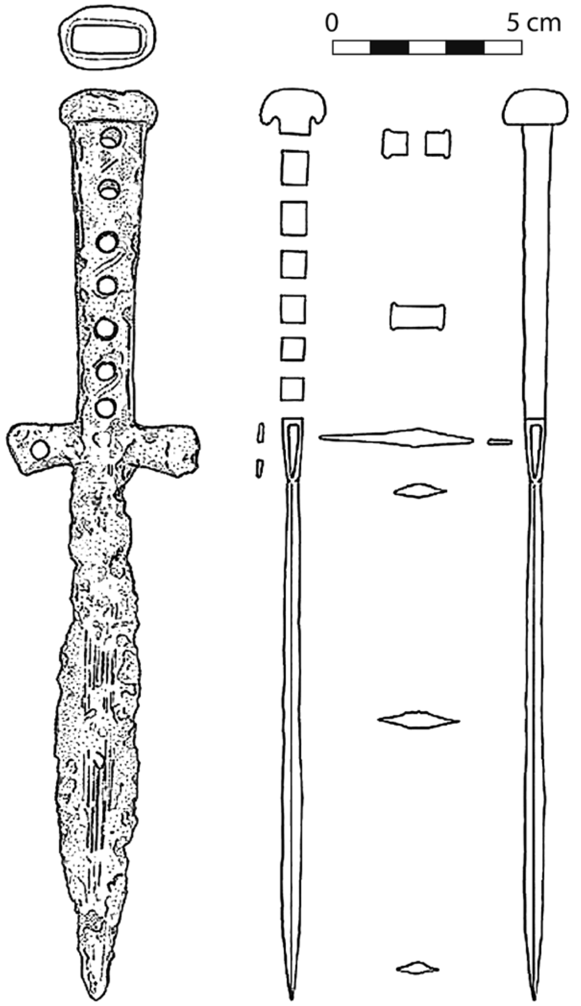

Figure 51. Iron dagger from Slovenská brána (Porta Slovenica), Slovakia. — After Čambal 2017: 351 fig. 2. — Scale 1:2.

The cemeteries of the Mezőcsát culture are mainly found clustered around the Tisza in the Great Hungarian Plain (Alföld), but they are also quite frequent in south-west Slovakia in the Kisalföld, and there is even a small collection of inhumation graves belonging to the Mezőcsát culture in southern Moravia (Figure 43).[119] The burial customs of the Mezőcsát cemeteries are similar to those of the Chernogorovka culture of southern Ukraine, and for this reason their appearance is generally held to reflect the arrival of intruders from the grass steppe north of the Black Sea. As settlements are almost completely absent in the steppe landscape of the Great Hungarian Plain at the time of the Mezőcsát cemeteries, the new culture must have had a non-sedentary economy as mobile pastoralists.

With the appearance of the new culture, the Gáva Fluted Ware culture essentially ceased to exist in eastern Hungary, and at the same time sites of the Vál-Chotín culture in north-east Transdanubia and south-west Slovakia were also abandoned.[120] The absolute number of newcomers from the North Pontic steppe is unknown, but it is certain that the Mezőcsát culture included both eastern immigrants and members of the local population; this is evident from the pottery, most of which is closely related to the wares of the autochthonous cultures of the Carpathian Basin (Kyjatice, Gáva, Stillfried-Podoli, Dalj, etc.).

[118] See e.g. Metzner-Nebelsick 1998; 2000; 2010a; 2022.

[119] For distribution maps of sites of the Mezőcsát culture, see Bóka 2010: 156 fig. 11; Vávra 2016: 174 fig. 4; Parma and Stuchlík 2017: 208 fig. 1 (sites 2, 7, 8 and 9); Mogyorós 2018: 364 fig. 4.

[120] For the end of the Vál-Chotín culture, see Kőszegi 1988: 76-80; Pare 1998: 400-404; Metzner-Nebelsick 2002: 23-25; 87. — For the important cemetery of Budapest-Békásmegyer, see Kalicz-Schreiber 2010: 296 ff.; 314 ff.

It would be surprising if this massive cultural disjunction was not associated with disruption and strife in the Carpathian Basin – particularly in the Great and Little Hungarian Plains, but also in the surrounding regions. The new types of 'pre-Scythian' horse-gear and weaponry found during the 9th and 8th centuries BC in the Carpathian Basin suggest that the newcomers from the North Pontic steppe introduced innovative methods of equestrian warfare. Currently, potential evidence for the aggression of these equestrian-nomadic groups is a matter of intensive research, including the destruction or abandonment of 'mega-settlements' in the Alföld, the destruction of the defensive rampart at Teleac (Transylvania) in the late 10th century BC, and the mass graves found in various parts of the Carpathian Basin during the 9th/8th century BC.[121] It is also significant that the areas occupied by the nomadic pastoralists were surrounded by cultural groups who were clearly concerned with defence against military aggression: this is demonstrated by numerous hillforts dating to the 10th/8th century BC, such as Batina (north-east Croatia), Pécs-Jakabhegy, Velem-Szentvid, Sopron (south and west Transdanubia), Stillfried (Lower Austria), or Smolenice-Molpír (south-west Slovakia). This subject has been discussed in a new article by Gábor Szabó and Gábor Bakos, who note a peak in hillfort construction in the North Hungarian Mountains in Ha B, and particularly intense activity in Ha B2-3.[122] Fieldwork at some of the hillforts indicates that the region was endangered by repeated forays and military ventures over a long period of time, and the finds suggest that the attackers included equestrian nomads from east of the Carpathians. There were apparently repeated military conflicts during the 9th and 8th centuries BC. Szabó and Bakos also note that the mass graves in settlements of this period might not represent the aftermath of raiding and mass killing, but could have resulted from famine or epidemics during this unsettled time.

In her many publications, Carola Metzner-Nebelsick has presented an original and acute interpretation of the profound changes in the Carpathian Basin around 900 BC. She understands the radical disjunction as the result of system collapse, when old power structures dependent on metal production and distribution 'imploded', leaving a void in the eastern Carpathian Basin:

"Als Antwort auf eine ökologisch bedingte ökonomische und daraus resultierend politisch-religiöse Krise kam es zu einer kulturellen Neudefinition der Gesellschaft mit einem damit einher gehenden Wandel des sozialen Gefüges und der religiösen Vorstellungen, die sich für den Archäologen vor allem in den Bestattungssitten sichtbar manifestieren. ... Neben der vermutlichen Abwanderung einzelner Bevölkerungsteile nach Westen und Süden ging ein weiterer Teil zu einer nomadischen oder seminomadischen Lebensweise über, die den neuen Umweltbedingungen besser angepaßt war. Als Folge dessen kam es zu einer Intensivierung der Beziehungen mit sozial ähnlich strukturierten Gemeinschaften östlich der Karpaten. Diese fanden ihrerseits wiederum in dem durch Steppenvegetation geprägten Naturraum Alföld günstige Lebensbedingungen vor. Diese Prozesse und auch einzelne, vermutlich jedoch zahlenmäßig geringe östliche Zuwanderer – zu denken ist an kleinere Gruppen von Reitern oder Reiterkriegern, die das Know-how der neuen Zäumungstechniken nach Westen vermittelten – bewirkten schließlich die bekannte kulturelle Neuprägung des Alföld mit einem nun betont steppennomadisch geprägten Charakter."[123]

In this model, only a fairly restricted number of mounted warriors migrated to the Hungarian Plain from areas to the east of the Carpathian Mountains. The main cause of the crisis was the collapse of a system which was unstable and vulnerable to disruption. This is not the place to discuss these questions in greater detail; our short review of some current research is intended merely to emphasize the importance of this disjunction in the Carpathian Basin for our understanding of the Bronze/Iron transition. The potential explanations for the cultural break ca. 900 BC include: invasion and conquest by horse-riding

[121] See, for example, 'mega-sites' such as Baks-Temetőpart (Csongrád County) and Căuaş-Sighetiu (jud. Satu Mare): Kósa 2018: 35 ff.; Szabó 2019: 77 ff.; Marta et al. 2021; Szabó and Bakos 2022: 328 f. — For the Mass Graves, such as Pusztataskony-Ledence, Tiszabő-Galamb-dűlő, Hódmezővásárhely-Kopáncs, Tărtăria, Gomolava, Novi Sad and Stillfried, see Király et al. 2013; Szabó and Bakos 2022: 329-331. — For Teleac, see above (Chapter 9.1).
[122] Szabó and Bakos 2022.
[123] Metzner-Nebelsick 2010b: 213. — See also Metzner-Nebelsick 2000: 164; 2022: 143.

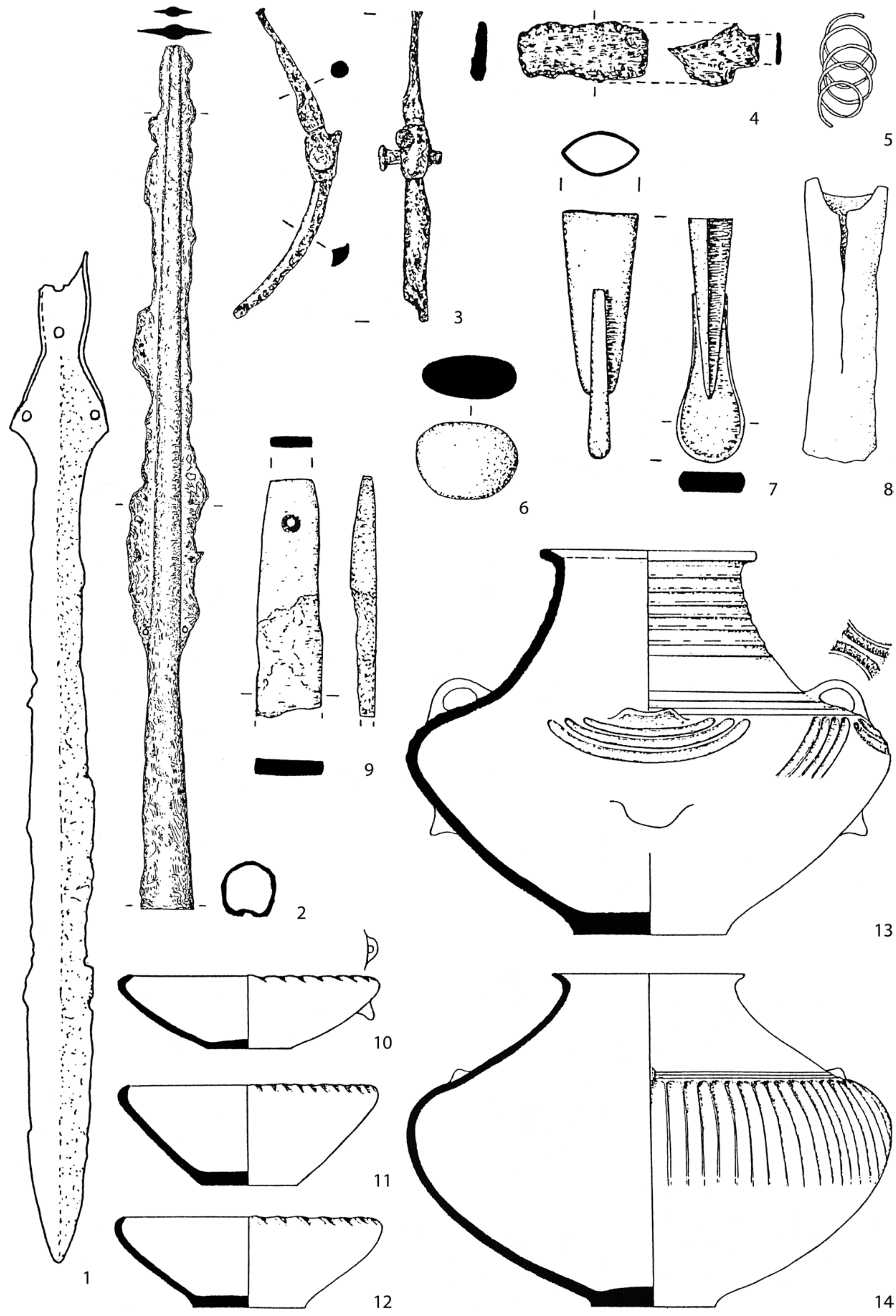

Figure 52. The furnishings from Brno-Obřany, Grave 169. — 1-4.8 iron; 5 gold; 6.9 stone; 7 bronze; 10-14 pottery. — After Stegmann-Rajtár 1993: pl. 1-2. — 1-2 Scale 1:3; 3-9 Scale 1:2; 10-14 Scale 1:5.

warrior nomads; environmental (ecological/climatic) deterioration; and system collapse due to 'internal contradictions', followed by radical economic and cultural reorientation.

Contact with the pre-Scythian cultures of the North Pontic steppe led to a fundamental change in weaponry, and the introduction of new types of horse-gear suited to equestrian warfare. Among the weapons which feature most prominently are bimetallic swords and daggers of Gamów-Pyatigorsk and Golovyatino-Leibnitz type and iron spearheads with a pair of perforations at the base of the blade (see, for example, Figures 51 and 52: 2).[124] These weapons are found particularly frequently in the western half of the Carpathian Basin, and presumably reflect intensive contacts with pre-Scythian equestrian nomads (Figure 53). Whereas many of these objects cannot be dated precisely, a few have been found in contexts of the late Urnfield period, indicating that these types of weaponry were already in use in Central Europe during the 9th century BC.[125] For the present study, it is obviously of crucial importance that iron weapons were already known and used in the Carpathian Basin and the area north-east of the Alps during the 9th century BC.

The Mezőcsát culture presumably played an important role in the transmission of the new kinds of iron and bimetallic weaponry from the North Pontic steppe and the north-western Caucasus to the Carpathian Basin. However, owing to the simple burial customs, it is difficult to be more precise: weapons are completely absent in the cemeteries of the Mezőcsát culture, horse-gear is rare, and there are hardly any metallic tools and implements. Furthermore, the individual graves are often difficult to date precisely. Iron knives are found in a few graves, showing that the Mezőcsát culture could have been the inspiration for the iron knives further to the west in the Stillfried-Podolí culture, where they are quite common in cemeteries in the late Urnfield period (Figure 48; for the case of Franzhausen 'Kokoron', see above).[126] Similarly, the iron bracelets found in contexts of the Urnfield culture north-east of the Alps might also have been obtained from the Mezőcsát culture, where they are also found in graves, and are a further indication for the source of the transmission of the technology.[127]

While the contacts with the North Pontic steppe were certainly important for the introduction of iron, the role of the other Post-Fluted Ware cultures in the transmission of iron artefacts and ironworking technology along the Danube should not be underestimated (for the Post-Fluted Ware cultures, see Figure 43). The iron flange-hilted sword from Brno-Obřany, Grave 169, which was very likely imported from Bulgaria, has already been mentioned in Chapter 5 (Figure 52: 1). Grave 140 from the same cemetery, belonging to the 8th century BC, contained another weapon indicating an eastern Balkan ancestry. The incompletely preserved iron blade measures 40.9 cm in length and is best interpreted as a *machaira*, related to the one-edged weapons of similar date known from the Basarabi culture; another *machaira* has been found in Slovakia, at the 'Čvirigovec' near Trenčianske Teplice, along with an iron spearhead with perforations at the base of the blade.[128]

There can be little doubt that the emergence of the Post-Fluted Ware cultures, with their new cultural orientation, was a most important factor associated with the massive increase in the importance of iron in the Carpathian Basin during the 9th century BC. It can hardly be a coincidence that the practice

[124] For the bimetallic swords and daggers, see Metzner-Nebelsick 2002: 370 ff.; 371 fig. 167; Kemenczei 2005: 68 ff.; Čambal 2017 (Slovenská brána); Čambal 2018: 130 pl. 1: 2 (Dolné Vestenice); Klochko 2020: 66 fig. 4: 7.8.9 (Lviv Oblast, three examples). — For the iron spears, see Deicke 2011: 71 ff.; 73 fig. 65; Kashuba 2014; Čambal 2015: 212 fig. 2: 6 (Trenčianske Teplice); Teržan 2017 (Ptuj, Šarengrad).

[125] For Brno-Obřany, Grave 169, Künzing, Grave C, and the hoards from Gamów and Breesen, see Miketta 2017.

[126] See Kemenczei 2005: 77 (Mezőcsát-Hörcsögös, Grave 55; Senica, Grave 2; Vel'ka Maňa).

[127] Mezőcsát culture, for example: Füzesabony-Kettös-halom, Grave 63: Patek 1989: 87 pl. 12: 10. — Mezőcsát-Hörcsögös, Graves 57, 60 and 65: Kemenczei 2005: 126 f. cat. no. A14; pl. 4: B4.5; Patek 1993: 42 fig. 29: 9-10; 43 fig. 30: 2.10-11. — Szeged-Algyő, Grave 83: Kemenczei 2005: 127 cat. no. A20; pl. 6: C4. — Szeged-Öthalom: Reizner 1904: 81 fig. II: 5. — Stillfried-Podolí culture, e.g.: Szombathely-Zanat, Grave 33: Miketta 2017: 271 f. cat. no. HU-6; pl. 59: B14. — Brno-Obrany, Grave 140: Miketta 2017: 245 cat. no. CZ-11A; pl. 21: 3. — Strání: Ondrkál 2020b: 26 f. fig. 15. — Note that iron bracelets were also found in the hoard from Nedilyska (see Chapter 6.3).

[128] For Brno-Obřany, see Pare 1998: 391; Miketta 2017: pl. 21: 1. — For Trenčianske Teplice, see Čambal 2015. — For well-preserved *machaira* from Romania, see Vulpe 1990: 74 ff.

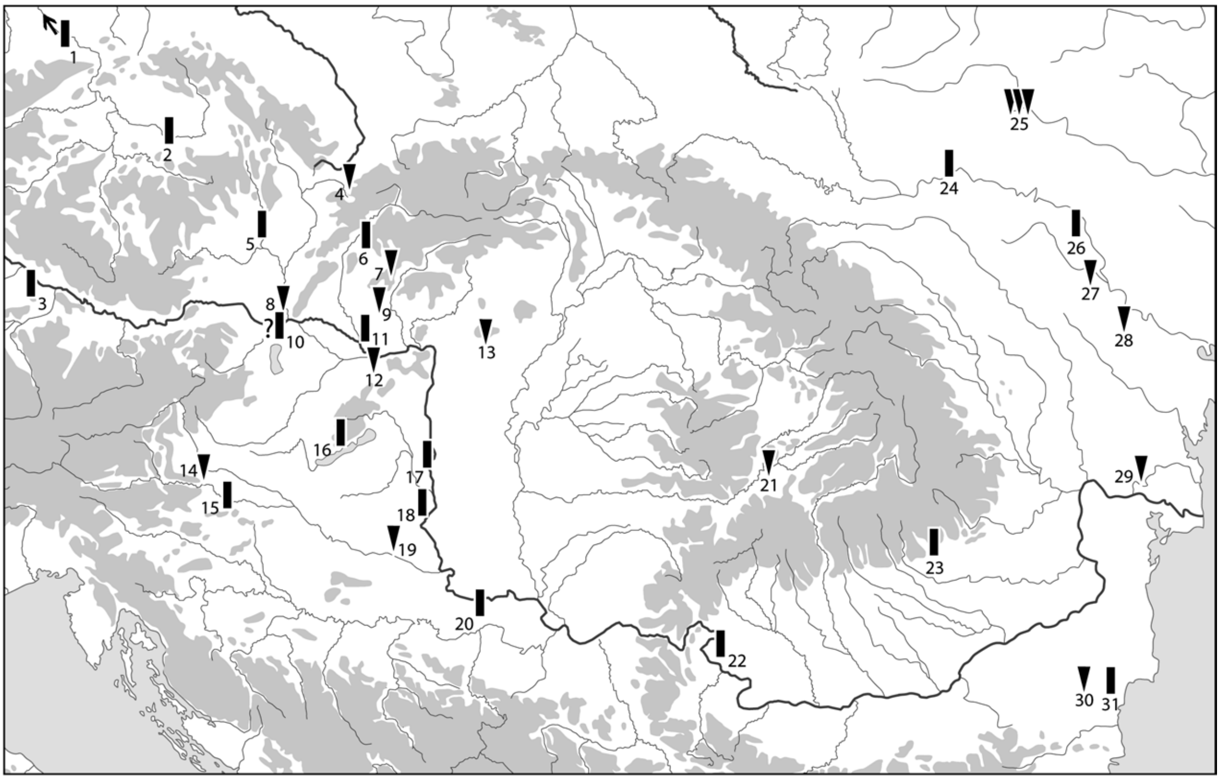

Figure 53. Distribution map of bimetallic and iron swords and daggers of Golovyatino-Leibnitz and Gamów-Pyatigorsk type (triangles) and iron spearheads with a pair of perforations at the base of the blade (rectangles). — 1 Breesen. — 2 Kolín. — 3 Künzing. — 4 Štramberk. — 5 Brno-Obřany. — 6 Trenčianske Teplice. — 7 Dolné Vestenice. — 8 Stillfried. — 9 Slovenská Brána. — 10 Petronell. — 11 Šala-Veča. — 12 Komárno. — 13 Mátra Mountains. — 14 Leibnitz-Gollikogel. — 15 Ptuj, Ulica Viktorina Ptujskega. — 16 Halimba. — 17 Dunakömlöd. — 18 Kakasd. — 19 Pécs-Jakabhegy. — 20 Šarengrad. — 21 Pănade. — 22 Gogoşu. — 23 Ploieşti. — 24 Loevtsi. — 25 Vynnitsia oblast (three examples). — 26 Mateuţi. — 27 Brăneşti. — 28 Berezki. — 29 Suvorovo. — 30 Belogradets. — 31 Dobrina.

of depositing hoards of bronze weapons and tools ceased with the emergence of the Post-Fluted Ware cultures: the Stamped Pottery *koinè*, the Bosut culture, and the Mezőcsát culture (compare Figures 43 and 54). The Post-Fluted Ware cultures demonstrate a new cultural orientation: rejecting old values and practices and open to new influences deriving from the eastern Balkans and the North Pontic steppe.

9.6 The demise of the Standard Bronze value system

The end of utilitarian bronze hoard deposition in the Carpathian Basin, analysed in Chapter 9.4, cannot be understood in isolation. This is because the cessation of bronze hoards was a widespread, almost pan-European, phenomenon around the Bronze/Iron transition. Imke Westhausen has provided a useful review of hoards of the Early Iron Age in the area between France, the Carpathian Basin and Poland.[129] Following the intense hoarding activity in the Urnfield period, only approximately ten depositions are known from the area between central France and Bohemia/Upper Austria during the older Hallstatt period (Ha C).[130] Pierre-Yves Milcent has published similar figures for the Atlantic Zone in France: whereas a total of 220 hoards are assigned to *Bronze final* 3 (ca. 950-800 BC), only five hoards date to the older Hallstatt period (ca. 800-625 BC).[131] The virtual disappearance of utilitarian bronze hoards in this vast area at ca. 800 BC, including the Atlantic Zone in France and the British Isles and the Urnfield culture

[129] Westhausen 2019.
[130] Westhausen 2019: 284 fig. 4.
[131] Milcent 2017b: 714 table 1. — For the hoards in England, compare Huth 1997: maps 1 and 4.

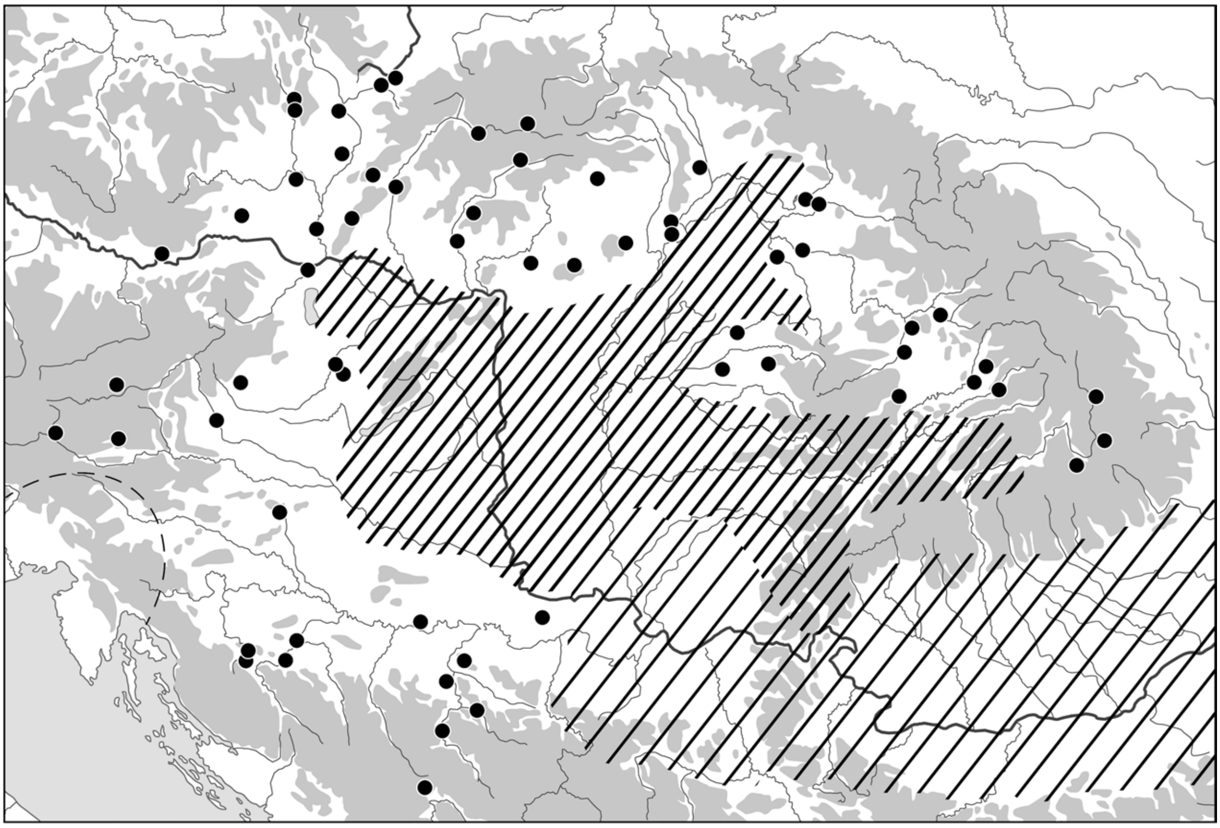

Figure 54. Schematic map of the terminal stages of the deposition of hoards of bronze tools and weapons in the Carpathian Basin and around the Lower Danube. — Widely spaced hatching: hoard deposition ceased around the first half of the 10th century BC. — Closely spaced hatching: hoard deposition ceased ca. 900 BC.

between central France and the area north of the Alps, is highly significant. This is made even more remarkable, considering that after 800 BC bronze continued to be used for making tools and weapons in western Europe.[132]

Hoards with utilitarian bronze artefacts seem to come to an end slightly earlier in the Iberian Peninsula. There was a peak in hoard deposition in *Bronce Final* 2 (the Hió/Huelva phase), but in the subsequent *Bronce final* 3 (corresponding to the Vénat phase in France, ca. 9th century BC), hoards had become rare.[133]

In the Nordic Zone (northern Germany, southern Scandinavia, north-west Poland) bronze hoards are very frequent in Per. V, and they often contain a wide range of artefacts, including numerous tools and weapons. As the end of Per. V overlaps with the start of the Hallstatt period (Ha C1a), it is likely that this hoarding activity continued during the 8th century BC. In Per. VI, however, hoard deposition declined; according to Jørgen Jensen, the decline began earlier in the western part of the Nordic Zone than in the east (especially Poland).[134] In northern Germany and Denmark, the number of hoards not only

[132] The swords of Gündlingen type are clear evidence for the continued use of bronze for weaponry. — Utilitarian bronze artefacts are found in the rare hoards of Ha C, such as Wattenheim (socketed axes, socketed gouges, a spearhead) and Worms-Neuhausen (socketed axes) in Rheinhessen; see Sprater 1939; Zylmann 1999. — For the bronze tools and weapons in the 'Launacien' hoards in south-west France (ca. 650-550 BC), see Guilaine et al. 2017.

[133] Burgess and O'Connor 2008: 55; 58; the authors suggest that this might reflect the precocious adoption of iron in Iberia under Oriental influence.

[134] Jensen 1997: 216: "In southern Scandinavia the multi-type hoards in Period VI concentrate in the east, and at the same time they show links with the areas south of the Baltic. The reason for this is unlikely to be identified in local conditions but should no doubt instead be sought in the wider North European context, because the deposition-customs changed at about the same point in time, and the circulation of bronze gradually ceased throughout the whole lowland area of North Germany and Poland, although the eastern parts of that area were the last to be affected."

decreased markedly in Per. VI, but the range of deposited artefacts was also much more restricted, mainly comprising jewellery and small numbers of bronze socketed axes.[135] In Lower Saxony, for example, most of the hoarded objects in Per. VI are items of jewellery. The only bronze utilitarian implements comprise six socketed axes from four hoards; it is curious that in all four cases, the hoards also contain socketed axes made of iron.[136] Clearly, the hoards of Per. VI in southern Scandinavia and northern Germany only contain very few bronze utilitarian artefacts – almost exclusively socketed axes.

As mentioned above, hoards are more common in Poland during Per. VI than in the areas of the Nordic Zone further to the west.[137] In the early part of Per. VI ('Ha C') the hoards still contain a wide range of bronze tools and weapons, including socketed axes, shaft-hole hammer-axes, chisels, sickles, swords, and spearheads.[138] For example, the hoard from Kalinówka Kościelna from the Podlachia region in north-east Poland contains no less than 52 bronze socketed axes. However, these hoards with bronze utilitarian artefacts are only found in northern Poland (north of Poznań), whereas they are absent further south.[139] Wojciech Blajer attributes the earlier cessation of hoarding in southern Poland (as compared to northern Poland) to the influence of the Hallstatt culture.[140]

This very short review shows that a general trend can be observed across Europe at the end of the Bronze Age. The deposition of utilitarian bronzes stopped earlier in the south: in the central and eastern Balkans already by the first half of the 10th century BC, in the plains of Hungary ca. 900 BC, and in the western Iberian Peninsula during the 9th century BC. In the vast area between the Atlantic Zone in France and Britain, and the Urnfield culture north of the Alps, hoarding ceased at around 800 BC. And in the Nordic Zone and in the Lusatian culture in Poland, hoard deposition with bronze utilitarian artefacts gradually declined during the 8th and 7th centuries BC.[141] This general trend is illustrated on a schematic map (Figure 55).[142]

This northward trend in the cessation of utilitarian bronze hoard deposition affected large parts of Europe and must be understood as a coherent 'wave' of cultural change advancing through the continent. This indicates the existence of widely shared attitudes to bronze in the early 1st millennium BC. I discussed this special conceptualization of bronze in the European Bronze Age in an article published in 2000 entitled 'Bronze and the Bronze Age', in which I argued for the 'Standard Bronze hypothesis'.[143] The hypothesis entails the following four propositions: (1) Tin bronze was adopted in a special way: by ca. 1800/1700 BC practically all metal artefacts were made of Standard Bronze (copper was alloyed with at least 5% tin), even when it was unnecessary from a technological viewpoint. The adoption of 'total bronze' in this manner should be understood as a cultural, rather than a technological choice; (2) This cultural norm was observed over large parts of central and western Europe, in what I called the European Metallurgical Province (following Evgeniy Chernykh): from the Atlantic coast in the west to the Carpathian Mountains in the east, and from southern Scandinavia and the British Isles in the north reaching southwards as far as northern Iberia and northern Italy; (3) In this area, obtaining, exchanging and displaying bronze was vitally important both in economic production and social reproduction. It was therefore imperative for societies to access bronze; (4) Bronze exchange and display became a cultural norm, part of a value system in which Standard Bronze had a convertible material value and came to be used as a kind of

[135] See Jensen 1997: 184 fig. 108; 316 f. (cat. no. 8).
[136] Laux 2017: pl. 110; 111: 1-8; 112: 1-8.
[137] See Jensen 1997: 184 fig. 108; Westhausen 2019: 284 fig. 4.
[138] Blajer 2001: 354-357.
[139] Blajer 2001: 354-357; map 7.
[140] Blajer 2001: 407; 416; see also Dzięgielewski et al. 2020: 206.
[141] Unfortunately, the chronology of the hoards of Per. VI in the Nordic Zone and Ha C in Poland is rather unclear, and at present it is often difficult to date them precisely. — The author is grateful for helpful advice on this question from Dr Ronald Heynowski (Dresden).
[142] Because of limited time, I have not included a discussion of the latest stages of hoard deposition in Italy and Slovenia.
[143] Pare 2000.

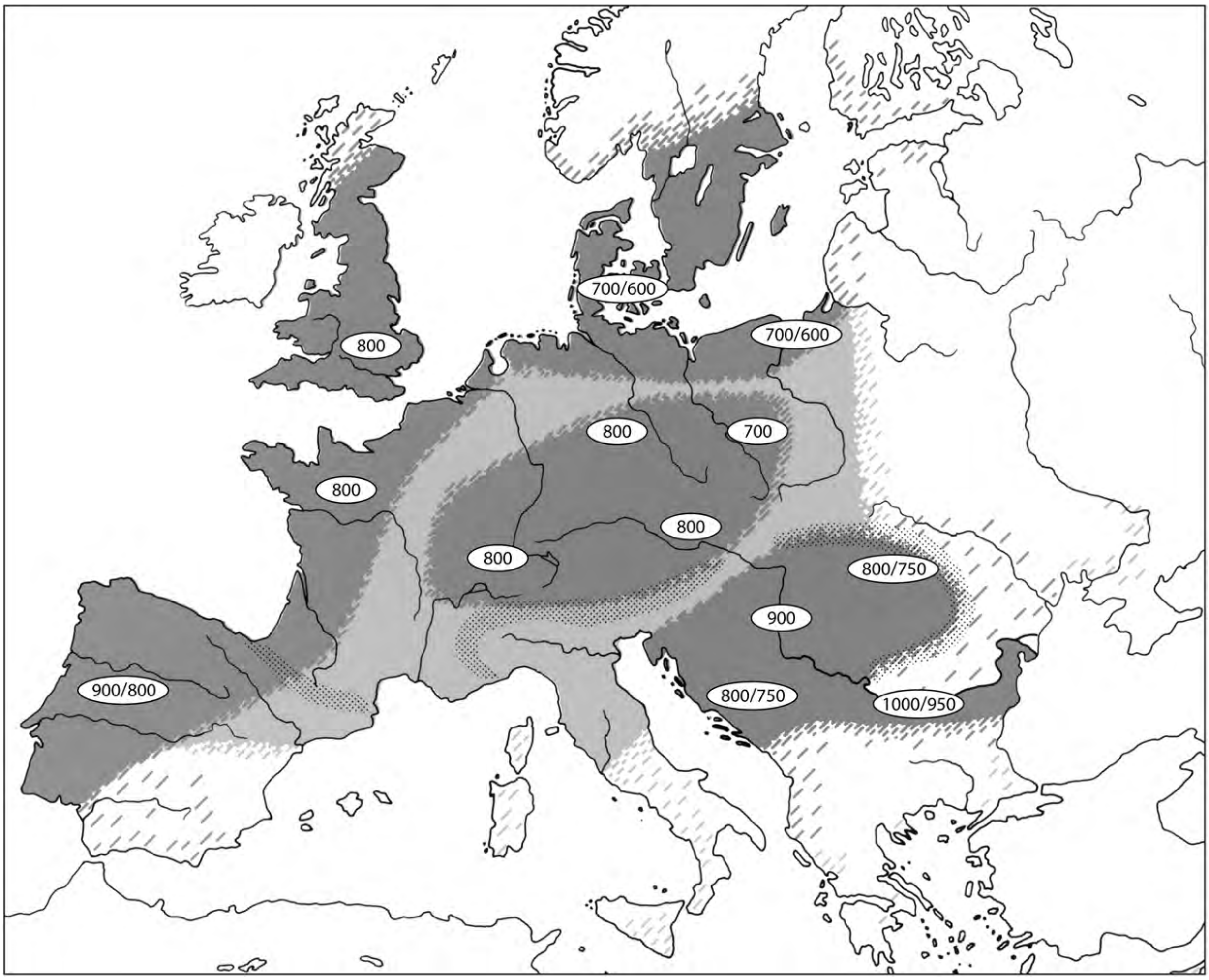

Figure 55. Schematic map of the terminal stages of the deposition of hoards of bronze tools and weapons (approximate dates in years BC). — The base map is taken from the frontispiece in Hänsel and Hänsel 1997; shading shows areas of intense (dark grey) and less intense (light grey) hoarding activity during the Late Bronze Age.

currency.[144] The Late Bronze Age hoards are evidence for the continuing validity of the standard bronze 'currency' until its collapse at the Bronze/Iron transition.

These ideas were subsequently elaborated in a perspicacious study by Stuart Needham on the end of the Bronze Age in lowland Britain.[145] He also agrees that during the Bronze Age bronze was a kind of socio-political currency: "After centuries of dependence on it, bronze was a staple for all aspects of Bronze Age life, whether practical, structural, political or religious. In many and varied ways, bronze was the underlying currency of existence. It is this superstructure that was blown away at the [Bronze/Iron] transition, opening the way for political structures with an utterly different basis. ... The transition is not so much about replacing bronze with iron, but rather, doing away with a *social value system* based heavily on bronze and creating a new system constructed in a wholly different way. ... [How] can we ignore the possibility that collapse of the *bronze standard*, which supported the social value system of the Late Bronze Age, would have caused substantial restructuring of the political order? ... The logic of the bronze system depended on its interconnectedness and general observance over large areas. This inevitably meant that

[144] In the context of the Atlantic Zone, Dirk Brandherm and Magdalena Moskal-del Hoyo (2014: 40) refer to "metal-based wealth-finance systems".
[145] Needham 2007.

any destabilising tendencies would have knock-on effects down the line; a chain reaction that could not have been rebuffed by any single cultural group even if particular responses to it were potentially quite varied."[146]

Needham emphasizes the far-reaching effects of the collapse of the Standard Bronze 'currency': along with the reconceptualization of bronze came the necessity of creating new 'Early Iron Age' social value systems. He also developed three models for the eclipse of bronze by iron as the primary metal for tools and weapons.[147] The three models, partially re-formulated by the present author, are as follows:

1. *Gradual displacement*: ironworking was gradually developed during a prolonged phase of diminishing bronze use.
2. *Rapid replacement*: iron was introduced rapidly for utilitarian purposes, as a consequence bronze was equally rapidly abandoned.
3. *Bronze crisis*: following a severe reduction in the quantity of bronze in circulation, there was a period of low-intensity metal use in which iron gradually replaced bronze. Two different variants can be suggested within this model:
   a. The supply of bronze was interrupted, necessitating the accelerated development of ironworking to produce an alternative metal;
   b. The social value of Standard Bronze was undermined, and the bronze standard was replaced by an alternative basic value system.

As iron was still rare in north-west Europe in the 9th-8th centuries BC, the first two models can effectively be rejected.[148] And, considering the large quantities of bronze available in the Late Bronze Age, there is no obvious reason why the bronze supply should suddenly have vanished. For these reasons, Needham concluded that the bronze crisis was caused by normative, not technological change: the abrupt devaluation of Standard Bronze as a means of social (and religious) communication. According to Needham, after the 'collapse', a new value system was introduced in lowland Britain, based on the control of land and agricultural production, food storage and redistribution.[149]

The profound transformation at the Bronze/Iron transition in lowland Britain described by Needham recalls the situation around 800 BC in central and eastern France. Pierre-Yves Milcent summarizes the crisis succinctly: "During Early Ha C, in the first two thirds of the 8th century BC, a climatic, socio-economic, and cultural value crisis actually impacts Hallstattian societies in Gaul. This crisis marks the break between the Bronze and Iron Ages. It corresponds to deep changes: abandonment of settlements on high positions and fortified sites, scattering of settlements, disappearance of metallic hoards on land, scarcity of metallic objects immersions in rivers, dislocation of long distance networks from the Late Bronze Age, moving from cremation without tumulus to inhumations under mounds, real development of iron metallurgy, disappearance of 'pictogram' style decoration on fine potteries and abandonment of the Late Bronze Age Continental élite set, etc."[150]

As stated by Milcent, alongside the cessation of bronze hoard deposition, the abandonment of defended hill settlements is the most noticeable feature of the cultural disjunction at the end of the Bronze Age over the whole area of the West Hallstatt culture.[151]

[146] The quotations are taken from Needham 2007: 39; 58; 60.
[147] Needham 2007: 49 and 50 fig. 3.
[148] For the earliest iron artefacts in France, see Jambon et al. 2022.
[149] Needham 2007: 58: "The broad transformation ... from social power vested in the control of exchange networks, to that based on control of land and agricultural production, is very much a feature of the Late Bronze Age/Earliest Iron Age transition; indeed, it is perhaps the essence of the transition." — An analogous change to a new value system has been proposed by Pierre-Yves Milcent for Atlantic France. After the bronze collapse, in the Early Iron Age large enclosed settlements with extensive food storage capacity (storage pits and raised granaries) appeared, which now seem to represent the centres of large agro-pastoral domains belonging to the new élite. See Milcent 2017a: 104; 2017c: 93 ff.
[150] Milcent 2017a: 103 f.
[151] For example, France: Milcent 2009: 469 fig. 18; 471 fig. 20; Bavaria: Ostermaier 2012: 195; 208-212; Bohemia: Chytráček and Metlička 2004: 19 map 1; 20 map 2; 123 f.

In summary, Needham added a very important fifth proposition to the Standard Bronze hypothesis: (5) The collapse of the social value system based on Standard Bronze necessitated the restructuring of the social order and the reorganization of society according to new principles. The Standard Bronze system relied on widely-shared attitudes to bronze, a cultural norm; the system was, therefore, inherently vulnerable to normative change. At the Bronze/Iron transition, the traditional conceptualization of bronze was undermined, it was no longer deemed suitable for social transactions or as a means of communication with the gods. Naturally, the effects of the collapse of the Standard Bronze system would not have been uniform everywhere – they would be stronger in regions in which élite groups relied in good part on the control of bronze exchange networks to maintain their positions of authority and power. In these societies, the display of prestigious bronze artefacts and the dedication of bronze votive offerings to the gods played an essential role, and the collapse of the Standard Bronze system was liable to lead to fundamental changes in economic and social organisation: system collapse.

The schematic map on Figure 55 shows a wave of cultural change advancing through Europe. This implies that the process was somehow 'unavoidable', in the words of Stuart Needham "a chain reaction that could not have been rebuffed by any single cultural group". As explained above, the cessation of hoarding was not primarily the result of technological change (the replacement of bronze by iron for utilitarian artefacts), but instead the effect of normative change. This entails that the rapid depreciation in the social value of bronze was caused by the transmission of knowledge about and attitudes to the new metal, iron. Obviously, we will never know exactly how this took place. But we do know that iron tools and weapons were already in use in the eastern Balkans, in the Carpathian Basin, and in the area north-east of the Alps during the 9th century BC. We also know that in eastern France, Switzerland, Germany, and Poland iron was treated as a high-status metal during the 9th century BC, used to manufacture elaborate and prestigious weapons and implements (see Chapter 9.3 and Figure 48). It was surely the knowledge of the new metal, and the high status associated with it, which spread as far as the Atlantic Zone and undermined the social value of Standard Bronze. Following this reasoning, the introduction of the technology of iron production in the East Mediterranean and the Aegean, and the spread of this innovation through south-east and Central Europe, should be understood as the ultimate cause for the widespread cessation of utilitarian bronze hoard deposition in these areas.

The end of utilitarian bronze hoard deposition within a short space of time ca. 800 BC, both in the Atlantic Zone in France and Britain, and in the Urnfield culture between central France and Moravia/Lower Austria, is the clearest sign for the collapse of the Standard Bronze system. If our arguments are correct, and the cessation of hoard deposition was caused by the abrupt depreciation of the social value of bronze, this normative change must have been communicated rapidly across central and north-west Europe. What makes this normative change particularly important is the fact – predicted by Stuart Needham – that it tends to be accompanied by a wider cultural disjunction, a general crisis or system collapse.

There is a fascinating phenomenon connected with the cessation of utilitarian bronze hoard deposition at the Bronze/Iron transition which sheds light on the Standard Bronze value system. This was described and discussed by Christoph Huth in an article published twenty-five years ago.[152] The hoards of the Bronze Age typically contain functional artefacts (complete or fragmentary, used or unused) and raw material (complete or fragmentary ingots, casting cakes and casting debris) which all, in essence, had a convertible metal value – as metal which could be weighed, exchanged, melted down (comparable with silver or gold bullion) or recycled. After the demise of the Standard Bronze system, in a number of European regions votive hoard deposition resumed, but with a completely different character: now containing non-functional, as-cast axes made of technically unusable, non-standard copper alloys. The most famous examples are the hoards of Armorican axes, but this practice is also documented in southern England (Sompting and linear-facetted axes), in the Low Countries (Geistingen axes), in the north-western Iberian Peninsula (palstaves with casting-jets and palstaves of Samieira type), in south-east Spain (*lingotes-hacha*), in Albania, Montenegro and Dalmatia (Albano-Dalmatian axes), and around the

[152] Huth 2000.

Caput Adriae (*pani a piccone*, axes of Šempeter type, etc.).[153] We encountered an example of this practice in Chapter 9.4, with the miniature socketed axes found in the latest bronze hoards in the Carpathian Basin, which were clearly never meant to be functional, utilitarian implements.[154]

In his discussion of the Late Bronze Age hoards of the Atlantic Zone and the Early Iron Age Armorican axes, Pierre-Yves Milcent comes to the following conclusion: "In summary, the two series of hoards in Atlantic Gaul, that of the Late Bronze Age and that of the Early Iron Age, reflect the strict succession of two very different pre-monetary systems. The Early Iron Age series is based on genuine primitive money ('axes' which are designed to be technically unusable), and replaces the earlier, more simple system based on quantities of bronze objects which had been secondarily 'defunctionalized', and sometimes fragmented according to the needs of an exchange calibrated by weighing. In this perspective, the transition to the Iron Age, in the 8th century BC, corresponds well to a rupture, at least in the Massif Armoricain, involving the establishment of new standards of premonetary transaction, and the creation of objects purely of exchange value."[155]

Unfortunately, the interpretation of the phenomenon of as-cast, non-functional axes cannot be pursued further here, but two basic features deserve emphasis. Firstly, in all the areas in which the phenomenon is observed, axes become axe-tokens, apparently used as a kind of special-purpose money, or 'sacred money'. The important point in our context is that the non-functional axes demonstrate an abrupt and overt dissociation from the essential basis of the Standard Bronze value system: the convertible material value of the standard bronze alloy. Secondly, the fact that the Standard Bronze system was rejected in this specific, radical manner in so many different areas of Europe can only be explained by the existence of a value system and conceptualization of metals which was widespread in the European Metallurgical Province during the Bronze Age. The Bronze/Iron transition was accompanied by fundamental normative changes. The new forms of special-purpose money introduced in some areas – non-functional axes made of useless alloys – can be understood as the radical antithesis of the traditional basis of the Bronze Age value system.

9.7 Discussion and conclusions

Our critical review showed that the supposed evidence for the introduction of iron in Europe before the 11th century BC, for example from Lăpuş and Rozavlea in Romania, Gánovce in Slovakia, or Bargeroosterveld in Holland, is not sufficiently convincing – at least on the basis of the available published evidence. Even during the 11th and 10th centuries BC, signs of an 'innovation horizon' are still weak in Central Europe. Some iron knives in the Carpathian Basin and three bimetallic artefacts from Bavaria and Switzerland, all probably dating to the 10th century BC, are the most significant representatives of this initial horizon of iron use (Figure 46). The scatter of small objects which purportedly date to the 11th or 10th century BC, such as rings, 'awls', 'burins' and rivets, is difficult to interpret, partly because they mainly derive from chance discoveries or unsystematic excavations.[156]

Viewed on a larger scale, a clear east-west gradient is apparent. During the 11th and 10th centuries BC, iron objects are more numerous to the east of the Carpathian Mountains than in Central Europe (compare Figures 26 and 46). At this time, iron is still completely absent in central and western France,

[153] Huth 2000; see also: Buttler and Steegstra 2002 (Geistingen axes); Galán Domingo 2005 (palstaves in the north-west Iberian Peninsula); Milcent 2017b (Armorican axes); Renzi 2010 (lingotes-hacha); Roberts et al. 2015 (southern England); Turk 2018 (Slovenia); Žeravica 1993: 32 ff. (Albano-Dalmatian axes).

[154] See the comments in Dietrich 2021: 756: „Auffallend sind geringe Größe und Gewicht ebenso wie die kupferne Färbung des Metalls, die auf wenig oder kein Zinn schließen lässt. Es handelt sich klar um Stücke ohne praktische Funktion, die am ehesten als speziell zur Niederlegung hergestellte Votive angesprochen werden können." — A related practice is seen in a hoard from the Island of Ouessant, off the coast of Brittany, in which the socketed axes and adzes are between 3.8 and 4.3 cm long. See Roussot-Larroque and Le Bihan 2004; Milcent 2017b: 722. — In both cases, the non-functional nature of the votive objects is expressed by their miniaturisation.

[155] Milcent 2017b: 731 (my translation).

[156] See also the comments at the end of Chapter 12.1.

the British Isles, and northern Europe. Similarly, in the Balkans iron artefacts are much more common in the east (Bulgaria) than further west. Iron appears in the archaeological record relatively late in northern Italy and southern France, where the new metal was first introduced in the course of the 8th century BC.

In Chapters 5, 8 and 9, the introduction of iron and ironworking in Central and south-east Europe has been described in five stages:

1. *Emergence and expansion of the Stamped Pottery complex*: The Stamped Pottery complex originated in the Thracian Plain (Pshenichevo I), where iron artefacts were already being manufactured at the beginning of the 10th century BC. The expansion of the complex during the 10th and 9th centuries BC transformed the cultural geography of the regions between the Iron Gates and the Dnister, and reflects the pre-eminent influence of the innovative iron-using communities in Thrace (see Figure 43). In a later stage of the Stamped Pottery complex, the developed iron industry of the Basarabi culture (with the Bâlvăneşti-Vinţ series of hoards) played an important role in the westward and northward transmission of ironworking during the 8th century BC.
2. *Decline and demise of the Fluted Ware* koinè: During the 10th century BC, we can observe a retreat of the Fluted Ware *koinè* in the area between the central Balkan Peninsula and Moldavia. This ‘roll back’ can be explained by the loss of influence of an economic and value system based on the production, exchange, and display of bronze, which had its epicentre in the Gáva culture in the north-east Carpathian Basin. In the central Balkans, this transition – from the Belegiš II-Gáva to the Bosut culture – is marked by a profound economic and cultural disjunction.
3. *Cessation of utilitarian bronze hoard deposition*: During the 10th and 9th centuries BC, the deposition of hoards with utilitarian bronze implements came to an end around the Lower Danube, in the central Balkans, and in a large part of the Carpathian Basin (see the schematic map on Figure 54). This clearly indicates a reconceptualization of the social value of bronze: tools and weapons of bronze were no longer deemed suitable as offerings to the gods. By the end of the 10th century BC, the manufacture of bronze swords and other significant élite accoutrements made of bronze had come to an end (e.g. Figure 50). This general tendency of impoverishment happened in parallel with the decline and demise of the Fluted Ware/Gáva *koinè*.
4. *System collapse in the Carpathian Basin*: At ca. 900 BC, the previously existing power structures in the Carpathian Basin dependent on bronze production and distribution ‘imploded’, leaving a void. At the same time, an influx of equestrian warrior nomads from the North Pontic steppe led to disruption and drastic socio-economic reorientation; communities in the Alföld adopted a non-sedentary economy as mobile pastoralists. Following the crisis, iron was used widely for utilitarian artefacts, especially weapons with Pontic-Caucasian affinities (Figure 53).
5. *End of the Standard Bronze value system*: In the Urnfield culture between central France and the area north of the Alps and in the Atlantic Zone in western France and Britain, the deposition of hoards with utilitarian bronzes ceased almost completely ca. 800 BC (Figure 55). As already established for the Lower Danube, the central Balkan Peninsula and the Carpathian Basin, this abrupt devaluation of bronze as a means of social and religious communication corresponds to a profound reconceptualization of the status of metals over this vast geographical area. In the previous value system, Standard Bronze had a convertible material value and could be used as a kind of currency.[157] The adoption of iron for weapons and other implements in the Carpathian Basin and in the area north-east of the Alps during the 9th century BC provides a plausible explanation for the abrupt reconceptualization of bronze further to the west and north-west (see Figures 48 and 53). The use of iron as a decorative metal and for the manufacture of bimetallic artefacts is indicative of the prestigious status of the new metal in a wide area, including eastern France, Switzerland, southern and northern Germany, and Silesia. According to this scenario, the status of Standard Bronze was undermined by the growing prestige of the new metal.

[157] Ludwig Pauli neatly characterized this as „eine Änderung des Geldsystems im weitesten Sinne“. See Pauli 1985: 201.

From our review of the evidence, we have learned that in a series of regions along the Danube, and reaching westwards as far as the Atlantic Zone, the Bronze/Iron transition took place at a time of profound cultural and economic transformation and reorientation. As explained above, this has been established by eminent archaeologists such as Rastko Vasić for the central Balkans, Carola Metzner-Nebelsick for the Carpathian Basin, Pierre-Yves Milcent for France, and Stuart Needham for Britain. This is a particularly interesting observation, because it shows that in these regions, the concept of a Bronze Age/Iron Age transition is not merely an antiquarian convention: the concept refers to significant historical processes.[158]

In the above summary, the developments described in each of the five stages have been presented as if the introduction of iron and/or the rejection of bronze was of essential importance for the profound cultural and economic changes described in each of the regional case studies. As I have tried to show, in this way it is possible to formulate a coherent narrative as a sequence of consecutive structural changes which proceeded along the Danube, a chain of events sharing the adoption of iron and/or the rejection of bronze as the common thread or *Leitmotiv*.

Similar ideas were already expressed by Georg Kossack in an article published in 1980, in which he discussed the radical changes that took place during the 10th century BC in the Carpathian Basin and the regions to the east and south-east: „Denn ungefähr zur gleichen Zeit begann das Jahrhunderte hindurch stabile karpatenländische Kommunikationssystem unter vielfacher Lösung weiträumigster Kontake auseinanderzufallen und in seiner Wirkkraft nach außen zu erlöschen. Es öffnete sich ostwärts des Karpatenbogens und entlang der Donau unter Bildung neuartiger Kulturen (Cozia, Ostrov, Babadag, später Basarabi) dem Schwarzmeerraum. Die Gründe dafür kennen wir noch nicht. Es bleibt bloße Vermutung, wenn man annimmt, daß die damals einsetzende Eisenproduktion das Gleichgewicht zwischen den Anforderungen an die Güterproduktion und deren Leistungsfähigkeit stören und den Zerfall festgefügter Ordnungen beschleunigen mußte".[159] Kossack suggested that the onset of iron production might have been an important causal factor behind the formation of the Stamped Pottery complex and the downfall of the Fluted Ware/Gáva *koinè* (for the distribution of the Post-Fluted Ware cultures, see Figure 43).

We are confronted with the fundamental question: Why is the Bronze/Iron transition in these specific regions marked by such radical cultural and economic transformations? The progressive, wave-like advance of the Bronze/Iron transformation from Thrace along the lower and middle Danube, via the Carpathian Basin, to the north Alpine area and the Atlantic Zone, described in our five-stage scenario, suggests that it is necessary to apply a large-scale model. These questions are discussed further in Chapter 12.3-4.

[158] For a discussion of the system collapse in Central and north-west Europe at the Bronze Age/Iron Age transition, see Chapter 12.3.
[159] Kossack 1980: 137.

List 9.1. Iron finds dating to the 11th-10th centuries BC in the area between eastern France and Moldavia (see Figure 46). — For Figure 46: 14-16, see Chapter 8.2 and Figure 60; for Figure 46: 27-34, see Chapter 6 and Figure 26.

France

Champigny (Dép. Aube), inhumation grave discovered by workmen in 1879: two small iron rings and another object of iron (resembling a punch enclosed in a bronze sleeve). Jambon et al. 2022: 511 cat. no. 2.
Custines (Dép. Meurthe-et-Moselle), from the bed of the Moselle: bronze spearhead with remains of two iron rivets (one for fixing the casting core). Miketta 2017: 268 cat. no. FR-15; Jambon et al. 2022: 511 cat. no. 3.

Belgium

Han-sur-Lesse (Prov. Namur): bronze spear ferrule with iron rivet. Miketta 2017: 236 cat. no. BL-1.

Switzerland

Nidau (Ct. Bern): bimetallic spearhead with bronze socket and iron blade. Miketta 2017: 239 cat. no. CH-5.
Saint-Aubin-Sauges (Ct. Neuchâtel): bimetallic knife with bronze hilt and iron blade. Miketta 2017: 239 cat. no. CH-7.

Germany

(?)Babenhausen (Lkr. Darmstadt-Dieburg): iron ring, supposedly from an urn grave found in 1880, but documentation is lacking. Miketta 2017: 146 note 110; 251 cat. no. DE-13.
Bad Nauheim, Grave excavated in 1878: iron rivet in the side of a birch-bark vessel; fragmentary iron ring, diameter 4.2 cm. Wilms 2017.
Dresden-Coschütz, 'Heidenschanze': iron pin with profiled biconical head (Figure 47). Miketta 2017: 251 cat. no. DE-11; Jünger 2020: pl. 63: A.
Neudegg (Lkr. Donau-Ries): bimetallic sword with bronze hilt and iron blade. Miketta 2017: 259 cat. no. DE-30.

Czech Republic

Buchlovice (okr. Uherské Hradiště), Holý Kopec: bronze knife with iron rivet. Salaš 2012: 350 fig. 1: 1.
Horní Lideč (okr. Vsetín): bronze sword with three iron rivets. Miketta 2017: 246 cat. no. CZ-12.
Jenišovice (okr. Mělník), hoard in a pottery vessel, found in 1897: iron ring. Miketta 2017: 242 cat. no. CZ-3.
(?)Maškovice (okr. Litoměřice), bronze hoard in a pottery vessel, discovered during ploughing in 1853: remains of an iron chain, originally 12.5 cm long. Miketta 2017: 242 f. cat. no. CZ-4.
Staňkovice (okr. Louny), Grave 7: iron awl or burin. Bouzek 1978; Miketta 2017: 244 cat. no. CZ-9.

Austria

Völs (Bez. Innsbruck-Land), Graves 31 and 37: iron awl or pin fragments. Miketta 2017: 233 f. cat. no. AT-6.

Slovakia

Chotín (okr. Komárno), Grave 108: iron knife. Miketta 2017: 275 cat. no. SK-2.

Hungary

Budapest-Békásmegyer, Grave 347: iron knife with bronze rivet. Miketta 2017: 270 cat. no. HU-1.
Sopron-Krautacker (Kom. Győr-Moson-Sopron), Grave 79: iron awl or pin fragment. Personal communication, Carola Metzner-Nebelsick (Munich).

Romania

(?)Bobda (jud. Timiş), Grave 10: 'iron ornaments', possibly including a pendant and an iron finger ring or bracelet. Moga 1964: 296.
(?)Câţcău (jud. Cluj), hoard: 'piece of iron' inside the hilt of a bronze solid-hilted sword. Bader 1991: 163 f. no. 382; pl. 55: 382.
Cernat (jud. Covasna), pit-house 1 in the defended settlement 'Vârful Ascuţit': socketed chisel, trunnion axe, double-axe, knife, 12 tongue-shaped billets (Figure 45). Székely 1966.
Hida (jud. Sălaj), hoard: bimetallic knife. Petrescu-Dîmboviţa 1978: 149 no. 261; pl. 260: A23.
Teleac (jud. Alba), defended settlement: fragment of an iron socketed axe and two indeterminate fragments; possibly also a tongue-shaped iron billet. Vasiliev et al. 1991: 126 ff.; 212 fig. 16: 3; 213 fig. 17: 5.

List 9.2. Iron and bimetallic knives dating to Ha B (see Figure 48). — After Miketta 2017: 219 list 1c, with some changes and additions.

France

Saint-Romain-de-Jalionas (Dép. Isère): iron solid-hilted knife inlaid with bronze, and with two decorative bronze rings. Miketta 2017: 269 cat. no. FR-19; Jambon et al. 2022: 511 cat. no. 10; 513 fig. 9.

Switzerland

Saint-Aubin-Sauges (Ct. Neuchâtel): bimetallic knife. Miketta 2017: 239 cat. no. CH-7.

Germany

Albersdorf-Kaiserberge (Kr. Dithmarschen), Grave 1: bimetallic knife. Miketta 2017: 248 cat. no. DE-1A.
Aurich (Lkr. Aurich): bimetallic knife. Miketta 2017: 248 cat. no. DE-2.
Tellingstedt (Kr. Dithmarschen): bimetallic knife. Miketta 2017: 250 cat. no. DE-7.
Teugn/Thronhofen (Lkr. Kelheim), Grave 24: bimetallic knife. Hohlbein 2016: 333 cat. no. 1226; Miketta 2017: 261 cat. no. DE-38.
Zülow (Lkr. Ludwigslust-Parchim): bimetallic knife. Miketta 2017: 250 cat. no. DE-8.

Czech Republic

Brno-Obřany (okr. Brno-město), Grave 169: iron knife (Figure 52: 4). Miketta 2017: 245 f. cat. no. CZ-11.
Hostomice nad Bílinou (okr. Teplice): iron knife. Miketta 2017: 241 f. cat. no. CZ-1.
Hradec Králové, Slezské Předměstí (okr. Hradec Králové): iron knife. Miketta 2017: 242 cat. no. CZ-2.
Mutěnice (okr. Hodonín), Grave 1: iron knife. Miketta 2017: 246 cat. no. CZ-13.
Plaňany (okr. Kolín): iron knife. Miketta 2017: 243 cat. no. CZ-6.
Podolí (okr. Brno-venkov): iron knife. Miketta 2017: 246 f. cat. no. CZ-14D and perhaps 14B.
Rataje nad Sázavou (okr. Kutná Hora): iron knife. Miketta 2017: 244 cat. no. CZ-8.

Austria

Franzhausen, Nußdorf ob der Traisen (Bez. St. Pölten), 'Kokoron' cemetery: iron knives in Graves 35, 62, 119, 123 and perhaps Grave 347. Lochner and Hellerschmid 2016.
Hadersdorf-Kammern (Bez. Krems-Land), Grave 21: iron knife. Miketta 2017: 234 cat. no. AT-7.
Kleinklein (Bez. Leibnitz), Hochschusterwald, Grave 24: iron knife. Lippert 2013: 37; 38 fig. 5; Miketta 2017: 78 f.; 235 f. cat. no. AT-10 (the iron knife from Masser-Kreuzbauer, Grave 17 probably dates to the start of the Hallstatt period).
Stillfried (Bez. Gänserndorf), Grave 12: iron knife. Miketta 2017: 235 cat. no. AT-9A.

Poland

Pawłów Trzebnicki (pow. Trzebnica): bimetallic knife. Miketta 2017: 274 f. cat. no. PL-6.
Wrocław-Grabiszyn (Wrocław), Grave 88: bimetallic knife. Miketta 2017: 275 cat. no. PL-7.

Slovakia

Babinec (okr. Rimavská Sobota): iron knife. Miketta 2017: 275 cat. no. SK-1.
Chotín (okr. Komárno), Grave 108: iron knife. Miketta 2017: 275 cat. no. SK-2.
Rybník (okr. Levice): iron knife. Miketta 2017: 276 cat. no. SK-4.

Hungary

Budapest-Békásmegyer (Kom. Budapest), Grave 347: iron knife with bronze rivet. Miketta 2017: 270 cat. no. HU-1.
Szombathely-Zanat (Kom. Vas), Grave 4: iron knife. Miketta 2017: 271 f. cat. no. HU-6A.

Slovenia

Škocjan-Brežec (Obalno-kraška region), Grave 272: iron knife. Miketta 2017: 279 cat. no. SL-2B.
Tolmin (Goriška region), Grave 417: iron knife. Miketta 2017: 279 cat. no. SL-3.

Romania

Hida (jud. Sălaj), hoard: bimetallic knife. Petrescu-Dîmboviţa 1978: 149 no. 261; pl. 260: A23.

List 9.3. Bronze objects dating to Ha B decorated with iron inlays or applications (see Figure 48). After Berger (2012; 2014) and Miketta (2017), with some changes and additions.

France

Chavéria (Dép. Jura), Tumulus 9: sword. Jambon et al. 2022: 515 no. 20.
(?)Humes-Jorquenay (Dép. Haute-Marne): sword. Jambon et al. 2022: 516 and fig. 12: 2.
Saint-Michel-de-Maurienne (Dép. Savoie), from the Thyl: sword. Jambon et al. 2022: 516 no. 21.
Saint-Paul-Trois-Châteaux (Dép. Drôme): sword. Jambon et al. 2022: 516 no. 22.

Switzerland

Geneva (Ct. Geneva): bracelet.
Grandson-Corcelettes (Ct. Vaud): sword, bracelet.
Mörigen (Ct. Bern): swords, bracelets, knife.
Pully-Chamblandes (Ct. Vaud), Grave 70: pin.
Zürich-Alpenquai (Ct. Zürich): anklet, pins.

Germany

Blaubeuren-Asch (Alb-Donau-Kreis), Tumulus 6: sword.
Bruck an der Alz (Lkr. Altötting): sword.
Dessau-Kühnau (Dessau-Roßlau): sword.
Feichten an der Alz/'Wald an der Alz' (Lkr. Altötting): sword.
Flachslanden (Lkr. Ansbach): sword.
Gailenkirchen (Lkr. Schwäbisch Hall): sword.
Haina/Römhild (Lkr. Hildburghausen): pin. Kade 1925: 10 fig. 3; Neumann 1963: 21; 197; 37 fig. 9: 13; Peschel 1981: 546; 574 no. 331.
Kronach (Lkr. Kronach), 'Heunischenburg': spearhead.
Künzing (Lkr. Deggendorf), Graves B and F: swords.
Nächstenbach (Rhein-Neckar-Kreis): sword.
Pfaffenhofen an der Zusam (Lkr. Dillingen an der Donau): sword.
Riedlingen (Lkr. Donau-Ries): sword.
Straubing-Sand (Straubing), Grave 148: anklets.
Töging am Inn (Lkr. Altötting): sword.
Trochtelfingen (Lkr. Reutlingen), Tumulus II, Grave 1: pin.
Unterkrumbach (Lkr. Nürnberger Land): sword.
Unteruhldingen (Bodenseekreis): pin.
Wesel (Kr. Wesel): sword.
Zuchering (Ingolstadt), Grave 316: pin.

Austria

Helpfau-Uttendorf (Bez. Braunau): sword.
Obereching-Sankt Georgen (Bez. Salzburg), Grave 70: pin.
Salzburg-Maxglan (Bez. Salzburg): knife.

Poland

(?)Czysta (pow. Słupsk): sword.
Gamów (pow. Racibórz): sword and dagger.
(?)Witkowo (pow. Słupsk): sword.

Chapter 10
Italy

The subject of the earliest iron in Italy has been reviewed comprehensively in recent decades by several authors, so that it is relatively easy to gain an overview of the present state of research. In a number of articles, Filippo Delpino collected possible examples of iron objects from Bronze Age contexts.[1] With the aid of scientific analyses, Delpino and his colleagues were able to show that many of these supposed examples of early iron, for example residues of iron oxide on bronze artefacts in Late Bronze Age hoards, were in fact caused by natural processes.[2] In view of this useful research, potential evidence for early iron was subsequently treated much more critically. Regional studies have been published for Sicily by Rosa Maria Albanese Procelli and for Sardinia by Fulvia Lo Schiavo.[3] Raffaele De Marinis and Claudio Giardino contributed authoritative surveys of the evidence.[4] And recently three articles on the introduction of iron in Italy have been published in the proceedings of a conference held in 2016 at Calafell in Catalonia.[5]

Very early dates have been claimed for some iron objects. The earliest is the small 'awl', only 15 mm long, from Collective Grave 21 in the cemetery of Selvicciola near Ischia di Castro (Prov. Viterbo). The cemetery was used both during the Copper Age (Rinaldone culture) and the Early Bronze Age, as radiocarbon dates between the second quarter of the 4th and the end of the 3rd millennium BC confirm.[6] At this early date, implements made of iron are exceptional and without further scientific analyses it is impossible to say how the 'awl' was produced. As it is so small and the shape so unspecific, the possibility cannot be excluded that the 'awl' is a recent intrusion, perhaps the remnant of a modern nail. An iron finger ring was discovered in Grave 21 at Castelluccio di Noto (Prov. Siracusa, Sicily), which dates at the latest to the 15th century BC. It is possible that the ring was imported from the Aegean or the East Mediterranean, and Claudio Giardino is of the opinion that the finger ring was made from meteoritic iron.[7] However, in their recent article, Marco Pacciarelli and Francesco Quondam regard the context as questionable.[8] The two iron 'rods' from another Sicilian tomb, Thapsos, Grave 48 (Priolo Gargallo, Prov. Siracusa), may not have belonged to the original inventory; the grave was disturbed before the excavation and the 'rods' could derive from the modern activity at the site. Grave 48 contained Mycenaean (LH IIIA) pottery, and the original burial probably took place in the 14th century BC.[9] Finally, an enigmatic metallic object has been reported from excavations at the *nuraghe* Antigori (Sarroch, Prov. Cagliari) in Sardinia. It is described as a poorly preserved (corroded and oxidised) semi-circular fragment of sheet iron, ca. 3 cm long, which is attached to a piece of lead.[10] The fragment was found associated with Mycenaean and Cypriot pottery (LC II), and the context probably dates to the 13th century BC. Without scientific analyses, it is an open question if the metallic object truly represents the remains of an iron artefact.

While the evidence from these four sites is difficult to interpret conclusively, it is clear that the iron objects are not sufficient to demonstrate an exceptionally early start of iron production in Italy. Furthermore, they can hardly be regarded as imports, considering that wrought iron was unknown (or exceedingly rare) in Cyprus and the Aegean before the 12th century BC. The ring from Castelluccio is a possible

[1] Delpino 1988; 1990; 1993.
[2] Delpino et al. 2004.
[3] Albanese Procelli 1994; 2001; Lo Schiavo 1988a; 2005.
[4] De Marinis 2004; Giardino 2005. — See also Pare 2017: 38 ff.
[5] Pacciarelli and Quondam 2020 (central and southern Italy); Lo Schiavo and Milletti 2020 (Sardinia); Paltineri et al. 2020 (northern Italy).
[6] Grazzi et al. 2012.
[7] Albanese Procelli 1994: 58 fig. 1; 1996: 124; 119 fig. 3: d; 2001: 241. — Giardino 2005: 496.
[8] Pacciarelli and Quondam 2020: 30.
[9] Albanese Procelli 1994; 2001: 241; 2003: 99-103. — The iron 'rods' have a maximum length of 9.5 cm. — Albanese Procelli (2001: 241) recommends that the supposed context of the Thapsos 'rods' should be treated with caution.
[10] Ferrarese Ceruti et al. 1987: 17; 24; Atzeni et al. 2005: 161; Lo Schiavo 2005: 403; 2013: 112; Lo Schiavo and Milletti 2020: 78 no. 2.

exception; the hypothesis that it is made of meteoritic iron, as Claudio Giardino suggested, should be tested by metallographic analysis.

10.1 Southern Italy

Early iron artefacts, dating before the 9th century BC, are not yet known from Apulia, but this could possibly be explained by the fact that graves of the Final Bronze Age are extremely rare in this part of the Italian Peninsula. However, at two settlement sites there is evidence for early iron production. Remains of metalworking have been uncovered at Coppa Nevigata (Manfredonia, Prov. Foggia). During excavations in 1909, Angelo Mosso found several kilograms of slag, remains of a smelting furnace and corroded iron objects. The slag, which Mosso believed derived from iron smelting, was found at a depth of 50 cm in layers of the Final Bronze Age, together with 'Mycenaean' and Iapygian Protogeometric pottery.[11] These finds should therefore be assigned to the 11th or 10th century BC, although today the published contexts are generally regarded as unreliable.[12] However, Claudio Giardino recently located some remains from the wall of a furnace or forge from Mosso's excavations in the Museo Archeologico Nazionale in Naples, which seem to confirm that ironworking took place at the site.[13] Unfortunately, owing to the unsatisfactory documentation of the excavation, it still remains uncertain whether the evidence for ironworking truly came from undisturbed contexts of the Final Bronze Age. In the second case, iron smithing slag and remains of a forge or smelting furnace have been found at Otranto (Prov. Lecce), in 'cantiere 3'.[14] Iron was certainly being manufactured at Otranto in the Early Iron Age, but it is uncertain whether production already began during the Final Bronze Age.

Calabria has more conclusive evidence for the early introduction of iron. In the settlement at Broglio di Trebisacce (Prov. Cosenza), excavations uncovered a forge pit belonging to a blacksmith's workshop. The pit had two phases of use: the first probably belongs to the phase *Bronzo Finale* 2 (11th century BC), and the second to the 10th or 9th century BC (*Bronzo Finale 3/Primo Ferro* 1).[15]

Marco Pacciarelli has argued that the iron spearhead from Grave 4/1929 from the cemetery of Castellace (Oppido Mamertina, Prov. Reggio Calabria) should be regarded as the earliest iron artefact in Italy.[16] However, as the only other object in the grave was a whetstone, the chronology cannot be regarded as reliable. In his discussion of the cemetery, Pacciarelli emphasized the close relations of the grave goods with Albania.[17] He discussed the possibility that the introduction of ironworking in Calabria could have taken place in the context of contacts across the Strait of Otranto with the eastern coast of the Ionian Sea. Indeed, iron spearheads were already in use in southern Albania during the 10th century BC, as we have seen in Chapter 8.1 (Lofkënd, phase III).

Some bimetallic dirks, with bronze hilts and iron blades, from Calabria and Basilicata merit a detailed discussion. In the case of the piece from San Leo (Palmi/Gioia Tauro, Prov. Reggio Calabria), only a small part of the iron blade is preserved, and the original length cannot be ascertained.[18] The hilt shares typological similarities with related bronze weapons from Sicily (Modica, Prov. Ragusa; Molino della Badia, Prov. Catania) and Calabria (Roggiano Gravina, Prov. Cosenza), which belong in the phase *Bronzo Finale* 3.[19] A further bronze hilt from a bimetallic dirk, today housed in the British Museum, was found in Armento (Prov. Potenza) in Basilicata; it was probably manufactured slightly later, already in the Early

[11] See Mosso 1909: 311-329; Cazzella 1991: 50-51; Giardino 2005: 500. — The author is grateful to Claudio Giardino (Rome) for helpful advice concerning ironworking at Coppa Nevigata.
[12] See, for example, Pacciarelli and Quondam 2020: 32.
[13] Giardino 2017: 101-106.
[14] Orlando 1996: 233-236; Giardino 2017: 106 f.
[15] Peroni and Vanzetti 1998: 15-19; 58; Vanzetti 2000: 145 f.; Alessandri et al. 2004; Pacciarelli and Quondam 2020: 30; 32.
[16] Pacciarelli 1999a: 41 f. fig. 34: 43; 66 f.; 2000b: 179 f.; Pacciarelli and Quondam 2020: 30.
[17] Pacciarelli 1999a: 67 ff.
[18] Pigorini 1900: 191 ff.; Bianco Peroni 1970: 105 cat. no. 285; pl. 42: 285; Costamagna 1999: 23 note 4 and fig. 13: 9; 2000: 226; Pacciarelli 1999a: 66; Albanese Procelli 2001: 244; Pacciarelli and Quondam 2020: 32.
[19] Guzzo 1982; La Rosa 1989: 24 fig. 18; Giardino 1995: 24 fig. 11: 1.2.

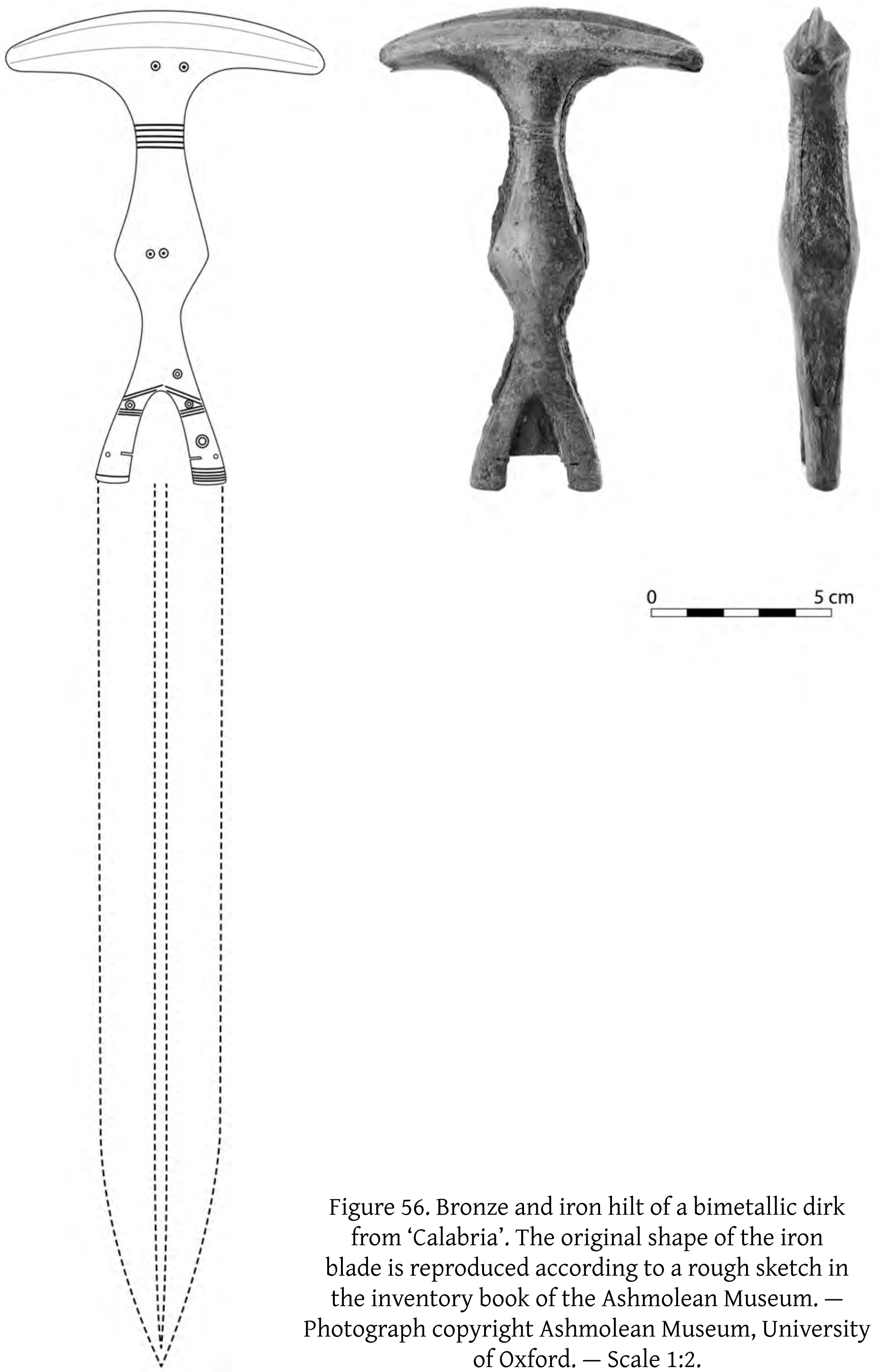

Figure 56. Bronze and iron hilt of a bimetallic dirk from ‘Calabria’. The original shape of the iron blade is reproduced according to a rough sketch in the inventory book of the Ashmolean Museum. — Photograph copyright Ashmolean Museum, University of Oxford. — Scale 1:2.

Iron Age.[20] Bimetallic dirks were manufactured until the end of the 9th century BC, as examples from the cemetery of Incoronata (Prov. Matera) demonstrate.[21]

Another bimetallic dirk does not have an exact provenance. It was acquired by Arthur Evans in Naples in 1889, and it is only recorded that it came from ‘Calabria’ (Figure 56). It was originally 37.3 cm in length, but today only a small fragment of the iron blade survives. Four ribs at the top of the grip, some bundles of slanting lines and some dots-and-circles are visible and are all that remain from the original decoration

[20] Bietti Sestieri and Macnamara 2007: 82 cat. no. 227; 104 pl. 48: 227; Pacciarelli and Quondam 2020: 37 note 7 (*Primo Ferro* 1).
[21] For Incoronata, Grave 230, see Chiartano 1994: pl. 41.

of the bronze hilt.[22] The hilt has a very characteristic shape, with slender shoulders and a pronounced rhomboidal thickening on the grip. These unusual features are also found on dirks from Crete, indicating that the Calabrian weapon was manufactured after the 10th century BC.[23] As mentioned in Chapter 8.1, the Calabrian dirk has a close parallel from the cemetery of Psar in south-east Albania.[24] This underlines the close relationship between southern Italy and Albania during the Early Iron Age, which continued during the 8th century BC (see the discussion of swords of Basarabi-Novi Sad type in Chapter 8.6).

The excavations conducted by Paolo Orsi in 1922 and 1923 in the Early Iron Age cemetery of Torre Galli near Drapia (Prov. Vibo Valentia, Calabria) brought to light the most important complex of early iron artefacts in Italy.[25] As Marco Pacciarelli explains, Torre Galli is the only site in Italy in which iron objects were used regularly as grave furnishings at the very beginning of the Iron Age.[26] In his 1999 monograph, he divided the graves into two chronological phases: Torre Galli 1A (later 10th century BC) and 1B (earlier 9th century BC). In phase 1A already more than 10% of the metal artefacts from the cemetery are made of iron, including dirks, daggers, spearheads, knives, fibulae, and finger rings.[27] The occurrence of iron is summarized in Table 7, using Pacciarelli's chronology. Iron was used most regularly for dirks, the most prominent weapon in southern Italy at the start of the Early Iron Age; only two examples are made entirely of bronze. Knives and finger rings were also frequently made from iron.

It is interesting that the use of iron hardly changed between phases 1A and 1B; in most categories of grave goods, there is only a slight increase in the frequency of iron examples.

The importance of the iron and bimetallic dirks as status symbols is underlined by the use of imported ivory on the hilts; furthermore, the space between the bronze sheet scabbard and the hilt was often fitted with an ivory scabbard mouth decorated with a pair of discs or dots-and-circles. The owners of the dirks doubtless belonged to the highest social rank of the community, whereas the more numerous spearmen had a less elevated social status.[28] The two bimetallic dirks from Graves 34 and 36 resemble the bimetallic weapons discussed above; however, the bronze hilt is formed as a flat tang which originally held organic (ivory) hilt-plates (Figure 57: 1-2). Bimetallic spearheads, with an iron blade and a bronze socket, were found in Graves 34 and 163 (Figure 57: 3-4).

As Raffaele De Marinis noted, the development of iron usage in the Basilicata region during the Early Iron Age can be examined by studying the cemeteries of Incoronata-San Teodoro (Prov. Matera) and Santa Maria di Anglona (near Tursi, Prov. Matera).[29] While Incoronata mainly belongs to the 9th century BC (*Primo Ferro* 1A1-2A1), Santa Maria di Anglona (*Primo Ferro* 2A2-2B) can mainly be assigned to the 8th century BC. In a series of impressive diagrams, Pacciarelli and Quondam illustrate the gradual replacement of bronze by iron in the manufacture of weapons and tools.[30] The following figures provide a simplified summary. Whereas during the 9th century BC (at Incoronata), only 20% of the graves contain an iron object, in the 8th century BC (at Santa Maria di Anglona), the number rises to 75%. At Incoronata, during the first half of the 9th century BC all the knives are of iron, otherwise iron was used for swords and a few spearheads and fibulae. In the second half of the 9th century BC, the proportion of iron spearheads (compared to

[22] Today, the bimetallic dirk is in the Ashmolean Museum, Oxford (accession number 1927.1447).
[23] See, for example, Knossos, North Cemetery Tombs 75 and 218: Kilian-Dirlmeier 1993: pl. 43: 298; 44: 299; Coldstream and Catling 1996: fig. 175: 75.f54; fig. 176: 218.f15. — For more distant parallels from Cyprus, see for example Amathus, Loures Tombs 964 and 967: Stefani and Violaris 2018: fig. 6: c; 11: b); Kouklia, Plakes Tomb 144: Karageorghis and Raptou 2014: pl. 88: 43.
[24] Psar: Aliu 1995: 139; 143 pl. 4: 31.
[25] In all, Orsi excavated 334 tombs in the cemetery; for the full documentation, see Pacciarelli 1999b. — The iron finds from Torre Galli have recently been discussed by Raffaele De Marinis (2004: 67); Claudio Giardino (2005: 500); Albert Nijboer (2010: 11); Marco Pacciarelli and Francesco Quondam (2020: 34 f.).
[26] Pacciareli 1999b: 61 f.
[27] Pacciarelli and Quondam 2020: 34.
[28] Pacciarelli and Quondam 2020: 34 f.
[29] De Marinis 2004: 67.
[30] Pacciarelli and Quondam 2020: 36 fig. 4: A-C; 37 fig. 5.

Table 7. Summary of the occurrence of iron objects in the cemetery of Torre Galli, Calabria.

IA	10 Dirks: 1 bimetallic, 7 iron (80%)	38 Spearheads: 2 iron (5%)	18 Knives: 9 iron (50%)	125 Fibulae: 7 iron (6%)	6 Finger rings: 3 iron (50%)	6 Daggers: 2 iron (33%)
IB	6 Dirks: 1 bimetallic, 5 iron (100%)	32 Spearheads: 2 bimetallic, 1 iron (9%)	23 Knives: 14 iron (61%)	194 Fibulae: 16 iron (8%)	7 Finger rings: 4 iron (57%)	2 Daggers: 0 iron (0%)

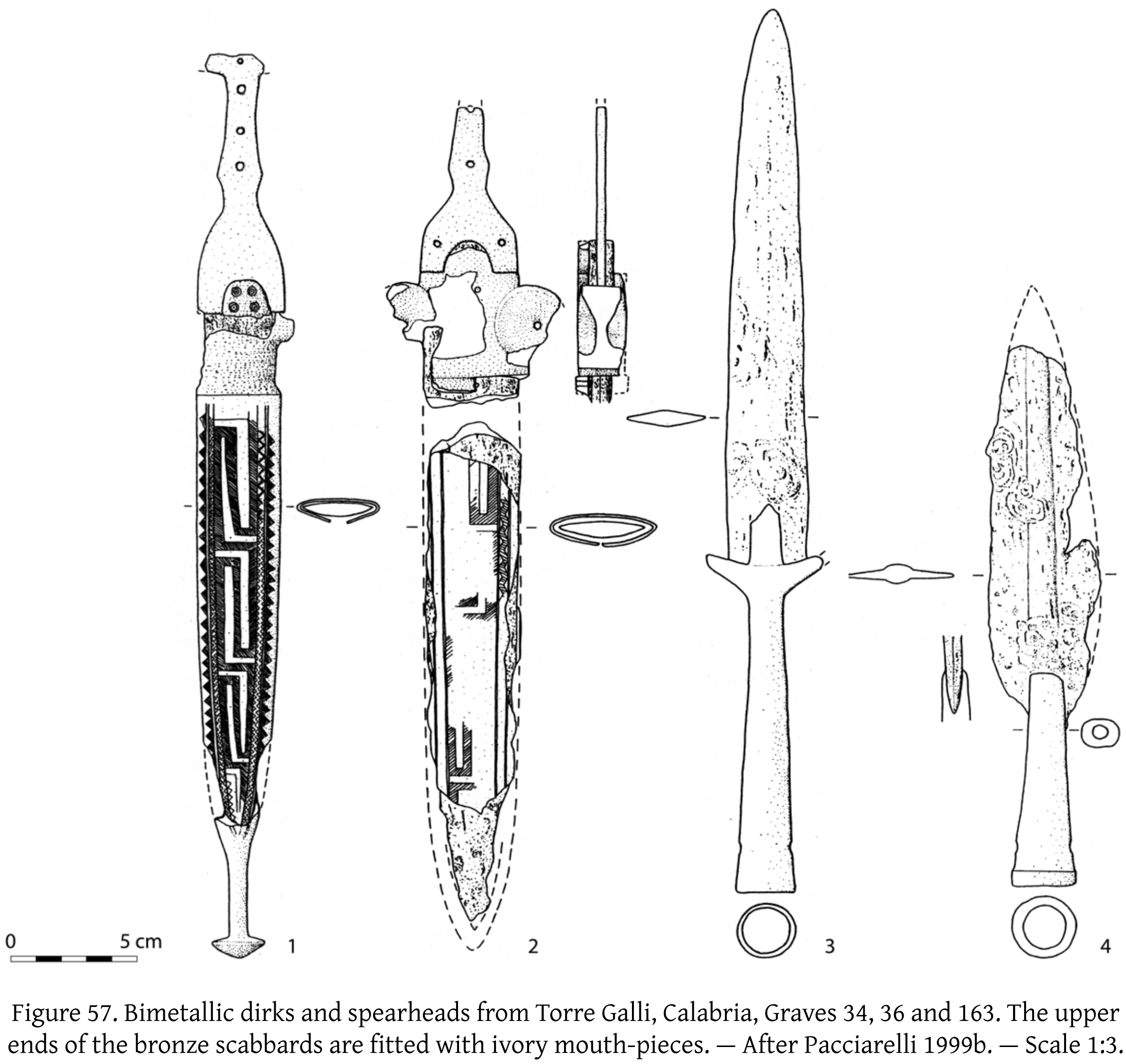

Figure 57. Bimetallic dirks and spearheads from Torre Galli, Calabria, Graves 34, 36 and 163. The upper ends of the bronze scabbards are fitted with ivory mouth-pieces. — After Pacciarelli 1999b. — Scale 1:3.

those of bronze) had risen to 40%; in Santa Maria di Anglona, the proportion of iron spearheads reached 80%, indicating that the transition to full iron production was achieved during the 8th century BC.[31]

It is interesting to compare the development in iron usage in Calabria and Basilicata to the very different situation in Campania. The cemeteries of Pontecagnano (Prov. Salerno) provide the most valuable information. Rafaele De Marinis notes that iron is still rare in the 9th century BC, with less than 5% of tombs containing iron artefacts.[32] The earliest iron weapon is a dirk from Pagliarone, Tomb 889, which dates to the mid- or second half of the 9th century BC.[33] By the 8th century BC, iron had replaced bronze in the production of dirks and short swords, but the majority of the spearheads were still made of bronze.[34] During the 8th century BC, approximately one-third of the graves contained iron grave goods. From this brief summary of the evidence, it is apparent that the adoption of iron in Campania clearly took place much less rapidly than in the regions further south. As Pontecagnano belonged to an enclave of the Villanova culture in Campania, this seems to reflect a more hesitant approach to iron, which is very much a feature of the Villanovan culture in Etruria.

10.2 Sicily

As mentioned at the start of the chapter, the introduction of iron in Sicily has been studied by Rosa Maria Albanese Procelli; the subject has also been treated recently by Marco Pacciarelli and Francesco Quondam.[35]

A fragment of an iron knife blade was deposited together with the bronze objects in the hoard from Modica (Prov. Ragusa).[36] This well-known complex is dated to an advanced stage of *Bronzo Finale* 3. However, most early iron objects from Sicily come from the cemeteries of Molino della Badia and Madonna del Piano near Grammichele (Prov. Catania). Like Modica, these are located in the south-east of the island.[37] At least 14 iron objects have been discovered in the two cemeteries: nine band-shaped finger rings and four knives come from tombs at Madonna del Piano, which have been dated by Rosa Maria Albanese Procelli to *Bronzo Finale* 3, approximately corresponding to the 10th century BC (e.g. Figure 58: 1.2).[38] A further bimetallic two-edge knife or dagger comes from the Molino della Badia cemetery (Figure 58: 3); as it is a stray find it cannot be dated precisely, although a position at the end of the Final Bronze Age or the beginning of the Early Iron Age seems most probable.[39] From a typological point of view, the knives belong to local forms, making it certain that iron artefacts were manufactured in Sicily (see for example Figure 58: 2). The cemeteries in the area of Grammichele maintained close relations with Calabria. Indeed, it is likely that parts of the population immigrated from Calabria during the 11th/10th century BC.[40]

From the above discussion, it is clear that iron was introduced in Calabria and south-east Sicily during the 10th, and possibly already during the 11th century BC. In both areas, iron artefacts were already being manufactured locally during the 10th century BC. The practice of collective burial in rock-cut tombs in Sicily makes it difficult to trace the development of ironworking during the Early Iron Age, before the period of Greek colonisation.

[31] For these figures, see Pacciarelli and Quondam 2020: 34 f.
[32] De Marinis 2004: 68.
[33] Pacciarelli and Quondam 2020: 35 ff.
[34] For the introduction of iron at Pontecagnano, see also Pacciarelli and Quondam 2020: 40-43.
[35] Albanese Procelli 1994; 2001; Pacciarelli and Quondam 2020: 32 ff.
[36] Giardino 1995: 24 fig. 11: 21; Delpino et al. 2004: 73 f.; 69 fig. 10.
[37] See also the iron fragments from Monte Dessueri, Grave 132 (near Mazzarino, Prov. Caltanissetta): Panvini 1998: 37; pl. 34: 1; 2003: 181 f.; Albanese Procelli 2001: 247.
[38] Albanese Procelli 1994; 1996: 119 ff.; 2001: 242 ff.; 2003: 99 f. — For a selection of the iron objects, see Pacciarelli and Quondam 2020: 31 fig. 2: 4-11.
[39] Pacciarelli and Quondam 2020: 32.
[40] Albanese Procelli 1994: 63.

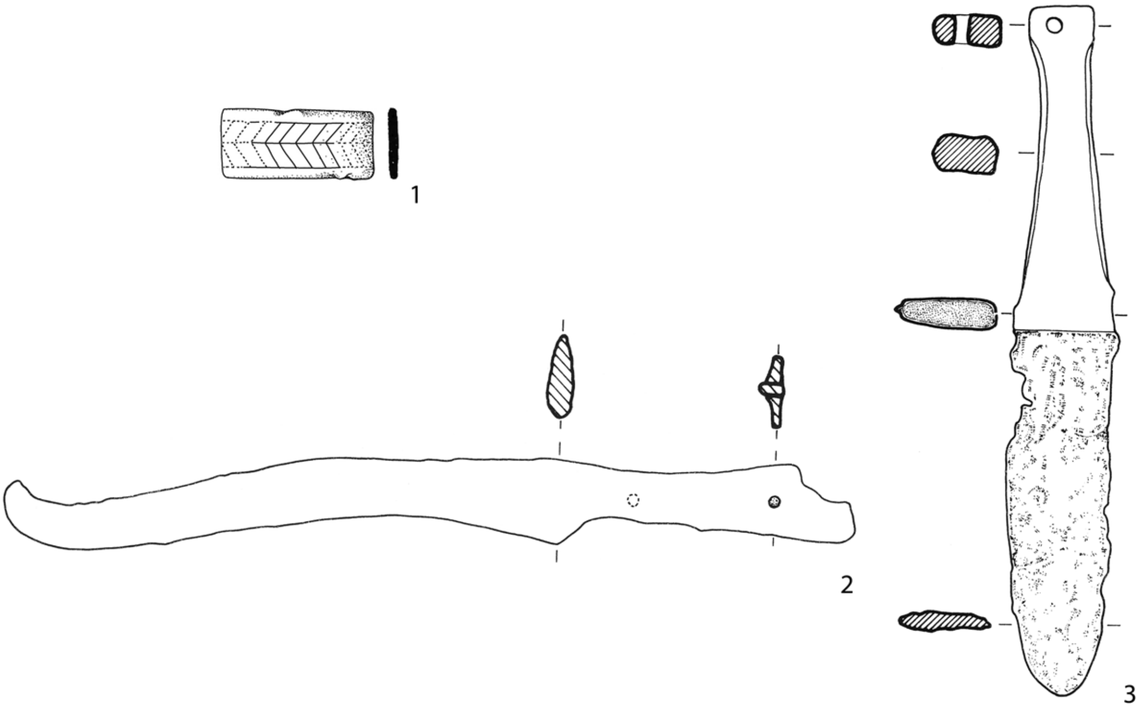

Figure 58. Early iron artefacts from south-east Sicily. — 1 Iron finger ring from Madonna del Piano, Grave 152. — 2 Iron knife from Madonna del Piano, Grave 146bis. — 3 Bimetallic two-edged knife or dagger from Molino della Badia. — 1 after Albanese Procelli 2001: 256 pl. 1: 4; Pacciarelli and Quondam 2020: 31 fig. 2: 11. — 2-3 after Albanese Procelli 2003: pl. 9: 2. — 1 Scale 1:1; 2-3 Scale 1:2.

10.3 Sardinia

Unfortunately, it is at present impossible to survey the introduction of iron in Sardinia in a satisfactory manner. The special nature of the archaeological monuments often makes the excavation results difficult to interpret. For example, the custom of collective burial in Sardinia and the long periods of use of the monumental megalithic tombs (specially the *tombe dei giganti*) generally make it impossible to assign the grave goods to a specific burial. And the stratigraphic contexts of iron artefacts from early excavations in *nuraghi*, potentially from contexts dating to the Final Bronze Age, were often not documented with sufficient care.[41] In several publications, Fulvia Lo Schiavo has collated numerous iron finds which could potentially belong to the Bronze Age.[42]

Sardinia had a close relationship with Cyprus during the Late Bronze Age: this is demonstrated by the presence of imported Late Cypriot pottery, and a range of metal artefacts, particularly the copper oxhide ingots, show that trade between the two islands was relatively intense. Fulvia Lo Schiavo et al. wrote the following: "… there is a great concentration of Cypriot elements, mostly Late Cypriot III bronze-work dating to the twelfth or eleventh centuries B.C., in Sardinia, which inspired a flourishing local production. In the light of this evidence, it is most acceptable that at least some Cypriot metalworkers settled in Sardinia at this time."[43] It is perfectly plausible that these Cypriot craftsmen brought with them the technology of ironworking, and possibly also of extractive metallurgy. This is probably the reason why Lo Schiavo attempted to demonstrate that iron was adopted particularly early in Sardinia. However,

[41] Ferrarese Ceruti et al. 1987: 24 f.
[42] Lo Schiavo 1981: 289 f.; 1988a; 2005. — An up-dated list of iron objects from questionable contexts has recently been published: Lo Schiavo and Milletti 2020. — The author is grateful to Nicola Ialongo (Göttingen) for advice on some of the more obscure Sardinian contexts discussed here.
[43] Lo Schiavo et al. 1985: 63.

when the evidence is reviewed critically, it transpires that most of the putative Late Bronze Age iron find contexts are unlikely or unreliable. There follow brief comments on some of the most frequently mentioned examples.

1. An iron 'stiletto' with a steatite head with openwork decoration (length 15.9 cm) from a *tomba dei giganti* at Motrox 'e Bois (Usellus, Prov. Oristano) seems to be one of the rare iron artefacts from a Final Bronze Age context.[44] The 'stiletto' is badly preserved, and unfortunately its exact original shape is unclear. The function of the object is therefore uncertain, with suggestions including a large pin, a stylus, or a stiletto or small dagger (*pugnaletto*).[45] The chamber of the tomb contained ca. 20 burials, which were provided with numerous furnishings of bronze, silver, bone, and glass. Furthermore, the tomb contained at least 16 amber beads of Tiryns and possibly also of Allumiere type. A date in Late Bronze Age 2 (11th century BC?) seems appropriate for the iron 'stiletto'.
2. A band-shaped iron bracelet was found in the course of excavations in the megalithic tomb at Bidistili (Fonni, Prov. Nuoro).[46] The *tomba dei giganti* was built in *Bronzo Medio* II. According to the excavator, the bracelet belonged to the latest burial in the chamber of the megalithic tomb and was associated with pottery of the 11th century BC.[47]
3. At San Sperate (Prov. Sud Sardegna), excavations in a settlement in Via Monastir uncovered remains of ironworking (smelting?) slag and a piece of iron sheet in the top layer of a well of the Final Bronze Age (*pozzo* S.12). According to Alberto Mossa, this layer dates to the transition from the Final Bronze Age to the Early Iron Age.[48] In view of the small size of the area investigated during the rescue excavation these results should be treated with caution.[49]
4. In the settlement of Brunku 'e s'Omu (Villa Verde, Prov. Oristano), iron fragments and iron slag were uncovered in the uppermost layer in Hut 16, which dates to the Final Bronze Age. However, as the excavators explain, the remains of ironworking derive from "sporadic frequentation successive to the abandonment of the structure".[50]
5. An iron fishing hook was found in *Tomba dei giganti* 1 from San Cosimo (Gonnosfanadiga, Prov. Medio Campidano).[51] Unfortunately, it is unclear to which burial it belonged: the grave was disturbed by tomb robbers, and owing to the acidic soil conditions no bones were preserved. Most of the grave goods belong to a developed stage of the Middle Bronze Age, but the grave was probably re-used during the Late Bronze Age. The chemical composition of a glass bead could even indicate a date in the Iron Age. In view of this brief summary of the available information the complex of grave goods cannot be regarded as a closed assemblage.
6. A large collection of bronze objects was found in the settlement of Sa Sedda 'e Sos Carros (Oliena, Prov. Nuoro), which probably come from votive depositions. Among the finds are also some iron items and iron slag, but today these cannot be assigned to a particular phase of the site.[52]
7. The hoard discovered in 1882 at Forraxi Nioi (Nuragus, Prov. Cagliari) supposedly included iron artefacts, among them an iron axe blade.[53] Unfortunately, the date of the individual depositions, as well as the reliability of the find associations, is unclear.
8. In the case of the iron finds from Sa Mandra 'e Sa Giua (Ossi, Prov. Sassari), the problem lies in the divergent opinions expressed concerning the chronology of the deposition. The hoard of 12 iron implements and 14 bronze artefacts was hidden in a niche in the wall of the *nuraghe*. A socketed implement, eight tanged knives, two fragmentary handles and a twisted rod were all made of iron. The objects apparently belonged to a craftsman who worked wood, bone or ivory. Although Fulvia

44 Contu 1957: 172 f.; pl. 20; Lo Schiavo 1988a: 87 fig. 3; 2005: 401 f.; Usai 2007: 100 f.; Lo Schiavo and Milletti 2020: 78 no. 4.
45 Lo Schiavo and Milletti 2020: 80 ff.
46 Lilliu 2003: 446; Lo Schiavo 2005: 401; Giardino 2005: 501; Lo Schiavo and Milletti 2020: 78 no. 3.
47 Lilliu 2010: 51 f.
48 Lo Schiavo and Milletti 2020: 78 no. 8; 85 f.; Mossa 2016: 3 ff.; 2017: 51 ff.
49 See the comments in Lo Schiavo and Milletti 2020: 85 f.
50 Lo Schiavo and Milletti 2020: 85; Cicilloni et al. 2015: 138 ff.; 144: "sicuramente riferibili ad una frequentazione sporadica successiva all'abbandono della struttura".
51 Ugas 1981: 10 note 45; Bellintani and Usai 2012: 1123 f.; 1128.
52 Tylecote et al. 1984: 140 f.; Lo Schiavo 1981: 283 fig. 288-291; 2005: 401; Lo Schiavo et al. 2005: 152 f.; 223 f.
53 Tylecote et al. 1984: 133 ff.

> Lo Schiavo suggested a date in the Final Bronze Age, Nicola Ialongo drew attention to parallels for some of the objects at Vetulonia and in the hoard from Chilivani (Prov. Sassari), which make a later date more plausible – perhaps in the late 8th century BC.[54]

In most of these cases, either the find associations or the chronology of the contexts in which the iron objects were found are not sufficiently clear. The 'stiletto' from Motrox 'e Bois and the bracelet from Bidistili, both probably dating to the 11th century BC, represent the most convincing evidence for iron before the Early Iron Age. The position at the transition from *Bronzo Finale* to *Primo Ferro* seems plausible in the case of the ironworking remains from San Sperate, although a later date cannot be ruled out. In conclusion, it should be emphasized that the present state of research does not allow more definite conclusions concerning the introduction of iron in Sardinia.

10.4 Central Italy

There is no incontrovertible evidence for iron in the Final Bronze Age in central Italy. Two small iron objects – a small disc and an undiagnostic fragment – have been reported from cremation graves of the 10th century BC from Forchetta di Palano (Allumiere, Prov. Roma) and Colognole (Collesalvetti, Prov. Livorno).[55] The objects have been lost and it is doubtful if they belonged to the original grave inventories.

In Latium vetus, iron was still rare during the 9th century BC. The extensive cemetery at Osteria dell'Osa provides the most significant information. Only two of the 450 tombs of Osa phase II contained iron artefacts.[56] The knife from Grave 153 is exceptionally early, dating to the later 10th century BC (Osa phase IIA1).[57] Interestingly, the grave goods show that this is the grave of a woman of high social rank.[58] The other artefact, from phase IIB, is a strange bimetallic fibula assembled from two broken iron fragments and joined together using a tin alloy, and decorated with tin wire. Considering that it was made from remains of a broken artefact joined together with a cast tin alloy, this object can be understood as persuasive proof that a blacksmith was not working at this time at Osteria dell'Osa.[59] Iron utilitarian artefacts are otherwise almost completely absent before the second half of the 8th century BC (Osa phase IIIB), when the graves contain a wide range of iron artefacts, including dirks, spearheads, knives, spits, fibulae, and pendants.[60] The cemeteries of the Latial culture must be treated with a certain degree of caution, because full-sized tools and weapons were only rarely provided in graves before phase III; nevertheless it does seem significant that there is so little evidence for iron artefacts before the middle of the 8th century BC.

In Etruria, iron was also rare during the 9th century BC.[61] In the cemetery of Veio, Quattro Fontanili, for example, iron is still uncommon in Veio IIA: "The scarcity of iron metallurgy is striking: iron is rare among men and virtually non-existent among women".[62] At this time, over 85% of the knives in male

[54] Lo Schiavo 2004: 241-254; 2009: 249-252; Ialongo 2010: 334 fig. 7: 36; 341 fig. 12: B. — For Chilivani (Ozieri, Prov. Sassari), see Lo Schiavo 1988b; 1990. — Nicola Ialongo also argues for an Iron Age date for the hoard from Su Benticheddu (Oliena, Prov. Nuoro); see Lo Schiavo 1978; 2005: 401; Ialongo 2010. — In the case of the iron and bronze boat models from the cave of Su Fochile (Urzulei, Prov. Nuoro), found in a thick layer of ash, a date in the Iron Age is again possible. See Moravetti 1978; Lo Schiavo 1981: 290; 1990: 545 note 32. — An Iron Age date is likely for the grave (with iron grave furnishings?) from Antas (Fluminimaggiore, Prov. Carbonia-Iglesias); see Ugas and Lucia 1987; Bernardini 2011: 354 f. — For further possible early iron finds, see Santoni 2014: 114 f.; 147 f. — A slag fragment was discovered in Layer 5 of the excavations in the *nuraghe* Corti Beccia di Sanluri. If, as the excavator claims, it is indeed iron slag, then it would be important evidence for iron production ca. 1200 BC (*Bronzo Recente*). See Ugas 1982: 40; 43 no. 89.

[55] Klitsche de la Grange 1891: 224; Torelli 1992: 168 cat. no. 9.2; Pacciarelli and Quondam 2020: 46 note 11. — The grave from Colognole contains a type of serpentine fibula which is well-known in the Allumiere area. See Fugazzola Delpino and Pellegrini 2010: 80; Savella 2015: 96 cat. no. 408.

[56] Bietti Sestieri 1992b: 89 f.; De Marinis 2004: 68 (a knife and a fibula). — Compare Osa phase III, when 15 of the total of ca. 80 graves in the cemetery contained iron artefacts.

[57] Bietti Sestieri 1992a: 559 f.; fig. 3a.8: 7; Pacciarelli and Quondam 2020: 37.

[58] Bietti Sestieri 1992a: 559 f.; 1992b: 131; 151.

[59] For the strange bimetallic fibula from Grave 40, see Bietti Sestieri 1992a: 379 no. 43 unI; 484-486 (C. Caneva and C. Giardino); 750.

[60] De Marinis 2004: 68 note 9. — The only exception before phase IIIB is the iron spearhead from Grave 230 (phase IIIA).

[61] De Marinis 2004: 68. — See also Hartmann 1985; 1989; Corretti and Benvenuti 2001.

[62] Quote from Pacciarelli and Quondam 2020: 43.

graves were still made of bronze.[63] The situation only changed after the second quarter of the 8th century BC (Veio IIB-C), when iron started to replace bronze for utilitarian artefacts.

However, in Etruria iron was adopted comparatively early for the manufacture of dirks, probably because these were prestigious weapons belonging to the social group with the highest status. Iron seems to have replaced bronze for dirks already during the second half of the 9th century BC. The 'Tomb with the Crested Helmet' from Tarquinia, Monterozzi, with an iron dirk in a bronze scabbard and an iron spearhead, is a good example of these high-status weapon graves.[64] The fact that bronze remained the predominant metal for spearheads until the end of the Early Iron Age (third quarter of the 8th century BC) presumably reflects the lower social status of the spear (and the spearmen), recalling the similar situation encountered in the cemetery of Torre Galli in Calabria (see above).[65]

In conclusion, iron was evidently introduced much later in Latium and Etruria than in the south of the Italian Peninsular (Basilicata and Calabria). For example, Pacciarelli and Quondam note that the proportion of iron artefacts at Veio during the 8th century BC (Veio IIA-IIC) did not exceed the level at Torre Galli during the later 10th and earlier 9th century BC (Torre Galli IA-IB).[66] Considering the importance of the Early Iron Age 'proto-urban' centres in Etruria and Latium, it is surprising that they were so slow in adopting the new metal. Presumably there were factors which made the Villanovan and Latial cultures of west-central Italy resistant to the innovation process, as suggested above for the Villanovan enclave in Campania.[67] By contrast, in Abruzzo iron was adopted more rapidly: in the cemetery of Fossa (Prov. L'Aquila), for example, iron grave furnishings were already very common in the second half of the 9th and first half of the 8th century BC.[68]

10.5 Northern Italy

In northern Italy, iron was still unknown during the 10th and 9th centuries BC. In the Villanova, Este and Golasecca cultures of the Po Valley, the new metal was gradually introduced during the 8th century BC.[69]

An iron fragment from the important settlement of Frattesina (Fratta Polesine, Prov. Rovigo), on the eastern Po, could represent an important exception.[70] As Claudio Giardino explains, the iron artefact was excavated in a stratified context (level U4) belonging to an advanced moment of the Final Bronze Age (ca. 11th century BC). It comprises a piece of iron wire, 4 cm long, bent and twisted at one end.[71] Giardino believes that the fragment could come from a violin-bow fibula. However, some doubts have been expressed in the literature regarding the reliability of the stratigraphic context, and the unspecific form of the iron wire makes it conceivable that it is a later intrusion.[72] Considering the wide spectrum of exotic materials known from the settlement and the cemetery, it would hardly be surprising that an iron object should be found at Frattesina. These include 'Mycenaean' pottery, fragments of ostrich egg shell and ivory, which were imported from Apulia (locally produced 'Mycenaean' pottery), the Aegean or the East Mediterranean.[73] It is conceivable that rare iron objects were transmitted to Frattesina by Aegean or Cypriot seafarers or craftsmen. Furthermore, early iron artefacts have been found in nearby

[63] Pacciarelli and Quondam 2020: 43.
[64] Pacciarelli and Quondam 2020: 37; 42 fig. 9: A (Veio); Hencken 1968: 338 fig. 339 (Tarquinia); Bianco Peroni 1970: 126 ff. (scabbards of Pontecagnano type with remnants of iron sword blades, from Tarquinia, Vulci and Vetulonia).
[65] For Veio, see Pacciarelli and Quondam 2020: 42 fig. 9: B.
[66] Pacciarelli and Quondam 2020: 46; 42 fig. 9: D.
[67] Pacciarelli and Quondam (2020: 46) mention both socio-cultural and economic factors which might have hindered the replacement of bronze by iron.
[68] Cosentino et al. 2001: 189 f.; Nijboer 2010: 12 f.; Pacciarelli and Quondam 2020: 46 note 11. — For a later date for the onset of intensive and diversified ironworking at Fossa, see now Acconcia 2019.
[69] De Marinis 2004: 68; Paltineri et al. 2020: 65.
[70] Giardino 2019: 263; 270 ff. — A second iron fragment was a surface find and cannot be dated securely.
[71] Giardino 2019: 269 fig. 3: A; 270 fig. 4.
[72] Pacciarelli and Quondam 2020: 32 note 3; Paltineri et al. 2020: 51 note 1.
[73] Bietti Sestieri 1997: 392 ff. — For the ivory comb of Frattesina type from Enkomi (Cyprus), see Bettelli and Damiani 2005: 22 fig. 1: 12.

western Slovenia (the Karst/Soča region), as explained in Chapter 8.2. Both Frattesina and the centres of the Karst/Soča regions were involved in supra-regional exchange networks, which could offer a plausible explanation for the very early presence of sporadic iron artefacts.

In Bologna, the first iron artefacts appear in graves dating to the first half of the 8th century BC (Bologna IIA). In Bologna IIB, iron becomes more widespread, with the iron finds including knives, palettes, horse bits, bracelets, and fibulae.[74] Iron mainly appears in graves of members of the highest social rank; Grave 776 (mid-8th century BC), with a bronze solid-hilted sword and a bronze *stimulus*, for example, has an iron *sanguisuga* fibula decorated with gold wire and an iron ritual palette.[75] And iron linchpins from two-wheeled vehicles were provided in Benacci, Grave 494 and Benacci Caprara, Grave 39.[76]

In the Este and Golasecca cultures, iron artefacts appear in the archaeological record at approximately the same time as Bologna.[77] Iron is mainly found in the graves of the aristocratic élite, most conspicuously in the form of bimetallic (bronze and iron) objects, especially knives and pins (e.g. Figure 59: 1.2.4).[78] In the 'Tomba del Signore' from Rivoli Veronese, dating to the later 8th century BC, the grave furnishings included a bimetallic sword and an iron spearhead with bronze rings decorating the socket (Figure 59: 3.5).[79] A high-ranking individual from Padova was buried in the second half of the 8th century BC with two iron knives, the larger example provided with a horn pommel terminating in a bronze disc.[80] The knives from the 'Tomba del Re' at Padova and from Este, Ricovero, Grave 236 are exceptionally large (lengths 42 cm and 35 cm respectively), suggesting that they were not only status symbols, but had a special purpose, perhaps as sacrificial implements. In the area of the Golasecca culture, the earliest iron artefact, a bimetallic knife, was found in a grave from Moncucco (near Como), together with a solid-hilted bronze sword.[81]

In the Este culture, iron gradually replaced bronze for utilitarian implements during the 7th century BC. This is illustrated by the choice of metals for certain tools (awls, saws, rasps, files) in a series of graves from Este and Padova.[82] In the Golasecca culture, at around 700 BC iron was even used for constructional fittings on the two-wheeled vehicle in the 'Tomba del Carrettino' in Como-Ca' Morta.[83]

10.6 Discussion and conclusions

From our discussion of the present state of research it transpires that the introduction of iron and the inception of the local manufacture of iron artefacts in Calabria and Sicily took place in the 10th or 11th century BC (Figure 60). Blacksmiths were operating at Broglio di Trebisacce during the 11th/10th century, and perhaps at San Sperate in Sardinia around 900 BC. Evidence for iron smelting has only been found at Coppa Nevigata where, unfortunately, the poor documentation of the excavation makes the suggested position in the Final Bronze Age questionable. The sheer quantity of iron artefacts at Torre Galli makes it likely that iron was already smelted locally by the late 10th century BC. Judging from the evidence from Basilicata, the use of iron increased steadily during the 9th century BC, and in the following century iron had almost completely replaced bronze for utilitarian implements.

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74 Morigi Govi and Tovoli 1979: 21.

75 Pincelli and Morigi Govi 1975: 476 f.; pl. 317: 8; 320: 28.

76 Tovoli 1989: 138; 141; pl. 52: 104; 55: 142. — Pare 1998: 305 fig. 3: 68.

77 Paltineri et al. 2020: 65.

78 For examples, see Paltineri et al. 2020: 52 (e.g. Este, Ricovero 143; 236; Rebato 221; Candeo 302).

79 See Cupitò 2017. — For a useful analysis of the chronology of related late solid-hilted swords, see Baur 2019.

80 Padova, Tomba del Re: Calzavara and Chieco Bianchi 1976: 229 ff.; pl. 47: 14.15.

81 The grave belongs to the phase Golasecca IA2. See De Marinis and Gambari 2005: 204 f.; 221 pl. 8.

82 See e.g.: Este, Ricovero, Grave 236 (second half of the 8th century BC): iron awl, two bronze awls, one bronze saw, two bronze rasps. — Este, Randi, Grave 14 (second half of the 8th century BC): iron awl, bronze awl, bronze saw, bronze rasp. — Este, Ricovero, Grave 235 (first half of the 7th century BC): iron rasp, iron 'palette'. — Padova, Emo Capodilista, Grave 318 (second half of the 7th century BC): bronze saw, iron file, iron rasp, iron hammer-head. — See Gamba et al. 2013: 350 f.; Franzin and Vidale 2016.

83 Bertolone 1957; Pare 1992: pl. 132: B.

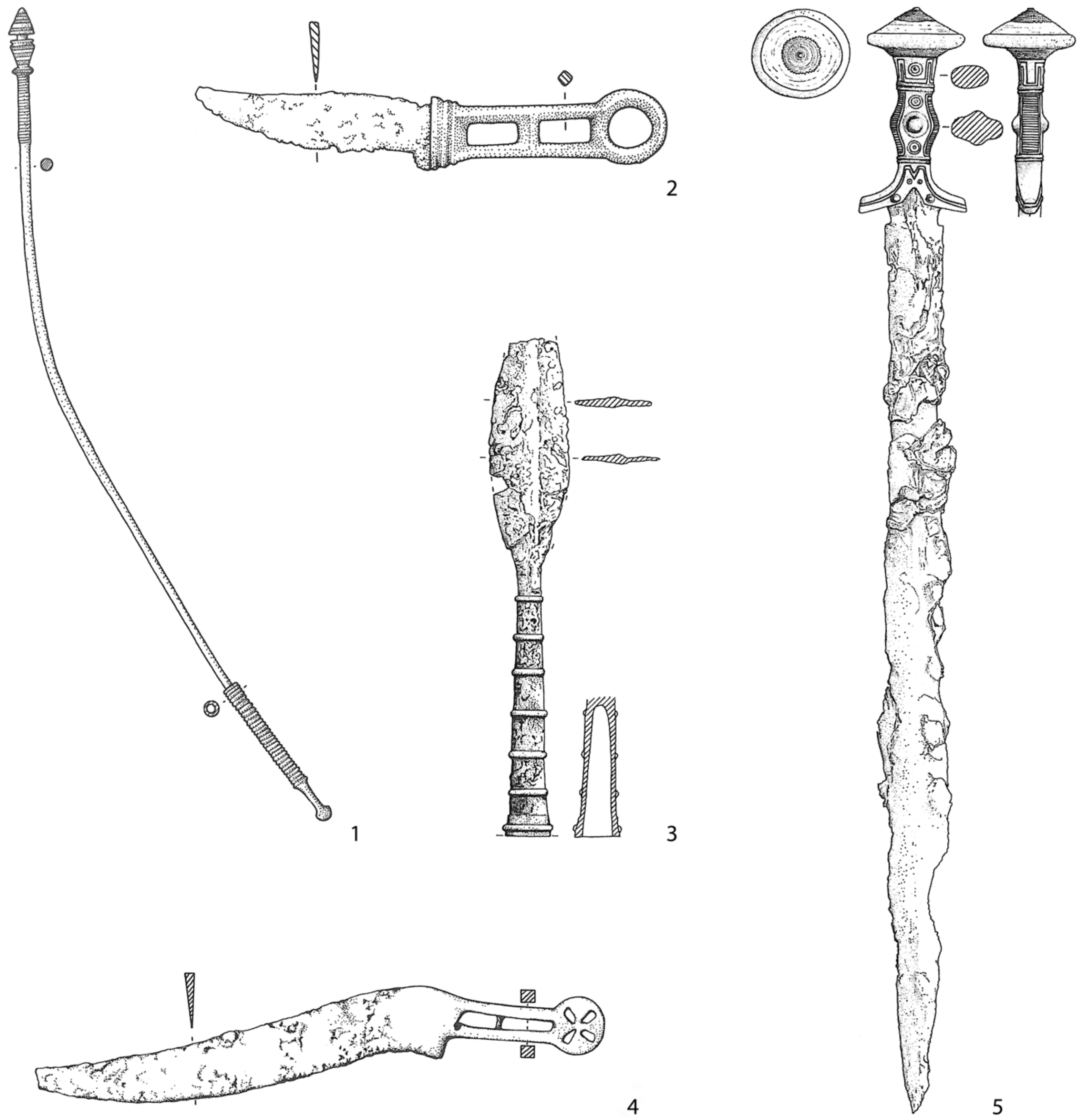

Figure 59. Bimetallic artefacts of the 8th century BC from northern Italy. — 1.2 Este, Casa di Ricovero, Tomb 143 (after Chieco Bianchi and Calzavara Capuis 1985: pl. 14: 4; 16: 12). — 3.5 Rivoli Veronese (after Cupitò 2017: 515 fig. 2: 3.4). — 4 Este, Casa di Ricovero, Tomb 236 (after Chieco Bianchi and Calzavara Capuis 1985: pl. 209: 67). — 1-2 Scale 1:2; 3-5 Scale 1:4.

In the 9th century BC, iron was still uncommon in the Villanova and Latial cultures in Campania, Latium and Etruria; the new metal was gradually adopted for a wide range of artefacts during the 8th century BC. In the area north of the Apennines, iron was completely absent in the Villanova, Este and Golasecca cultures during the 9th century BC; the first iron artefacts in northern Italy appear in the 8th century BC, and are mainly found in high-status graves. The present state of research does not allow reliable conclusions concerning the introduction of iron in Sardinia.

In view of the early and rapid introduction of iron in Calabria and Basilicata, it is surprising that the new technology spread so slowly northwards, and was only adopted in the Villanova culture after a

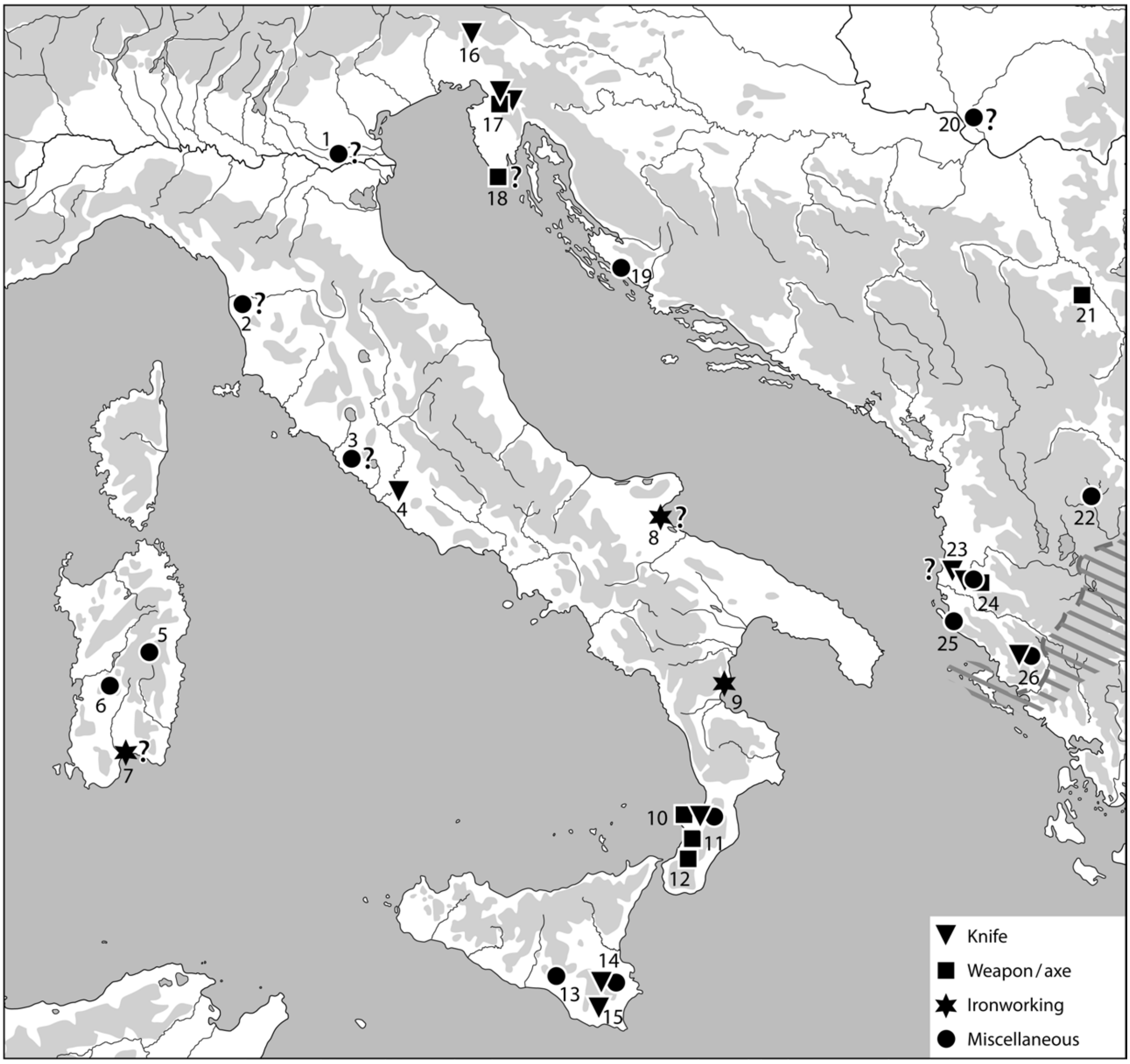

Figure 60. Distribution map of iron objects and evidence for ironworking dating to the 11th-10th centuries BC in the central Mediterranean and western Balkan Peninsula. — 1 Fratta Polesine. — 2 Colognole. — 3 Forchetta di Palano. — 4 Osteria dell'Osa. — 5 Bidistili. — 6 Motrox 'e Bois. — 7 San Sperate. — 8 Coppa Nevigata. — 9 Broglio di Trebisacce. — 10 Torre Galli. — 11 San Leo. — 12 Castellace. — 13 Monte Dessueri. — 14 Grammichele (Molino della Badia, Madonna del Piano). — 15 Modica. — 16 Tolmin. — 17 Brežec, Škocjan. — 18 Pećina na Gradini. — 19 Vrana. — 20 Bobda. — 21 Leskovac, Hisar. — 22 Sivec. — 23 Patos. — 24 Lofkënd. — 25 Vajzë. — 26 Kakavijë.

considerable delay. Marco Pacciarelli and Francesco Quondam speak of "the gap in the adoption of iron that constantly characterizes the mid-Tyrrhenian communities".[84] They discuss several possible explanations for the retarded adoption of iron; unfortunately, the reasons for the apparent hesitant approach or perhaps even resistance to iron in the central Tyrrhenian area remain obscure.[85]

Although research has generally concentrated on a very restricted selection of key centres (particularly Torre Galli, Pontecagnano, Osteria dell'Osa, Veio, Bologna and Este), the chronological gradient from south to north in the adoption of iron in Italy is clearly evident. In some regions, it is noticeable that

[84] Pacciarelli and Quondam 2020: 45.
[85] See Pacciarelli and Quondam 2020: 45 f.

specific types of artefacts appear especially frequently among the earliest iron objects: for example, knives and finger rings in Sicily and at Torre Galli; and knives in the Este and Golasecca cultures. This choice of knives and rings during the initial phase of iron usage seems to be a common feature which has been encountered in other parts of the Ancient World.

In four cases, it has been claimed that iron artefacts should be dated before the 12th century BC. However, owing to their rarity, they are not sufficient to demonstrate local production (smelting) of iron in Italy, and our review of the evidence in Chapters 2-4 has shown that it is very difficult to imagine that iron artefacts were imported from the East Mediterranean or the Aegean at such an early date. It is most likely that the iron objects are recent intrusions, and do not belong to the Bronze Age contexts.

During the Final Bronze Age, the inhabitants of the southern part of the Italian Peninsula and eastern Sicily remained in contact with the Aegean and the East Mediterranean, and there is a strong correlation between the introduction of iron and evidence for long-distance trade during the 11th and 10th centuries BC. While it seems certain that iron was introduced in the context of these sea-borne contacts, it is unclear exactly how the technology was transmitted: by seafarers living across the Strait of Otranto, from the Aegean, or perhaps from Cyprus?[86]

In south-east Sicily, excavations in the cemeteries of Madonna del Piano and Molino della Badia have brought to light numerous graves containing artefacts made of elephant ivory, including a total of 36 combs and the handles of five knives.[87] Ivory combs were found in four of the nine graves with iron objects from Madonna del Piano which were discussed above.[88] Clearly, these ivory finds demonstrate trade with the East Mediterranean in an advanced stage of the Final Bronze Age. Furthermore, the characteristic shape of the combs – with a trapezoidal handle – shows that the ivory was worked locally in Sicily.[89]

In Sardinia, the iron stiletto from Motrox 'e Bois was found in a tomb containing amber beads of Tiryns and probably Allumiere type. As explained in the discussion of the finds from Hordiivka in Ukraine (Chapter 6.2), these amber beads are important evidence for a wide-ranging communication network functioning during the 11th century BC, involving centres in the central and East Mediterranean, the Aegean, and the western part of the Black Sea.

In Calabria, the intensive and systematic research in the plain of Sybaris offers a further example for long-distance trading relations. At Broglio di Trebisacce, where excavations uncovered an early iron smithy, large warehouses with huge wheel-turned storage vessels came to light on the acropolis. These vessels, which sometimes have a capacity of almost 1000 litres, were manufactured by specialist potters who must have learned the technique of making such large vessels from Aegean or East Mediterranean craftsmen. The closest parallels for the vessels are to be found among the cordoned pithoi from the north-eastern Peloponnese and from Cyprus.[90] Remains of ivory-working in the settlement of Torre Mordillo, further inland in the plain of Sybaris, are further evidence for trade with the East Mediterranean.[91] The bronze greaves from Castellace, Grave 2, have parallels in Acarnania (Kouvarás), Achaea (Kallithea), and Cyprus (Enkomi).[92] And, finally, we should recall the East Mediterranean imports from the cemetery of Torre Galli, such as scarabs, hemispherical bronze cups, and ivory.[93] There is also plentiful evidence for close relations between Calabria and Albania, showing that boats must have frequently crossed the Strait of Otranto.[94]

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[86] For further discussion, and the concept of 'Mediterraneanization', see Chapter 12.3.
[87] Albanese Procelli and Chilardi 2005: 95 ff.
[88] Albanese Procelli 2001: 246.
[89] Bettelli et al. 2006.
[90] Bettelli 2002: 106 ff.; Levi and Schiappelli 2004: 99; 108 fig. 15. — For a possible Cypro-Minoan inscription on a pottery sherd from the blacksmith's workshop, see Bettelli 2002: 110 note 161.
[91] Vagnetti 2005.
[92] Pacciarelli 1999a: 39 ff.; 65 f.; Clausing 2002: 162 ff.; Stavropoulou-Gatsi et al. 2012: 255 f.; 255 fig. 7; Jung et al. 2017: 88 ff.; 89 fig. 9.
[93] Pacciarelli 1999b.
[94] See above for comments on the finds from Castellace; the bimetallic dirks from 'Calabria' and Psar; and the iron swords of

This situation is reflected in Homer's account of a voyage by the Greeks from the Ionian Islands ('Taphians'). In their search for copper, the Taphians sailed with a cargo of iron to Temesa. Athena – in the guise of Mentes – speaks to Telemachos:

"I am Mentes, wise Anchialus' son, lord of the sea-going Taphians. Now, as you see, with my ship and crew I beach here, in my journey over the wine-dark sea to men of a foreign tongue, on my way to Temesa, trading for copper and carrying shining iron." (*Odyssey*1: 180-184)

Today, most scholars identify Temesa with Campora San Giovanni (Prov. Cosenza), the most important Early Iron Age centre on the Tyrrhenian coast between Torre Galli and Pontecagnano.[95] The veracity of Homer's account is reinforced by the fact that the hinterland of Temesa is rich in copper ores.[96] According to our knowledge of the development of ironworking, the trading voyage described by Homer probably took place during the 10th or 11th century BC, at a time when iron was still difficult to obtain in Calabria.

It seems that initially iron was mainly used to make prestigious artefacts, and was often associated with burials of high-status individuals, frequently in graves with weapons. Iron was used particularly frequently for dirks, the most prominent weapon at the time of the Bronze/Iron transition. The dirks embellished with ivory from Torre Galli, and the bimetallic weapons from Calabria and Basilicata are particularly notable. The iron dirks are also conspicuous during the 9th century BC in Campania and Etruria, at a time when iron was otherwise only used rarely.

It is interesting that Rosa Maria Albanese Procelli reports that in the cemetery at Madonna del Piano in Sicily, the graves containing iron all contained female burials.[97] Grave 150bis from the excavations of 1970/71, for example, was one of the richest female burials and – uncommon for the cemetery – a cremation. This is possibly the earliest Sicilian context with iron artefacts, and may date as early as the 11th century BC.[98] This association of iron with women suggests that the conceptualization of iron was different in Sicily compared to southern peninsular Italy.

As explained above, in northern Italy iron artefacts were mainly found in graves of the 'aristocratic élite' during the 8th century BC: in Bologna, and in the Este and Golasecca cultures.[99] It is noticeable that in the Este and Golasecca cultures, knives, particularly bimetallic examples, are frequent among the early iron objects. The custom of manufacturing bimetallic artefacts in northern Italy is particularly interesting, because it recalls the similar practice north of the Alps. The earliest examples – from Switzerland – are considerably earlier than in northern Italy, dating to the 10th century BC; bimetallic artefacts became more common during the 9th century BC (see Chapter 9.3). As in the area north of the Alps (see Figure 48), iron was also used to decorate bronze artefacts in northern Italy, for example dress-pins, or as an inlay on a sword found in the Romagna region.[100] Both north and south of the Alps, iron was used to produce prestigious, and not merely functional implements; in northern Italy the fashion emerged considerably later than north of the Alps.

Earlier in this chapter, I noted *en passant* Marco Pacciarelli's statement that Torre Galli is the only site in Italy in which iron objects were used regularly as grave furnishings at the beginning of the Early Iron Age. Even at Torre Galli, only 10% of the artefacts in phase 1A were made of iron. This draws attention to a revealing paradox: according to the established usage in Italian archaeology, the Bronze Age/Iron Age transition, and the concept of the Early Iron Age, only have a rather tenuous relationship

Basarabi-Novi Sad type.

95 On Temesa, see for example La Torre 2006; 2009; De Sensi Sestito 2016; Perri 2022. On the Taphians and Temesa, see Kopanias 2023.

96 For copper mines in the neighbourhood of Temesa, see Strabo 6.1.5; 12.3.23. — On metal ores in the hinterland of Temesa, see Novellis and Veneziano 2011: 268 fig. 1.

97 Albanese Procelli 2001: 242 ff.

98 Albanese Procelli 2001: 245 f. — Note that the early iron knife from Osteria dell'Osa, Grave 153 was also associated with a female of high social rank.

99 See e.g. Paltineri et al. 2020: 65.

100 For the sword found between San Martino in Venti and Santa Aquilina (Prov. Rimini), see Bianco Peroni 1970: 123 no. 340 ('Caprucolo'); Naso et al. 2015: 19 note 28; fig. 8.

with the introduction of iron artefacts or iron technology. Instead, the start of the Early Iron Age refers to a profound transformation of social organization – most clearly visible in the Villanova culture – characterized by the processes of centralisation, proto-urbanisation (poleogenesis), ethnogenesis and (later) state formation.[101] In Italian archaeology, the term 'Early Iron Age' is filled with a specific and significant meaning, and it is important to comprehend the (minor) role of iron in this scheme of periodization. The adoption of iron does not define the start of the Early Iron Age; instead, the diffusion of iron is concomitant with the processes of transformation at the dawn of protohistory in Italy.[102]

[101] For an introduction to this complex subject, see Pacciarelli 2000a; Vanzetti 2004. For a short summary of some different views on the transformation at the transition between *Bronzo Finale* and *Primo Ferro*, see also Iaia 2013: 71 f.
[102] For further discussion, see Chapter 12.2 ('Italy and Iberia').

Chapter 11
The Iberian Peninsula and the Balearic Islands

The introduction of iron to the Iberian Peninsula was first discussed comprehensively by Martín Almagro-Gorbea more than 30 years ago.[1] Subsequently, research by Raquel Vilaça has added much new information from Portugal, giving rise to important new ideas concerning the transfer of technology from the East Mediterranean.[2] The present state of research has recently been summarized and discussed in several important studies.[3] Further regional studies were published in the acts of a conference which took place in 2016 in Calafell (Catalonia).[4] Some recent archaeometallurgical results have also achieved significant advances in our knowledge. These publications provide a very good basis for the following summary of the present state of research.

As there is general agreement among Portuguese and Spanish scholars that the introduction and dissemination of iron in the Iberian Peninsula was triggered by the arrival of seafarers from the East Mediterranean, the evidence for sea-borne contacts with the central and East Mediterranean is an additional aspect addressed in the following pages.

11.1 The Villena Treasure

The famous hoard found in a pottery vessel in 1963 near Villena (Prov. Alicante) contained the earliest iron objects known from the Iberian Peninsula. Villena is renowned for its collection of vessels and ornaments made of precious metals: 11 bowls, two flasks and 28 bracelets of gold, and three flasks of silver. The hoard also contained fragments of amber and two iron objects: a hemispherical pommel (4.5 cm in diameter) covered with gold sheet with openwork decoration, and an iron bracelet (8.5 cm in diameter).[5] The precise function of the pommel is uncertain; it may have served as the terminal of a sceptre or part of a dagger or sword hilt. In the past, widely varying dates have been suggested for the hoard, ranging from the 15th century to as late as the early 1st millennium BC.[6] Today, there is a general consensus that the hoard must be related to the defended settlement of Cabezo Redondo, located at a distance of 6.5 km from the place where the Villena hoard was discovered, especially considering that gold objects with a similar technology have been found in the 'Tesorillo' hoard from the settlement. As Cabezo Redondo was abandoned before the end of the 13th century BC, it follows that the hoard can hardly have been deposited after ca. 1200 BC.

In a very recent article, Salvador Rovira-Llorens, Martina Renzi and Ignacio Montero-Ruiz published the results of scientific analyses of the two iron artefacts from Villena.[7] In both cases, the nickel content was originally greater than 5%.[8] Furthermore, the Ni/Fe and Ni/Co ratios of both objects correspond to the ratios characteristic for meteoritic iron.[9] The authors therefore conclude that it is very probable that the two objects are made from meteoritic iron. According to the similar values of some further trace elements (Gallium, Germanium and Ruthenium), it is likely that both the pommel and the bracelet were made from the same meteorite.

1 Almagro-Gorbea 1993.
2 See for example Vilaça 2006; 2013a; 2013b.
3 Mielke and Torres Ortiz 2012; Ruiz Zapatero et al. 2012; Renzi et al. 2013; Álvarez Sanchís et al. 2016; Gomá Rodríguez 2018.
4 Belarte et al. 2020; Grevey and Gailledrat 2020; Suárez and Renzi 2020; Vives-Ferrándiz and Mata 2020.
5 Almagro-Gorbea 1993: 83 fig. 1: 2; Brandherm 2007: pl. 37: C2; Hernández Pérez et al. 2014.
6 15th/13th century BC: Hernández Pérez et al. 2014: 11. — First centuries of the 1st millennium BC: Almagro-Gorbea 1993: 82; Armbruster and Perea 1994: 84 ff.
7 Rovira-Llorens et al. 2023.
8 Pommel: 5.5% Ni; bracelet: 5.33% Ni. — Rovira-Llorens et al. 2023: 5 table 1 and 2.
9 The identification of meteoritic iron by comparing the Ni/Fe and Ni/Co ratios of the iron-nickel alloy was introduced by Albert Jambon (the method has been explained in Chapter 2.2). — See Rovira-Llorens et al. 2023: 6 fig. 4.

The fact that both of the objects were potentially made from the same meteorite makes it plausible that they were made locally, from a meteorite which landed in Spain. Indeed, no obvious parallels for the bracelet and pommel are known from the East Mediterranean. On the other hand, the location of the Villena hoard near Cape Nao and the Balearic Islands would be ideally suited for sea-borne trade with the East (see Figure 62). Furthermore, the gold finds from Villena and Cabezo Redondo are related to the so-called Villena/Estremoz type, which is mainly concentrated in the south-west of the Iberian Peninsula, renowned for its rich precious metal deposits.[10] If the community at Cabezo Redondo were involved in long-distance trade in precious metals, it is conceivable that the iron objects might have been received from their eastern trading partners as prestigious gifts.

11.2 Phoenician traders and the first colonial foundations

As already mentioned, in the Spanish and Portuguese scientific literature, there is an overwhelming consensus that iron and the technology of iron production were introduced in the course of trade with the East Mediterranean, and specifically with the Phoenicians. In the archaeology of the southern part of the Iberian Peninsula it is customary to distinguish two stages of contact with the Phoenicians: colonial and pre-colonial. According to the traditional chronological scheme, the latter stage corresponds to the last phase of the Final Bronze Age (ca. 9th century BC), whereas the Early Iron Age begins with the foundation of the first permanent Phoenician colonies.[11] The earliest of these settlements were founded on the south coast of Spain in the late 9th and early 8th century BC in locations favourable for trade with indigenous communities, such as promontories or islets close to the mouths of major rivers. The sites are distributed between the Gulf of Cádiz in the west and Alicante (e.g. La Fonteta) and the Balearic Islands (e.g. Sa Caleta, Ibiza) in the east. At first, the settlements had the character of small trading posts; later, some gained considerably in size and became true urban centres with political control over their surrounding territories. The Phoenician traders and settlers had a profound impact on the indigenous communities; this is especially impressive in the case of the Orientalizing culture of the Tartessian élite, which developed during the second half of the 8th and the 7th century BC. Among other things, Phoenician influence is visible in the introduction of wheel-made pottery in Andalusia during the 8th and 7th century BC.[12]

From the beginning, metalworking played an important role in the Phoenician settlements. Iron production is documented by reduction and smithing slags and tuyères in early contexts at Cerro del Villar, Morro de Mezquitilla and Toscanos in the Bay of Málaga, and at La Fonteta (Guardamar del Segura) in Alicante.[13] The ironworking remains from Morro de Mezquitilla are especially early, reaching back to the start of the 8th century BC. At La Fonteta large quantities of smithing slag were found, indicating that ironworking was carried out since around the middle of the 8th century BC. Most of the iron objects from the earliest levels at La Fonteta are iron knives; iron bars (fragmentary roasting spits?) and small iron cube-shaped objects (billets?) were also produced.[14]

Recent discoveries at Huelva and La Rebanadilla (Málaga) have blurred the traditional pre-colonial/colonial distinction: it has become clear that there was a significant Phoenician presence at some settlements considerably earlier than previously thought. Excavations at La Rebanadilla, an islet in the Guadalhorce estuary, have uncovered a ‘sanctuary’ surrounded by remains of ivory- and metalworking associated with Phoenician material (phase IV). The early Phoenician finds from Huelva, located on the estuary of the Rio Tinto, are even more important for our subject. Excavations took place in the Plaza de las Monjas and in Méndez-Núñez Street; unfortunately, as the find contexts were waterlogged and located 5-6 m below the present-day ground level it was impossible to document the stratigraphy systematically.

[10] Perea 2005: 97 fig. 3 (distribution map).
[11] For an excellent introduction to the Phoenician impact, see Mielke and Torres Ortiz 2012.
[12] See Mielke and Torres Ortiz 2012: 275 ff.
[13] Mielke and Torres Ortiz 2012: 271 ff.; Ruiz Zapatero et al. 2012: 154 ff.; Álvarez Sanchís et al. 2016: 153 ff.; Rafel and Armada 2021: 89.
[14] Vives-Ferrándiz and Mata 2020: 147; 146 f. fig. 4-5.

Alongside local Final Bronze Age and Phoenician pottery, sherds from Sardinia and Greece were also brought to light.[15] In addition, Phoenician alphabetic inscriptions, fragments of ostrich eggs, remnants of stone vessels, four lead precision weights, large quantities of elephant ivory (including a tusk weighing over 3 kg), and objects of glass, amber, iron and gold were discovered. Copper, silver and iron slags testify to the activity of metalworkers. The excavations at Huelva are clearly of exceptional importance for the question of the spread of iron metallurgy in the western Mediterranean.

Unfortunately, there are differing opinions on the date of the earliest Phoenician presence at Huelva and La Rebanadilla. While Alfredo Mederos Martín, for example, believes that the Phoenicians were already installed on the south coast of Andalusia since the second half of the 10th century BC, other authors argue that the first Phoenician settlers arrived during the second half of the 9th century BC.[16] These divergent views arise from basing the chronology either on some very early radiocarbon dates, or on cross-dating the Phoenician and Greek pottery. However, Ayelet Gilboa explains that the early pottery from Huelva can be related to Late Iron Age IIA in the Levant and Euboean Subprotogeometric I-III, indicating that the Aegean and Levantine settlers were already present in the first half of the 9th century BC.[17]

These new discoveries demonstrate that there was a significant presence of Phoenician traders along the Andalusian coast already during the 9th century BC. But it must be emphasized that there was an even earlier 'pre-ceramic' stage of trading activity (before the 9th century BC), during which the seafarers did not leave imported pottery in the indigenous settlements. In the 'pre-ceramic' stage, in the absence of imported pottery, it is either impossible or very difficult to distinguish the identity of the agents responsible for the sea-borne trading activity. Therefore, it is difficult to define the role of the Phoenicians in the western Mediterranean before the 9th century BC.

Later Phoenician seafarers certainly did not confine their activities to Andalusia, but travelled up the Portuguese Atlantic coast, possibly as far as southern Galicia (Figure 63: 1). At first, they lived in enclaves in indigenous sites; later they founded true colonies. The earliest sites, located on the Tejo estuary, have radiocarbon dates in the 9th century BC.[18]

11.3 The introduction of iron in Portugal

The inception of the use of iron in Portugal has been discussed in several articles by João Carlos de Senna-Martínez and Raquel Vilaça.[19] In all, 29 iron objects dating to the pre-colonial Final Bronze Age are known, almost all of which come from hillforts. The most frequent class of objects are fragments of knife blades, but four or five fragmentary saw-blades, one iron chisel, and one bimetallic socketed chisel have also been found (for a selection, see Figure 61).[20] The sites are concentrated in the region of the Baiões/Santa Luzia cultural group, which forms the southernmost part of the Atlantic Zone of the Bronze Age.

The high frequency of iron knife blades is significant, because, as Raquel Vilaça states, the one-edged knife with flanged and riveted tang was an innovative form of implement in the Portuguese Final Bronze Age.[21] Some of the Portuguese knives have the typical curved, one-edged blade – as known, for example, from the Aegean and Cyprus during the 12th and 11th centuries BC (e.g. Figure 61: 6-8).[22] However, most of the fragments are from narrow blades which often seem to have had two cutting edges (e.g. Figure 61:

[15] González de Canales et al. 2004; 2006a.b; 2008; 2010; see also Gilboa 2013: 326 ff.
[16] See e.g. Mederos Martín 2021: 136; Suárez-Padilla et al. 2021: 1495 ff.
[17] Gilboa 2022.
[18] See Arruda 2019 with further literature; see also Mederos Martín 2021: 130 ff.
[19] Senna-Martínez 2000; Vilaça 2006; 2013a; 2013b.
[20] According to Raquel Vilaça (2006: 82) the iron knife from Castro de Senhora do Bom Sucesso, Chãs de Tavares (Mangualde, Viseu District) is a stray find, and did not come from the hoard with bronze axes (compare Almagro-Gorbea 1993; Monteagudo 1977: no. 1319; 1341).
[21] Vilaça 2006: 95; 2013b: 54 f.
[22] See two examples from Moreirinha, two examples from Quinta do Marcelo, and one possible example from Monte do Frado: Vilaça 2013a: 633 fig. 2: 3-7.

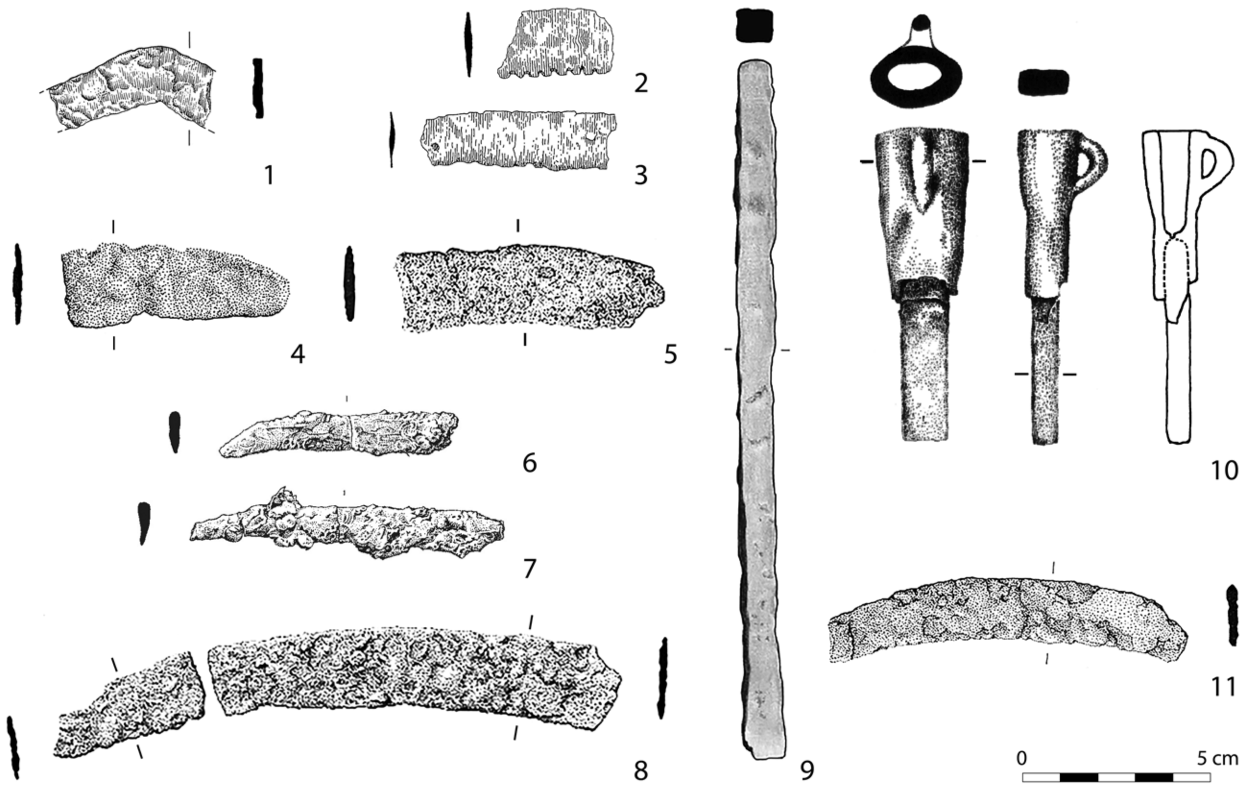

Figure 61. Selection of iron artefacts dating to the 11th-9th centuries BC from Portugal; note that the socketed chisel (10) has a bimetallic construction. — 1 São Julião. — 2.3.5 Monte do Trigo. — 4 Monte do Frade. — 6.7 Quinta do Marcelo. — 8.11 Moreirinha. — 9 Rocha do Vigio. — 10 Baiões, Nossa Senhora da Guia. — 1 after Vilaça 2013a; 2-5.8.11 after Vilaça 2006; 6.7 after Cardoso 2015; 9 after Araque Gonzalez et al. 2023; 10 after Da Silva et al. 1984. — Scale 1:2.

3-5). The latter blades seem to represent a form of implement characteristic for the earliest stage of iron usage in Portugal.

The eight sites with early iron objects will be summarized briefly:[23]

1. Monte do Trigo (Idanha-a-Nova, Castelo Branco District), Layer 2: 11 iron objects, mainly fragmentary blades, from five depositions. Seven radiocarbon dates of the 13th-11th century BC.
2. Moreirinha (Idanha-a-Nova, Castelo Branco District), Layer 2: eight iron objects. Two radiocarbon dates in the 12th-10th century BC.
3. Monte do Frade (Penamacor, Castelo Branco District), Layer 3: one small iron blade fragment. Four radiocarbon dates of the 11th-10th centuries BC.
4. Outeiro dos Castelos de Beijós (Viseu District), 'Sector B': one iron knife blade and two further iron fragments from the workshop of a bronze-smith. The three radiocarbon dates of the 12th-9th century BC do not come from the smith's workshop, but from contexts with an identical find spectrum.
5. Quinta do Marcelo (Almada, Setúbal District), rubbish pit 'Bolsa 2': two or three iron knives, two of which with bronze rivets.[24] Pit 2 is dated by radiocarbon to the 9th century BC.

[23] These details have mainly been drawn from the publications of Senna-Martínez (2000) and Vilaça (2006; 2013a; 2013b). — The radiocarbon dates are not analysed here in depth; for more detailed information, see Vilaça 2013a; Torres Ortiz 2008a; 2008b.
[24] See also Torres Ortiz 2008a: 68 f.; Arruda 2008: 360 f.

6. São Julião (Vila Verde, Braga District), 'Corte 3a', Layer 5: curved iron blade.[25] Four radiocarbon dates of the 10th-9th centuries BC.
7. Castro de Nossa Senhora da Guia (Baiões, Viseu District), from the well-known metal deposition: one bimetallic socketed chisel, the bronze socket was cast onto the iron blade; length of iron blade 3.8 cm.[26] Three radiocarbon dates of the 10th-9th centuries BC.
8. Rocha do Vigio (Évora District), from a hilltop settlement with a single occupation phase: iron chisel.[27] One radiocarbon date of the 9th/early 8th century BC.

The bimetallic chisel from Baiões and some of the knives from Moreirinha, Monte do Frade, and Monte do Trigo have recently been subjected to metallurgical analysis by Albert Jambon and colleagues.[28] This indicated that these knives from the Castelo Branco District were very probably made of iron smelted from local ores, ruling out the possibility that they were imported. The authors also note that the knives were rich in slag inclusions and were made by a blacksmith with rudimentary skills. This supports similar observations made by other authors, that the iron blades would not have been harder or sharper than bronze examples.[29] The chisel from Baiões (Figure 61: 10) is an exception, as it was manufactured with a more advanced technology; the authors suggest that in this case the iron might have been imported.[30]

Further evidence for ironworking during the 9th/8th century BC has been reported from two further sites in Portugal. Iron slag was found in a context apparently dating to the last phase of the Final Bronze Age at São Pedro do Crasto (Santarém).[31] And a further piece of iron slag, weighing 190 g, was associated with an imported bronze lotus-handle attachment in a secondary burial from a megalithic tomb at Nora Velha (Ourique, Beja District).[32]

The radiocarbon dates from Baiões were obtained from short-lived samples (beans/peas); however, they were not directly associated with the metal deposition.[33] Otherwise, the samples were all from charcoal, so it is to be expected that the measured dates are older than their contexts ('old wood' effect). Furthermore, the radiocarbon dates from the individual archaeological contexts (layers, pits) have ranges of 200-300 years, which makes their interpretation difficult.[34] In view of the assumed 'old wood' effect, the later values in the date-ranges are most likely to correspond to the true chronological position of the contexts. According to these considerations, the radiocarbon determinations seem to date the contexts mainly in the 11th, 10th, and 9th centuries BC.

The concentration of the earliest iron finds in the area between the Rivers Douro and Tejo is very conspicuous and demands an explanation (Figure 62). If it is accepted that the new metal and the technology of iron production were transmitted by seafarers from the central or East Mediterranean, the question arises why they visited this specific area in the far west of Europe. In the Portuguese research literature, a connection is drawn with the rich tin and gold deposits in the Beiras region. For example, Ana Margarida Arruda wrote as follows: "All the evidence shows that the Portuguese Atlantic coast was a target of occasional and episodic visits by populations from the Eastern Mediterranean at a moment that can be traced to the period – in radiometric chronology – between the eleventh and tenth centuries. ... The tin and gold of the Beiras region certainly suggest that it was the Tagus and Mondego estuaries that granted access to these metals and thereby indicate that it was on the banks of those rivers that a more permanent settlement of occidental Phoenicians took place."[35] According to Arruda, seafarers from

[25] See also Bettencourt 2000: 31; 123; pl. 61: 9.
[26] See also Da Silva et al. 1984. — Only a small portion of the blade is preserved today.
[27] Vilaça 2006: 92 f.; Araque Gonzalez et al. 2023: 7 ff.; 8 fig. 9; 10: 2.
[28] Jambon et al. 2023.
[29] Ruiz Zapatero et al. 2012: 151; Renzi et al. 2013: 179 f.; Álvarez Sanchís et al. 2016: 151.
[30] Jambon et al. 2023: 115 f.
[31] Gomá Rodríguez 2018: 357.
[32] Vilhena and Grangé 2011: 94 ff.
[33] Vilaça 2008: 384 f.
[34] For a summary of the radiocarbon dates, see also the recent article by Albert Jambon et al. 2023: 111 table 1.
[35] Arruda 2009: 121.

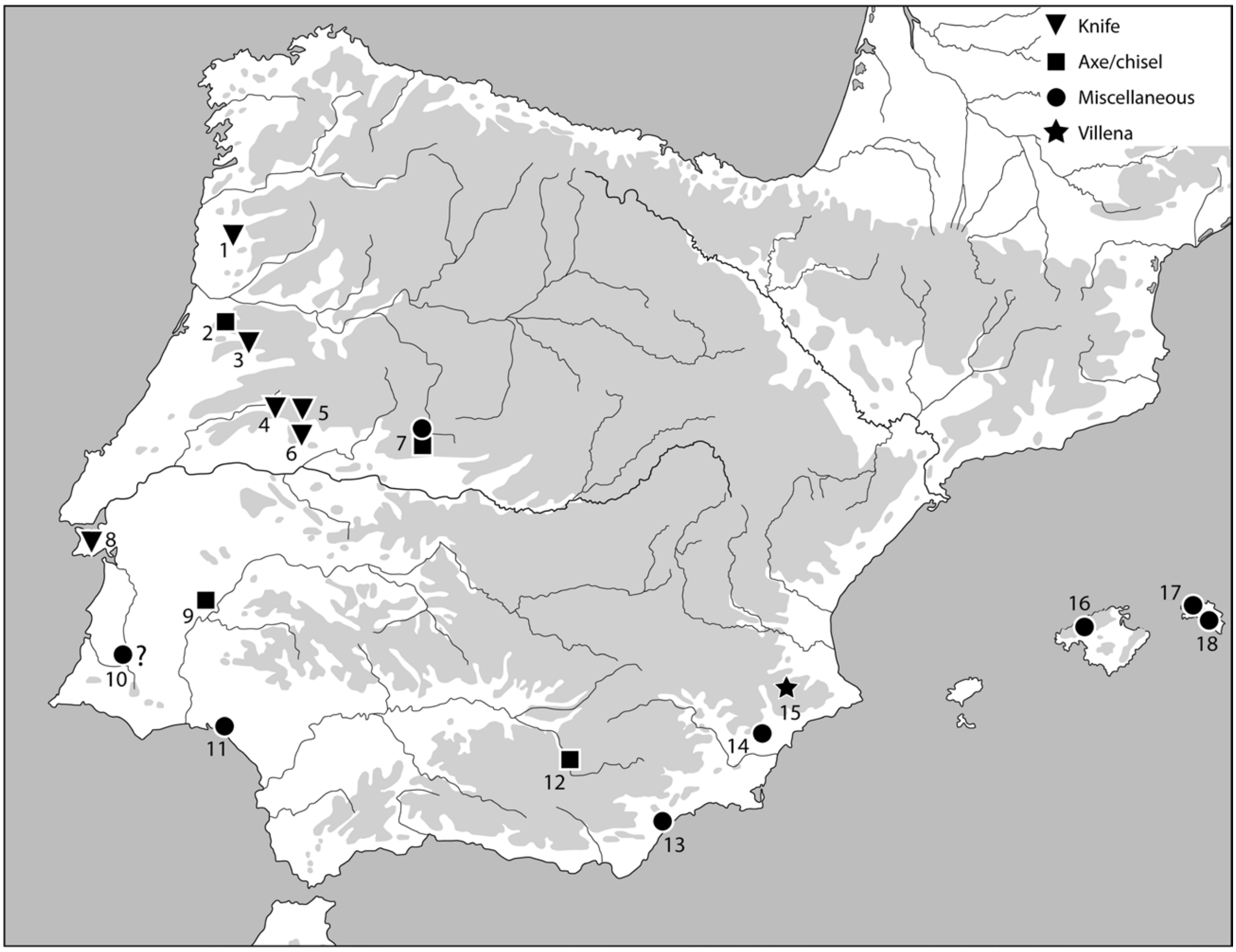

Figure 62. Pre-colonial iron finds (11th-9th centuries BC) from the Iberian Peninsula and the Balearic Islands; the early artefacts of meteoritic iron from Villena are also included on the map. — 1 São Julião. — 2 Baiões, Nossa Senhora da Guia. — 3 Outeiro dos Castelos de Beijós. — 4 Monte do Frade. — 5 Moreirinha. — 6 Monte do Trigo. — 7 Cerro del Berrueco. — 8 Quinta do Marcelo. — 9 Rocha do Vigio. — 10 Nora Velha. — 11 Ría de Huelva. — 12 Campotéjar. — 13 La Encantada. — 14 Peña Negra. — 15 Villena. — 16 Son Matge. — 17 Es Forat de Ses Aritges. — 18 Càrritx.

the East Mediterranean had already been visiting the Portuguese coast for two hundred years before the foundation of the first Phoenician trading posts in the Tajo estuary (see Figure 63: 1).

The gold and tin deposits mentioned by Arruda are found in a belt reaching from the northern part of the Spanish Extremadura (Prov. Cáceres), through central Portugal (Beira Baixa and Alta), as far north as Galicia in north-west Spain.[36] The tin mines were certainly in operation during the Final Bronze Age, as the bronze dagger from a mine shaft at São Martinho de Orgens (Viseu District) and fieldwork at the Cerro de San Cristóbal (Logrosán, Prov. Cáceres) demonstrate.[37] And the many gold artefacts from the south-west and west of the Iberian Peninsula make it more than likely that the gold deposits were being exploited during the Final Bronze Age.[38]

[36] For a schematic map of the Iberian metallic ore deposits, see Bottaini 2011: 104 fig. 1. — For more detailed maps of the tin and gold deposits, see for example Kalb 1980: 59 fig. 23; Cardoso 2004: 209 fig. 159; Pellicer Catalán 2000: 94 fig. 1; Rodríguez-Corral and Rodríguez-Rellán 2023: 5 fig. 3.

[37] Rodríguez Díaz et al. 2013; Vilaça et al. 2014. — The cargo of the shipwreck from Bajo de la Campana (Cartagena, Prov. Murcia), dating to ca. 600 BC, including tin from western Iberia and ivory from north Africa, provides an impression of the possible trading mechanisms during the Final Bronze Age; see e.g. Mederos Martín and Ruiz Cabrero 2004.

[38] See for example the distribution maps in Perea 2005.

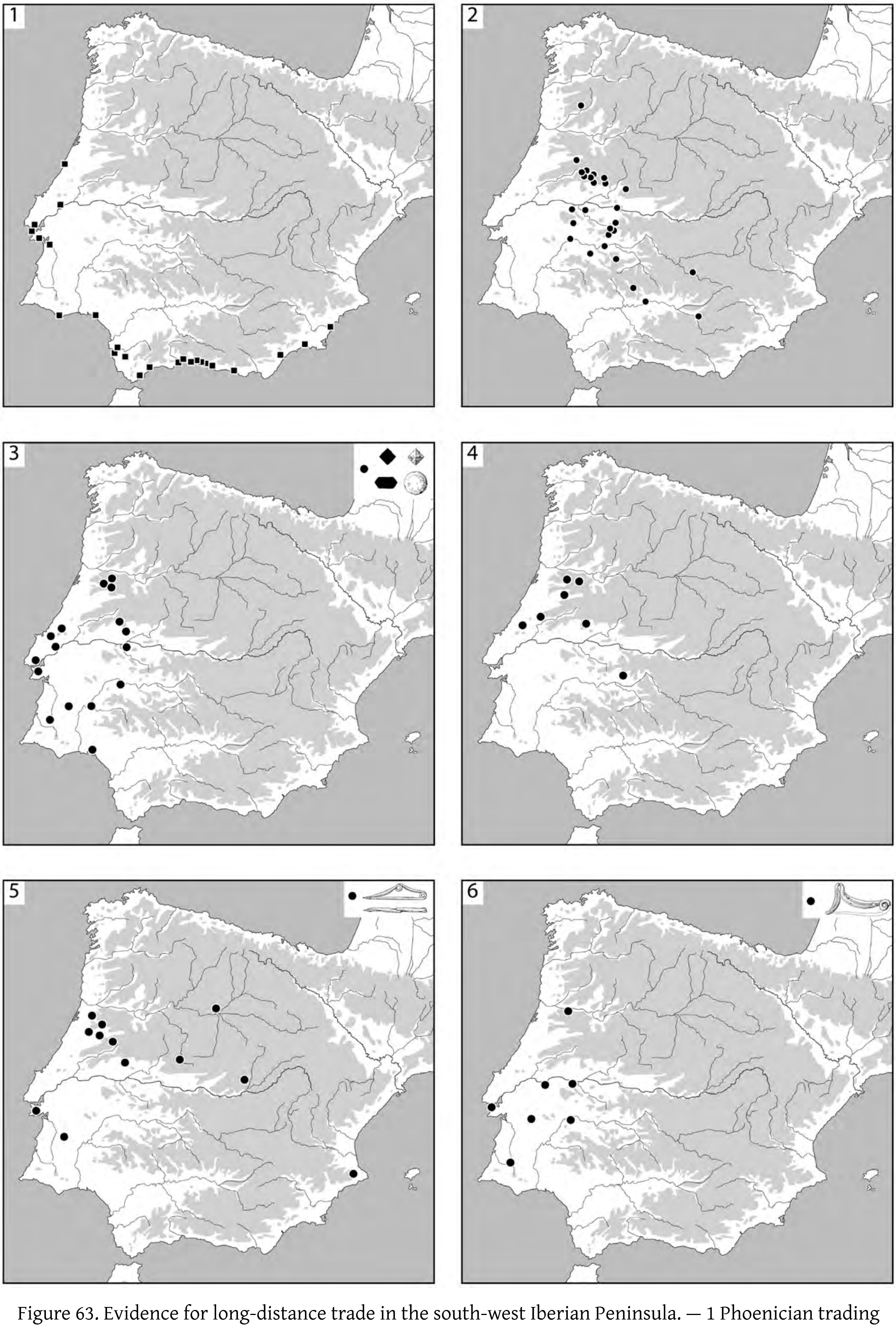

Figure 63. Evidence for long-distance trade in the south-west Iberian Peninsula. — 1 Phoenician trading stations and colonies of the 9th-7th centuries BC (after Pellicer Catalán 2007: 126 fig. 35). — 2 Early warrior stelae (after Celestino Pérez and Salgado Carmona 2011: 447 fig. 2 [Types IA and IB]). — 3 Precision weights (after Vilaça 2011: 157 fig. 11 [Types 1-5]). — 4 Rotary spits (after Armada 2011: 161 fig. 9.1). — 5 Fibulae of Roça do Casal do Meio type. — 6 Fibulae of Cassibile type ('heavy variant').

In the following paragraphs, evidence for long-distance trade linking the western and south-western part of the Iberian Peninsula with the central and eastern Mediterranean will be discussed. The discussion will focus on: i) warrior stelae; ii) weight metrology; iii) roasting spits; iv) fibulae; and v) the hoard from Baiões and some other bronzes.

i) Warrior stelae

Alongside the routes along the Mondego and the Tejo to the 'ports of trade' on the Atlantic coast, there is another route which was probably used for trading transactions between central Portugal and seafarers arriving from distant lands. This is the so-called 'stele route', which passed through the Spanish Extremadura, reaching as far as the Tartessian heartland.[39] The 'stele route' was already used long before the foundation of the Phoenician trading posts. New studies have shown that the older warrior stele (without representations of human figures) are distributed in the area between the Portuguese Beiras and the northern part of the Spanish Extremadura – precisely in the region where the earliest iron objects have been discovered (compare Figure 62 with Figure 63: 2).[40] Judging from the weapons depicted, the older stelae probably date around the 11th/10th century BC, and this chronology is reinforced by a comparable stele from Buoux (Dép. Vaucluse) in south-east France, which was found associated with a pottery vessel typical for the phase *Bronze Final* 2b.[41] The onset of the warrior stelae can probably be associated with processes of centralization and hierarchization focused on defended hillfort settlements.[42] The stelae indicate that the Beiras/Cáceres region was already of supra-regional importance at this early date.

ii) Weight metrology

In an important study, Raquel Vilaça discussed a convincing testament to pre-colonial trade between the East Mediterranean and Portugal.[43] She collected together a large number of precision weights, mainly from central and southern Portugal, most of which are based on a metrological unit of ca. 9.3/9.4 g (Figure 63: 3). Vilaça identifies this unit with the so-called 'Syrian' shekel. The hoard from Baleizão (Beja District), for example, contains six examples of this type of weight.[44] Apart from the precision weights, with masses between 2.32 g (1/4 unit) and 18.64 g (2 units), the hoard contains further bronze objects, a gold torc and bracelet of Sagrajas/Berzocana type, a gold ingot and some more small fragments of gold. The association of the precision weights with the gold ingot and gold fragments makes it very likely that the weights were used, among other things, for weighing gold. East Mediterranean seafarers presumably took part in such transactions, otherwise it would be difficult to explain the use of the 'Syrian' shekel in Portugal. This hypothesis receives further support from the hoard from Berzocana (Prov. Cáceres) containing two further gold neck-rings of Sagrajas/Berzocana type and a bronze bowl with close parallels in Cyprus and Canaan, for example in the hoard from Tell Jatt and from Megiddo Layer VIA, suggesting a date in the late 11th or early 10th century BC.[45] In the context of our subject, it is also important that these discoidal, biconical or octahedral weights have been discovered on sites with early iron objects, for example at Ría de Huelva, Monte do Trigo, Moreirinha, and Baiões.

iii) Roasting spits

When discussing early relations between Cyprus and the Iberian Peninsula, Grave 523 from Amathus, dated around the second half of the 10th century BC, is often mentioned as it contains an 'Atlantic' rotary spit and an Iberian fibula.[46] Comparable rotary spits are known from the western part of the

[39] Senna-Martínez 1999: 45. — See also Rodríguez-Corral and Rodríguez-Rellán 2023: 13 fig. 10.
[40] Celestino Pérez and Salgado Carmona 2011; Díaz-Guardamino 2012.
[41] Lachenal 2013: 30 ff. — The later stelae, with depictions of human figures and wheeled vehicles, date to the 9th/8th century BC.
[42] See e.g. Senna-Martínez 1999: 42; González-Ruibal 2004: 290 f.
[43] Vilaça 2011.
[44] Vilaça and Lopes 2005.
[45] Artzy 2006: 73 ff.; Torres Ortiz 2012: 456 f.; Ruiz-Gálvez 2014: 206; Zorea 2018.
[46] Karageorghis 1987: 719-722; Karageorghis and Lo Schiavo 1989; Nijboer 2008. — For the chronology, see Gilboa et al. 2008: 155 note 154; 158 note 167; Gilboa 2013: 332 note 31. — For an exact parallel for the fibula from Amathus, see the example from Castro

Iberian Peninsula – indeed, they represent the earliest metallic spits in Spain and Portugal (Figure 63: 4). These elaborately manufactured artefacts document the beginning of an élite fashion in this region at the end of the Bronze Age involving roasting meat on metal spits. As this fashion was practised in the East Mediterranean and in the Aegean since the 11th century BC, it seems justified to conclude that the innovation was introduced to the western part of the Iberian Peninsula from the east.[47]

iv) Fibulae

The introduction of the first fibulae in the Iberian Peninsula is a further innovation which requires a slightly more detailed treatment.

The earliest fibulae in the Iberian Peninsula are probably the two-looped examples with a low, more-or-less symmetrical triangular profile of the Roça do Casal do Meio type (Figure 63: 5).[48] The eponymous piece was found in an extraordinary tholos grave. Among the furnishings an ivory comb is most worthy of mention as the ivory must have been imported, and similar ivory combs are found in Italy (see Chapter 10.6).[49] Measurements on human bones produced a radiocarbon date in the 10th century BC.[50] The fibulae of Roça do Casal do Meio type have been found in numerous Portuguese settlements of the 11th-10th centuries BC.[51] Some of the settlements have also produced early iron finds (Baiões, Monte do Trigo, Cerro del Berrueco) or precision weights (Baiões, Castro dos Ratinhos, Monte do Trigo, Santa Luzia). A further example was contained in the hoard from Baleizão, together with the precision weights discussed above. It seems clear that fibulae were introduced to the western part of the Iberian Peninsula during the 11th/10th century BC. In view of the fact that fibulae were hardly used in Sardinia at this time, it is most likely that the stimulus for the innovation originated in Sicily or southern Italy.

Some slightly later fibulae are clearly related to the Sicilian tradition of fibula production. These belong either to a heavy variant (Figure 63: 6), or a light variant of the Cassibile type of fibula.[52] It is interesting that these fibulae are found mainly in the south-west of the Iberian Peninsula – especially in central and southern Portugal and in the Spanish Extremadura. The examples from Monte Airoso, Mondim do Beira, Nossa Senhora da Cola and Cerro de la Muralla have close parallels in the hoard from Castelluccio (Prov. Ragusa) in Sicily.[53] At this time, at the end of the Italian Bronze Age (*Bronzo Finale* 3b), there were apparently rather strong relations between south-east Sicily and the western Iberian Peninsula.

As Laias (Cenile, Ourense): Carrasco Rus et al. 2012: 313 fig. 1: 3.

[47] See: Armada 2011; Hamilakis and Sherratt 2012; Ruiz-Gálvez and Galán 2013. — For iron spits in Cypro-Geometric I, see Chapter 3.

[48] Fibulae of Roça do Casal do Meio type: Roça do Casal do Meio (Sesimbra, Setúbal District): Spindler and Veiga Ferreira 1973: 83 fig. 10: d. — Cabeço do Cucão (Pedra Cavaleira, Viseu District), Castelo dos Mouros (Vila Chã de Sá, Viseu District), Castro de Nossa Senhora da Guia (Baiões, Viseu District), Santa Luzia (Abraveses, Viseu District), Cabeço do Crasto de São Romão (Seia, Guarda District) and Monte do Trigo (Idanha-a-Nova, Castelo Branco District): Gil et al. 1989: 237 ff.; 246 fig.; Vilaça 2008: 389 fig. 4: 1.2.5-7; Senna-Martínez 2011: 292 fig. 5; Senna-Martínez et al. 2011: 417 fig. 6; 418 note 9. — Beleizão (Beja District): Vilaça 2013c: 19 fig. 4: 3. — Cabeço da Argemela (Lavacolhos, Castelo Branco District): Vilaça et al. 2011: 436 fig. 5: 7. — Castro dos Ratinhos (Moura, Beja District): Berrocal-Rangel and Silva 2010: 306 f.; 305 fig. 143: 30. — Cerro del Berrueco (Prov. Salamanca): Schüle 1969: 144 fig. 40: a. — Perales del Río (Getafe, Madrid): Zarzalejos and López Precioso 2005: 812 fig. 1. — Soto de Tovilla (Tudela de Duero, Prov. Valladolid): Quintana Lopez and Cruz Sanchez 1996: 32 fig. 5: 10. — Mola d'Agres (Agres, Prov. Alicante): Gil-Mascarell and Peña 1989: 131 fig. 3.

[49] Spindler and Veiga Ferreria 1973.

[50] Vilaça and Cunha 2005.

[51] See, for example, the radiocarbon dates from Santa Luzia and São Romão: Torres Ortiz 2008a.b; Vilaça 2008.

[52] For the light and heavy variants of the Cassibile fibula, see Pare 2008b: 92; 93 fig. 5.12: 1-2. — For the heavier variant, see for example Monte Airoso (Granja, Viseu District), Mondim do Beira (Viseu District), Quinta do Marcelo (Almada, Setúbal District), Nossa Senhora da Cola (Ourique, Beja District), Cerro de la Muralla (Alcántara, Prov. Cáceres), Los Concejiles (Lobón, Prov. Badajoz), perhaps also Castelo de Arraiolos (Évora District). See Vilaça 2008: 389 fig. 4: 3.8.9; Carrasco Rus et al. 2012: 319 fig. 3: 2-4.6; 2013: 41 fig. 3: 7-8; 45 fig. 4: 2-8; Cardoso 2004: 205; 207 fig. 157; Carreira 1994: 47 ff. fig. 9: 1; Vilaça et al. 2012: 148 ff. — For the lighter variant, see for example Las Lunas (Yuncler, Prov. Toledo), Talavera la Vieja (Prov. Cáceres), Castro de Serra Alta (Moura, Beja District): Soares et al. 1996: 575 fig. 5: 10; González Cordero and Morán Sánchez 2006: 34 fig. 9; Martínez and Vuelta 2010: 182 fig. 4: L9.L10; Carrasco Rus et al. 2013: 41 fig. 3: 4.

[53] Di Stefano and Giardino 1994.

Two further fibula types, the Monachil and the Huelva types, were used in the second half of the 10th and the first half of the 9th century BC, mainly in the south of the Iberian Peninsula, and especially in Andalusia. The Monachil type is especially significant for tracing contacts with the East Mediterranean.[54]

v) The hoard from Baiões

The best-known witness in Portugal for early long-distance contacts is certainly the metal deposition from the Castro de Nossa Senhora da Guia near Baiões in the Beira Alta.[55] Apart from the bimetallic socketed chisel, which has already been mentioned, the deposition contained bronze palstaves, sickles and bracelets, an elaborately manufactured three-pronged flesh-hook, parts of a sceptre, five hemispherical cups, and fragments of several 'wagon models' (incense-burners on wheels?).[56] The flesh-hook is similar to a two-pronged example from Beth Shean in Israel which dates to the late 13th century BC.[57] Certain technical details of the 'wagon models' (lost wax casting, the use of threads of twisted wax) exhibit similarities with bronzes – especially tripods and stands – from Sardinia and Cyprus.[58] The hemispherical cups from Baiões belong to a widespread group of vessels which are most common in the East Mediterranean.[59] In their Portuguese context, the cups from Baiões can be regarded as early examples of imported drinking vessels, comparable with the bronze bowl from Berzocana, mentioned above. The lotus-handle attachment of a bronze cauldron from the megalith at Nora Velha (Ourique, Beja District) is another import, dated to the 9th/8th century BC, somewhat later than the Berzocana and Baiões depositions.[60]

The role of Sardinia in the long-distance trade networks at the end of the Bronze Age should not be underestimated. On the one hand, some bronze objects from the western Iberian Peninsula are either Sardinian imports or they imitated Sardinian models.[61] On the other hand, Iberian bronzes are known from Sardinia, Sicily and central Tyrrhenian Italy. Although some of these date as early as the 11th century BC, the examples from the 10th century BC are much more numerous.[62]

Our discussion has shown clearly that in Portugal towards the end of the Bronze Age a series of innovations can be detected that were transmitted by seafarers from the central and eastern Mediterranean. Among other things, the type of knife with a single cutting edge and a rivetted flanged handle, precision weights, fibulae, metallic roasting spits, and specific bronze vessels can be mentioned as examples. It is more than plausible that the technology of iron production belongs to this innovation horizon. The striking concentration of these innovations of the 11th and 10th centuries BC in central and southern Portugal can best be explained by trading expeditions focused on gold, silver, and tin (see Figures 62 and 63).

The question of the protagonists in this sea-borne trade with the West is difficult to resolve. The likely identification of Tarshish with Tartessos and the silver-rich Rio Tinto region in the hinterland of Huelva suggests that long-distance trading ventures were undertaken by Phoenician centres such as Tyre in

[54] The fibulae of Monachil type have a symmetrical bow profile with a small bulge on the apex. Examples from the East Mediterranean are known from Amathus, Grave 523; Achziv, Grave 1; and Megiddo, Layer VA. An example from the settlement of Peña Negra (Prov. Alicante) came to light in a metalworker's workshop (phase I of the settlement, see below). — The fibulae of Huelva type have an asymmetrical bow profile. For examples, see the metal deposition from the Ría de Huelva (see below) and from the settlement of Cerro de la Miel (Prov. Granada); in both cases the find contexts indicate a date in the second half of the 10th century BC. — See Pare 2008b: 92 f.; 93 fig. 5.12: 4.6.

[55] Da Silva et al. 1984.

[56] For good colour photographs of the flesh-hook, 'wagon models' and hemispherical cups, see Armbruster and Perea 2007: 97 ff.; fig. 11.2-11.4.

[57] Panitz-Cohen and Mazar 2009: 573 fig. 10.8.

[58] Armbruster 2004: 57 f.

[59] See Pare 2015: 307 ff. fig. 4-9. — For an example from Sardinia (Matzanni, Prov. Cagliari), see Lo Schiavo 2006: 275; 271 fig. 1: 3.

[60] See Armada Pita et al. 2008: 480 fig. 7: 1. — As mentioned above, a lump of iron slag was found in the burial from Nora Velha.

[61] Vilaça 2008: 392 fig. 6; Fundoni 2009: 22 fig. 6: 1-3.5; Martínez and Vuelta 2010: 190 fig. 8.

[62] Lo Schiavo et al. 2009: 280; Fundoni 2013: 246.

the pre-colonial period.[63] However, Ayelet Gilboa has shown that it is unlikely that the Phoenicians were involved in such long-distance trade before the second half of the 10th century BC.[64]

If it is accepted that ironworking was transmitted to the Iberian Peninsula at some point during the 11th or first half of the 10th century BC, it is most likely that the technology was learned in the context of contacts with the closest trading partners, in Sardinia, Sicily or southern Italy. Nevertheless, a wider network of sea-borne trading relations existed, linking the West (the western Iberian Peninsula, the Balearic Islands) and the central Mediterranean (Sardinia, Sicily, southern Italy) with the Aegean and the East Mediterranean. The precision weights from Portugal and occasional imports such as the bowl from Berzocana, together with the wide distribution of ivory, demonstrate the involvement of Cyprus and the Levant in the trading network.

11.4 The introduction of iron in Spain

Our review will start with two case studies in which iron seems to have made an especially early appearance – the Balearic Islands and the settlement of El Berrueco in the western Meseta.

In the Balearic Islands, the earliest iron occurs in the form of jewellery, found as grave goods in burial caves. The most important finds are the iron bracelets from Es Forat de Ses Aritges, the iron bracelets and small iron 'clamps' from Càrritx (both Menorca), and the iron bracelets and pendants from Son Matge, layer 9 (Mallorca).[65] According to radiocarbon determinations, a date around 1000 BC seems likely for Es Forat de Ses Aritges; Càrritx and Son Matge are somewhat later and probably belong in the 9th century BC.[66] The early adoption of iron in the Balearic Islands in indigenous, pre-colonial contexts, is remarkable and demands an explanation. An early iron bracelet is known from Bidistili in Sardinia, as reported in Chapter 10.3, which could conceivably be considered as a possible origin for the pieces in the Balearic Islands. However, in the case of Es Càrritx some bronze bracelets were found in the same context as the iron bracelets; apart from the metal, these are identical with the iron examples. For this reason, it is likely that both the bronze and the iron bracelets were manufactured locally. It seems, therefore, that ironworking was already practised in the Balearic Islands from around the turn of the millennia; however, at present it is impossible to decide whether iron ores were smelted on the islands, or iron was imported as a raw material.

Our second case is the important defended settlement 'Cancho Enamorado' on the peak of the Cerro del Berrueco in the province of Salamanca, where very interesting early iron artefacts came to light. During excavations, a hoard was discovered in the lower stratigraphic level of a house. The hoard contained two bronze bracelets and a collection of iron artefacts: two razors, two chisels, an awl, and a ring.[67] As Martín Almagro-Gorbea noted, the razors are most important for the chronology of the hoard.[68] The razors from the hoard of Huerta de Arriba (Prov. Burgos) are similar.[69] However, some examples from south-east Sicily are closer parallels.[70] While Huerta de Arriba can be dated around 1100 BC, the Sicilian hoards from Niscemi and Castelluccio are characteristic for the Italian phases *Bronzo Finale* 2 and 3 respectively (11th-

[63] In the Old Testament, Hiram of Tyre and Solomon sent out 'Tarshish ships' every three years, which brought back gold, silver, ivory and other precious goods. — See, for example: 1 Kings 10:22; 2 Chronicles 9:21; Ezekiel 27:12.
[64] Gilboa 2022; the author argues for the "opening of the Mediterranean" in the second half of the 10th century BC. — For the increasing evidence for long-distance sea-borne trade in the Mediterranean during the second half of the 10th century BC, see also Pare 2008b: 95. — Contrast the view of Albert Nijboer, who believes that the Phoenician trading activities already reached the Iberian Peninsula during the 11th/10th century BC; see, for example, Nijboer 2018: 61; 64 ff.
[65] The small iron bead in a burial from Son Matge, supposedly dating to the 16th/15th century BC, does not seem reliable. See Guerrero Ayuso et al. 2002: 223.
[66] Lull et al. 1999: 230-234 (Es Forat); Guerrero Ayuso 2000: 42 f.; Guerrero Ayuso et al. 2002: 228 ff. (Càrritx, Son Matge). — See also Rafel et al. 2008: 265.
[67] Maluquer de Motes 1956: 189 fig.
[68] Almagro-Gorbea 1993: 86 f.
[69] Monteagudo 1977: pl. 152: B; 153: A.
[70] Giardino 1995: 22 fig. 9: 9; 25 fig. 12: B4 (Niscemi, Castelluccio).

10th centuries BC).[71] It is significant that the razors from the El Berrueco hoard find parallels in Sicily because, in turn, 'Atlantic' razors have been found in Sicily, where they are regarded as evidence for trade between the central and western Mediterranean.[72] As Almagro-Gorbea noted, the Sicilian razors are always made of bronze, so the razors from El Berrueco can hardly have been imported. This is important, because it appears most likely that the iron artefacts from El Berrueco were made locally.

Almagro-Gorbea also discussed an iron trunnion axe from the El Berrueco settlement. As a comparison he mentioned a similar axe from the hoard of Campotéjar (Prov. Granada).[73] Whereas the axe from El Berrueco is an isolated piece, the example from Campotéjar was found together with 30-40 other axes, which unfortunately have all been lost. It is important to emphasize that iron trunnion axes are otherwise completely absent in the Iberian Peninsula.[74] The closest parallel in bronze for the two iron trunnion axes comes from the Final Bronze Age settlement of Villa Vieja (Casares, Prov. Málaga).[75] According to the results of Lead Isotope analysis, the bronze example from Villa Vieja was probably imported, perhaps from Cyprus; it therefore seems quite likely that the iron examples from El Berrueco and Campotéjar are likewise imports.[76] Unfortunately, these axes cannot be precisely dated, although a position in the 10th or 9th century BC seems plausible. As explained in Chapter 4.4, the trunnion axe shape was sometimes used for copper or bronze ingots and probably also for iron billets; therefore it is conceivable that iron billets were traded in this form from the (Phoenician?) trading posts on the coast into the interior of the Iberian Peninsula. The position of El Berrueco in the western Meseta deserves a brief comment. It lies on the periphery of the distribution of the early warrior stelae (Figure 63: 2), and so the occurrence of iron could be understood in the context of contacts passing along the so-called 'stele-route', running between the lower Guadalquivir and the Beira Alta region (Baiões/Santa Luzia cultural group). However, the fact that the artefacts in the hoard from El Berrueco were probably not imported suggests that the technology of ironworking (or the objects) was transmitted from Portugal, where iron production (smelting and smithing) was already practised in the 11th/10th century BC.

In the following paragraphs, the present state of research on the introduction of iron into the rest of Spain will be summarized briefly.

Considering the well-documented presence of Phoenicians on the Andalusian coast since the first half of the 9th century BC, it is rather surprising that very few iron artefacts are known from indigenous contexts in the hinterland in the pre-colonial period before the 8th century BC. In south-west Spain, the only example is an iron fragment included among the finds from the famous metal deposit from the Ría de Huelva.[77] As it is a river deposit, lacking a systematically recorded context, it is not absolutely certain that the iron fragment belonged to the original bronze deposition. The Ría de Huelva finds, dated to the second half of the 10th century BC, have often been discussed in the specialist literature, among other things because the finds demonstrate contacts with the central and East Mediterranean.[78] The swords of Huelva/Saint-Philbert type, which have numerous representatives in the deposit, are known e.g. from Siniscola (Prov. Nuoro), Santa Marinella (Prov. Roma), and Castelluccio (Prov. Ragusa).[79] These finds from Huelva show that the southern regions of Spain already maintained trading relations with the central and East Mediterranean before the 9th century BC. Against this background, it cannot be excluded that the iron fragment from the Ría de Huelva reached the Andalusian coast in the context of such maritime contacts, for example involving Sardinia, Sicily, Cyprus or Phoenicia.

71 For Huerta de Arriba, see Milcent 2012: 166. — For Niscemi and Castelluccio, see Giardino 1995: 17; 21.
72 For the razor from Cassibile, Grave 78, see Hencken 1955.
73 Almagro-Gorbea 1993: 83 fig. 1: 4; Monteagudo 1977: 137 f.; Wesse 1990: 207; pl. 23: 223.
74 See Wesse 1990; Wesse and Díaz Andreu 1988.
75 Marzoli et al. 2014: 176 fig. 7. — For similar trunnion axes from the Aegean, see Figure 19.
76 Renzi et al. 2016: 203. — Note that imported carnelian beads were also found in the settlement of Villa Vieja. For distribution maps of carnelian beads in the western, central and eastern Mediterranean, see Gomes 2021: 29 ff.; 31 fig. 1; 40 fig. 4.
77 Ruiz-Gálvez 1995: 137 f.; 227; pl. 18: 96.
78 For the date of the deposition, see Torres Ortiz 2008a; 2008b; Milcent 2012: 169. — For the fibulae of 'Huelva' type, see Pare 2008b: 92 f.
79 Albanese Procelli 2008: 406; Lo Schiavo and Milletti 2011: 326.

During the 8th century BC, the technology of ironworking was quickly transmitted to some indigenous communities, e.g. at Acinipo and Los Castillejos de Alcorrín (both Prov. Málaga), where there is already evidence for smelting and smithing in contexts dating to the late 9th or early 8th century BC.[80] Shortly afterwards, iron artefacts reached the lower Guadalquivir valley, e.g. at Setefilla (Lora del Río, Prov. Sevilla). An iron knife was found in a grave dating to the first half of the 8th century BC (Grave 13); iron knives became more common after the mid-8th century BC in the Orientalizing phase. At Setefilla, the prestigious character of these early iron knives is underlined by an example provided with silver rivets, from Grave 17.[81]

Turning to the south-east, a flat fragment of iron covered with remnants of copper or bronze was found in Grave 4 from La Encantada (Cuevas del Almanzora, Prov. Almeria), which seems to date to the 9th or early 8th century BC.[82] Another early iron fragment was discovered during the excavation of a metalworker's workshop at Peña Negra I (Crevillente, Alicante), located close to the Phoenician trading-post at La Fonteta. The settlement of Peña Negra has further evidence for pre-colonial contacts with the East Mediterranean, including an ivory bracelet, fragments of unworked ivory, and carnelian beads.[83] Later, particularly in the 7th century BC, iron smelting was carried out at Peña Negra; blacksmiths were at work, and according to the excavated finds, knives were the most common implements produced. Iron was also smelted at Castellar de Librilla in Murcia, apparently already during the second half of the 8th century BC.[84] Iron knives appear in nearby indigenous cemeteries during the 7th century BC, for example at Les Moreres (Alicante) and Collado y Pinar de Santa Ana (Murcia). At this time, iron was evidently still rare, and the knives were regarded as prestigious objects.[85] It is noticeable that the earliest iron knives were often associated with bronze double-spring fibulae, which are a feature of the Orientalizing period in the southern Iberian Peninsula.[86]

In the Levante, iron knives again feature prominently among the earliest iron artefacts, for example in contexts of the 7th century BC in the settlements of Vinarragell and Tossal de la Vila in Castellón.[87] Jaime Vives-Ferrándiz and Consuelo Mata conclude that iron knives were the objects most in demand by the indigenous communities at that time.[88]

In the north-eastern part of the Iberian Peninsula, in Catalonia, iron finds first appeared in funerary contexts towards the end of the 8th century BC. At first, iron seems to have been a high-status metal, and iron objects remain very rare in settlements during the 7th century BC. The earliest iron artefacts are mainly knives, which were sometimes associated with bronze pivot or double-spring fibulae; iron personal ornaments, such as roll-headed pins, are found less frequently.[89] According to Joan Sanmartí and his co-authors, the production of iron tools and weapons only began after a considerable delay: "There are two distinct stages with regard to the use of iron in the area under study [Catalonia]. Initially, between the late eighth and the mid-sixth century BC, this metal was mainly used for the manufacture of knives and objects related to clothing and personal adornment; these items have been recovered mainly

[80] Suárez and Renzi 2020.

[81] The iron knife from Grave 17 was associated with a bronze double-spring fibula. — For the chronology of the graves from Tumulus A at Setefilla, see Brandherm and Krueger 2017: 313 fig. 6; Rafel and Armada 2021: 87; for the knife from Grave 13, see Rafel and Armada 2021: 88 fig. 11: 3.

[82] Lorrio 2008: 84 ff.; 297 f.; Ruiz Zapatero et al. 2012: 152; Álvarez Sanchís et al. 2016: 152.

[83] The bronze objects manufactured in the workshop are related to the Vénat facies (Final Bronze Age 3b). — See González Prats 1989; 1992: 253; Lorrio 2008: 308; Torres Ortiz 2008a: 70 f.; 91; Lorrio Alvarado et al. 2020: 524. — The fibulae from this phase at Peña Negra were mentioned above; see Carrasco Rus et al. 2013: 41 fig. 3: 1.2.

[84] Mielke and Torres Ortiz 2012: 271; 275; Ruiz Zapatero et al. 2012: 154; Álvarez Sanchís et al. 2016: 154; Vives-Ferrándiz and Mata 2020: 149; 148 fig. 6; Rafel and Armada 2021: 89.

[85] Vives-Ferrándiz and Mata 2020: 149; 148 fig. 7.

[86] This combination between the earliest diffusion of iron and bronze double-spring fibulae in the Iberian Peninsula is explained in Ruiz Zapatero et al. 2012: 155. — The double-spring fibula ('fibula de doble resorte') is also known as the Tossal Redó type; see Almagro Basch 1966: 7 fig. 11.

[87] Vives-Ferrándiz and Mata 2020: 149 f.; 149 fig. 8; 150 fig. 9: a.c.

[88] Vives-Ferrándiz and Mata 2020: 150.

[89] Pons i Brun 1987; Rovira Hortalà 1998; 2001; 2007; Ruiz Zapatero et al. 2012: 155; Álvarez Sanchís et al. 2016: 155. — Belarte et al. 2020: 130 ff.

in funerary contexts. ... the volume of production was quite small. In short, before the mid-sixth century BC, the use of iron seems to be limited basically to the sphere of the prestige economy. ... Starting in the second half of the sixth century BC, iron weapons, farming instruments and other elements of practical use in everyday life ... became key elements in the reproduction of a system of exploitation based on hereditary inequality."[90]

Unfortunately, it is uncertain whether the early iron artefacts were produced locally or imported; the first reliable evidence for smelting dates to the 6th century BC.[91]

The situation in the area north of the Pyrenees in Roussillon and western Languedoc is similar to Catalonia. The earliest iron objects are again found in graves of the late 8th century BC. As in Catalonia, the first iron artefacts are knives, which only seem to have been provided in male graves.[92] In south-eastern France, to the east of the Hérault, the first iron artefacts are associated with advanced variants of the Gündlingen sword type, corresponding to the later 8th century BC. While iron seems to have been introduced in the south-east at the same time as in south-west France and Catalonia, the manufacture of iron weapons (Gündlingen swords) shows that the new metal was adopted in a very different manner.[93]

The adoption of iron in the continental interior of the Iberian Peninsula seems to have coincided with the spread of Orientalizing influences and the bronze double-spring fibula.[94] The iron dagger blade and knife from a rich Orientalizing female grave at El Carpio (Belvis de la Jara, Prov. Toledo) are among the earliest iron finds in the southern Meseta, dating around the mid-7th century BC.[95]

Some years ago, Gonzalo Ruiz Zapatero and colleagues argued that the iron finds from five sites in the Meseta could be much earlier (9th/8th century BC), but the chronology of these contexts is very uncertain.[96] In the case of Los Castillejos de Sanchorreja (Prov. Ávila), the stratigraphic position of the two iron knives is unclear. An early radiocarbon date has been obtained from cremated bone from Grave 76 in the cemetery of Palomar de Pintado (Prov. Toledo), which contained an iron knife.[97] However, apart from Grave 76, the use of the cemetery is estimated to start in the late 7th or early 6th century BC ('Phase 1'), so that it seems possible that the high age of the cremated bone was caused by the uptake of carbon from the funeral pyre ('old wood' effect).[98] It seems that the iron objects (chisels?) from the settlement of La Muela de Alarilla (Prov. Guadalajara) and from Grave 32 at Arroyo Culebro (Leganés, Madrid) cannot be precisely dated; the same appears to be true for the iron remains from Layer IX at Soto de Medinilla (Valladolid).

Iron artefacts were introduced in the north of Spain (Asturias and Cantabria) somewhat later, at the end of the 7th or in the 6th century BC.[99] According to Ruiz Zapatero et al., the new metal could have reached Galicia earlier, owing to sea-borne trade via Portugal along the Atlantic coast; for example, the iron knives and sickle from the Castros of Torroso and Penalba (Prov. Pontevedra) could date to the 8th or 7th century BC.[100]

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[90] Sanmartí et al. 2021: 370 f.; 374.
[91] Belarte et al. 2020: 136; Rafel and Armada 2021: 89 f. (the putative evidence for iron smelting at Els Vilars [Prov. Lleida] at ca. 700 BC seems doubtful). — However, note that Anne-Laure Grevey and Eric Gailledrat (2020:122) consider that ironworking began in western Languedoc and Catalonia during the 7th century BC.
[92] Janin and Chardenon 1998; Filippini 2007: 400 fig. 6; Beylier 2020: 96 ff.
[93] Beylier 2020: 98.
[94] As stated for example by Álvarez Sanchís et al. 2016: 156: "La distribución de los objetos de hierro más antiguos y de las fibulas de doble resorte, jalona hacia el interior la difusion de éstos y otros elementos orientales."
[95] Pereira 2008: 120; 119 fig. 2: 17-18; Ruiz Zapatero et al. 2012: 158; Álvarez Sanchís et al. 2016: 156.
[96] Ruiz Zapatero et al. 2012; Álvarez Sanchís et al. 2016; for Palomar de Pintado and La Muela de Alarilla, see also Mielke and Torres Ortiz 2012: 274. — The chronology of the iron artefacts from these sites has been critically reviewed by Juan Luis Gomá Rodríguez (2018: 353-357).
[97] Pereira Sieso et al. 2003: 162 ff.
[98] For the 'old wood' effect in radiocarbon samples from cremated bone, see Olsen et al. 2013.
[99] Ruiz Zapatero et al. 2012: 160; Álvarez Sanchís et al. 2016: 157.
[100] Ruiz Zapatero et al. 2012: 156; 157 fig. 7: A; Álvarez Sanchís et al. 2016: 155.

From our short summary of the present state of research, some main trends can be distinguished. Apart from a few exceptions, in Spain the adoption of ironworking in indigenous settlements and the dissemination of iron artefacts coincided with the foundation of the first Phoenician colonies, ca. 800 BC. Before this date, hardly any significant iron finds are known from Andalusia. The situation changed radically in the 8th century BC, when traces of smelting and smithing are found in indigenous sites near the coast and the first iron artefacts appear in cemeteries further inland. In the Levante (Valencia, Catalonia), iron artefacts seem to have been introduced somewhat later, and were still unknown before the late 8th century BC. In south-west France, the evidence for the adoption of iron seems to be very similar to that in Catalonia. A general trend can be observed in the spread of iron usage in Spain in the course of the 8th and 7th centuries BC: starting in the south (Andalusia), passing to the east (Levante), and the centre (Meseta), and finally reaching the north (Asturias, Cantabria).

In southern and eastern Spain, knives represent by far the most common iron artefacts during the earliest stages of iron use; the preference for knives is apparent both in cemeteries and settlements. In all these areas, the early iron knives seem to have had a high social value, as prestigious artefacts.

As explained above, there are two exceptions to this general trend in the introduction of iron in Spain. In the Balearic Islands and in the western Meseta, in the settlement of El Berrueco, iron artefacts were produced considerably earlier, and seem to belong to a different, pre-colonial stage in the adoption of ironworking.

11.5 Discussion and conclusions

The introduction of iron in the Iberian Peninsula and the Balearic Islands can conveniently be divided into three stages: meteoritic, pre-colonial, and colonial.[101]

New archaeometallurgical analyses have shown that the pommel and bracelet from the Villena Treasure were almost certainly made of meteoritic iron. Both the provenance of the meteorite and the location of the production of the artefacts are at present uncertain. The artefacts could either have been manufactured using iron from a meteorite discovered locally, or they could have been imported – both possibilities are equally plausible.

In the pre-colonial period, the concentration of the earliest iron artefacts between the Douro and Tejo is significant (Figure 62: 2-7). The clustering of innovations in central and southern Portugal during the Final Bronze Age is presumably to be explained by contacts with foreigners in search of tin and gold (Figure 63). It is generally assumed that the trade passed along the so-called 'stele-route', although maritime trade-routes reaching as far as the Tejo estuary cannot be excluded. Scientific analysis of some of the iron objects from these Portuguese sites demonstrate that the iron was smelted locally, and archaeometallurgical studies revealed the rudimentary capabilities of the local blacksmiths. Local ironworking is also indicated by the typology of some of these implements: it seems unlikely that the razors, chisels and awl from El Berrueco were imported, and the same is true for the narrow, two-edged blades and saw-blade fragments from Moreirinha and Monte do Trigo.

It is unlikely that the technology of iron production was invented autochthonously in these areas. Among the early iron objects from central Portugal there are curved, one-edged knife blades which represent an innovation in the local Bronze Age context, indicating familiarity with foreign iron products.[102] And the razors from El Berrueco demonstrate contact with Sicily, where the production of iron artefacts is attested in the 10th century BC. As explained above, the early iron bracelets from the Balearic Islands were also manufactured locally. It seems, therefore, that ironworking was introduced in the area between

[101] For further discussion, see Chapter 12.2 ('Italy and Iberia').

[102] The absence or rarity of one-edged knives in the Bronze Age of the Iberian Peninsula has been noted by the following authors: Coffyn 1985: 178; Vilaça 2006: 95; 2013b: 54 f.; Vives-Ferrándiz and Mata 2020: 150; Grevey and Gailledrat 2020: 118-122; Jambon et al. 2023: 18. — For the similar situation in south-west France, see Beylier 2020: 97.

the Douro and the Tejo and in the Balearic Islands at roughly the same time as in Sicily, Calabria and Albania. Unfortunately, the radiocarbon dates are difficult to interpret, although the available evidence suggests that the transfer of ironworking technology between these regions in the central and western Mediterranean was already underway before the 10th century BC. This provides an interesting comparison with the introduction of the earliest iron artefacts in other areas during the 11th century BC, for example to the Bilozerka culture north-west of the Black Sea between the mouth of the Danube and the Dnipro (for discussion of the 'maritime horizon' and the concept of 'Mediterraneanization', see Chapter 12.2-3).

Before the 9th century BC, when characteristic imported pottery demonstrates the presence of Phoenicians in the Gulf of Cádiz, the identity of the sea-borne protagonists responsible for the innovations reaching the western Iberian Peninsula is uncertain. Rather than postulating long-distance trading enterprises planned and undertaken by the Phoenicians (or Cypriots) during this early stage, it is preferable to envisage a network of maritime contacts linking the various areas between the East Mediterranean, the Aegean, the central Mediterranean, the Balearic Islands, and the Iberian Atlantic coast. Although information and innovations could potentially pass throughout the network, the concentration of innovations in the western and south-western Iberian Peninsula is impressive, and surely reflects the strong demand for precious metals (gold, silver, tin) by trading participants in the East Mediterranean.

The diffusion of iron during the colonial period is described in Chapter 11.4. With the establishment of permanent Phoenician trading stations (*emporia* or *apoikiai*) on the south coast of Spain from the late 9th or early 8th century BC onwards, ironworking quickly gained a firm foothold in nearby indigenous settlements. During the 8th and 7th centuries, iron artefacts were gradually adopted further away, at first mainly in the southern and eastern parts of the Iberian Peninsula. Again and again in the specialist literature it is emphasized that one-edged knives represent by far the most frequent artefacts in the initial stages of iron usage; as in several other regions, studied in previous chapters, the Iberian Peninsula is another example with a 'knife horizon' when iron was first introduced. The earliest knives were apparently valued highly in the indigenous communities, and the evidence from cemeteries indicates that they were a marker of social prestige. Unfortunately, it is generally impossible to ascertain whether the knives were locally manufactured or if they were obtained by trade. The corroded iron knives do not lend themselves to fine typological analysis. However, on some examples the tangs have bronze rivets. As knives with bronze rivets were manufactured in the Phoenician settlement at La Fonteta, the bronze rivets could be interpreted as a characteristic feature of Phoenician knives, however this is far from certain.[103]

Larger iron artefacts, for example swords and spearheads, were first introduced in the course of the 7th century BC; these include iron variants of the latest bronze flange-hilted swords (Monte Sa Idda type).[104]

[103] Iron knives with bronze rivets: La Fonteta (Prov. Alicante): Vives-Ferrándiz and Mata 2020: 147 fig. 5. — Cachouça (Idanha-a-Nova, Castelo Branco District); Nossa Senhora dos Milagres (Pedrógão Grande, Leiria District); Quinta do Marcelo (Setúbal District); La Mazada (Prov. Zamora): Vilaça 2013a: 638; 639 fig. 6: 2.3. — Fraga dos Corvos (Trás-os-Montes, Bragança District): Senna-Martínez et al. 2012: 252 fig. 15. — Puisserguier, 'La Rouquette' (Dép. Hérault): Beylier 2020: 97. — Serralongue-Vallespir, 'Camp de les Olles' (Dép. Pyrénées-Orientales); Porcuna, 'Cerrillo Blanco' (Prov. Jaén); Lora del Río, 'Setefilla', Grave 20 (Prov. Sevilla): Grevey and Gailledrat 2020: 121; 120 fig. 4: C.

[104] See Brandherm 2007: 95 ff.; the bronze hilt from Peñon de la Reina (Prov. Almería) could originally have been fitted with an iron blade. — A further iron sword of Monte Sa Idda type has recently been found at Villanueva de la Fuente (Ciudad Real).

Chapter 12
Conclusions

In the following pages, some of the main results of our study will be summarized. As explained in the preceding chapters, particular forms of artefacts frequently played a conspicuous role in the earliest stages of iron use, which makes them especially important for tracing the diffusion of ironworking. The main developments in the introduction of iron in the study area are outlined in the following section; the adoption of ironworking in Central Asia and China is also briefly outlined. Finally, the discussion turns to an important terminological and theoretical aspect: the concept of an 'Iron Age'. It transpires that the term 'Iron Age' can be used in two ways, with very different meanings. This conclusion raises significant questions for our understanding of the fundamental changes which took place in Europe and Western Asia at the transition from the 2nd to the 1st millennium BC.

12.1 Frequently occurring forms of artefacts during the early stages of the adoption of iron

When iron objects first appear in the archaeological record in the various regions of Europe and Western Asia, it is often the case that certain forms of artefact play a particularly conspicuous role. This choice of specific types of objects in the early stages of iron use presumably reflects different conceptualizations of the new metal. The clearest examples of this empirical observation are the knives and the ring jewellery, which often occur as the predominant forms in the initial horizons of iron use. At a later, more advanced stage of iron production, larger prestige objects were manufactured, including bimetallic objects and, most prominently, weapons such as daggers and dirks. Examples of these particular forms will be discussed below.

The fact that the earliest iron artefacts belong to such a restricted range of specific and singular types could be interpreted as an indication that the archaeological record is biased, perhaps reflecting particular deposition practices, for example burial customs and the selection of specific grave furnishings. For this reason, the archaeological sources must be viewed critically. Nevertheless, the comparison of the selections of artefacts found in the initial horizons of iron use in the various regions of Europe and Western Asia is instructive, because common patterns are discernible. There follow short notes on the most frequently occurring forms of artefact during the early stages of the adoption of iron.

Small rod-shaped objects

The small iron rod-shaped implements, which have frequently been reported as among the earliest iron artefacts, are difficult to deal with. Although these 'implements' have variously been interpreted as awls, pin fragments, fine chisels, gravers, or burins, their unspecific shape and their corroded and/or fragmentary state of preservation generally does not allow a reliable interpretation of their original purpose. Examples of small rod-shaped objects have been reported from the following early sites: Selvicciola, Prov. Viterbo, Italy: collective grave (later 4th/3rd millennium BC); Voronezh Oblast, Russia: settlements of the Srubnaya culture (first half or mid-2nd millennium BC); Tashlyk, Mykolaiv Oblast, Ukraine: settlement of the Sabatinovka culture (first half or mid-2nd millennium BC); Mogou, Gansu Province, China (see below; 15th/14th century BC); Bargeroosterveld, Prov. Drenthe, Holland: wooden trackway (14th century BC); Kitzbühel, Tirol, Austria: cremation grave (13th century BC); Staňkovice, okr. Louny, Czech Republic: cremation grave (11th/10th century BC); Ljubljana, 'Tribuna', Slovenia: Settlement Phase I (11th/10th century BC).[1]

[1] The important settlement excavations at Ljubljana, 'Tribuna', have recently been published. The iron 'awl' was uncovered in a context of Settlement Phase I (11th/10th century BC); fragments of smithing slag came from Settlement Phase II (10th century BC). See Vojaković 2023: 535 fig. 3: 2; 570 ff.

As these examples illustrate, some of the rod-shaped objects come from very early contexts, which potentially makes them crucially important for the question of the introduction of iron metallurgy. However, the unspecific shape of these objects makes it perfectly possible that some or all of them could be later intrusions – such as remnants of medieval or modern nails which somehow entered the much earlier archaeological contexts. Basically, it is difficult or impossible to be sure which of the rod-shaped 'implements' are intrusive.

The contexts of a few fine chisels from the Near East and the Aegean are more convincing. The shape of the example from the Büyükkale area at Hattuša, from settlement phase Lower City 3 (mid-2nd millennium BC), is similar to contemporary bronze fine chisels. The piece from Kamid el-Loz came from a palace workshop (mid-14th century BC), and was found together with a finger ring made of smelted iron. And finally, the pointed iron rod from the palace of Thebes in Boeotia came from a jewellery workshop (mid-13th century BC), where a sharp implement of this kind would make a lot of sense.

As we have seen, the interpretation of the rod-shaped 'implements' is problematical. In the case of the examples which have been reported from very early contexts, it is quite likely that they are later intrusions – ancient, medieval or modern. On the other hand, when – for some reason – the contexts appear appropriate (e.g. workshops in palaces), it seems more plausible that they are, indeed, exceptionally early utilitarian iron implements. In conclusion, the interpretation of the rod-shaped objects is to some extent subjective; unfortunately, this limits the significance of this category of artefacts for the investigation of the introduction of ironworking.

Ring jewellery

Precious finger rings and bracelets made of *parzillum*/AN.BAR were already mentioned in cuneiform texts dating between the 20th and the 14th century BC.[2] They were often associated with other precious materials such as gold, silver or lapis lazuli. The finger rings found in graves at Sidon (iron and gold), Minet el-Beida (iron and silver), Megiddo (iron and gold) and Kition (iron and gold) are further evidence for this special use of iron for precious ring jewellery. Before the smelting of iron ores, iron could only be obtained from meteorites, which explains its potent symbolic meaning as the metal 'from the heavens'. In the Minoan and Mycenaean palatial period, between the 18th and 13th century BC, iron, in combination with other precious metals, is found almost exclusively in the form of finger rings. Scientific analyses suggest that the iron was of meteoritic origin, and this is certainly true in the case of the iron bracelet from the famous hoard of precious metal vessels from Villena in south-east Spain, probably dating to the 14th or 13th century BC. In all these examples, the use of iron for ring jewellery ensured that the symbolic aura associated with iron was closely bound to the body of the wearer.

Whereas the previous examples illustrate the use of iron ring jewellery as a marker of the highest social distinction, iron finger rings, earrings, bracelets, anklets and toe rings became much more widespread and less socially exclusive during the 'ring horizon', starting around the second half of the 13th century BC. Rings now represent the predominant form of iron artefact found in large parts of the Near East, from Babylon to Assyria, western Luristan and Lake Urmia, and reaching the Syrian coast, the southern Levant, and as far as Timna in the Negev (Figure 7).[3] The 'ring horizon' represents the first more regular use of iron detectable in the archaeological record. In these areas, the 'ring horizon' is most prominent in the 12th and 11th centuries BC, but rings still represent a prominent component of the find spectrum (together with knives) during the first half of the 10th century BC in the southern Levant, for example at Megiddo, Khirbet Qeiyafa and Tell es-Sa'idiyeh. As rings are not only predominant among the early iron artefacts in burials, but also in settlements and at the sanctuary at Timna, it is likely that in the Near East iron was, indeed, first used primarily for the production of ring jewellery. This seems to reflect a

[2] For example, texts from Kültepe, Mari, Sippar and Susa, and in the dowry of princess Tadu-Hepa in the kingdom of Mitanni.
[3] The iron finger ring dating to around the 11th century BC from Dzharkutan (Uzbekistan) should also probably be understood in the context of the Near Eastern 'ring horizon'. See the discussion of the early iron artefacts from southern Central Asia (below).

genuine choice, reflecting a specific conceptualization of the new metal. After the fall of the palaces, iron presumably retained some of its traditional symbolic meaning, which made it more suitable as a body adornment than for utilitarian implements.

The items of ring jewellery from Rhodes, from three tombs at Ialysos, are a distant echo of the Near Eastern 'ring horizon', and probably date around the 12th century BC. Most likely, the rings were brought to Rhodes by Levantine seafarers. The distribution of finger rings of the Submycenaean period forms a distinct cluster in central Greece, and they represent the first solid evidence for the local manufacture of iron in the Aegean (Figure 15). By contrast, it is likely that the early iron knives found scattered around the central and southern Aegean were imported (Figure 13). The earliest Athenian finger ring, from a grave dating around the transition from LH IIIC to Submycenaean, has a bronze hoop and an iron bezel, indicating that at that time iron was still considered as a precious metal. This ring provides a hint that the iron finger rings of the Submycenaean period somehow continued the memory of the precious Mycenaean signet rings.

The spectrum of the earliest iron finds from Sicily is similar to that in the Submycenaean Aegean: once again dominated by finger rings and knives. Furthermore, the nine band-shaped finger rings from the cemetery of Madonna del Piano are reminiscent of Submycenaean examples. Although the graves containing these early iron artefacts are conventionally dated later than the Submycenaean period (*Bronzo Finale 3*, ca. 10th century BC), the similarity between the selections of artefacts in the two areas, when iron first began to be manufactured locally, can hardly be fortuitous. It seems most plausible that contacts existed between the central Aegean and Sicily during the 11th century BC, at the time when iron was first introduced in the central Mediterranean.

This special significance, social value or symbolic meaning of iron ring jewellery seems to be a feature linking the Near Eastern 'ring horizon', Rhodes, the Aegean and Sicily. Some further cultural groups around the Mediterranean might also have shared this conceptualization, originating in the Bronze Age palaces and the 'ring horizon'. Ring jewellery is also prominent among the earliest iron finds from the burial caves in the Balearic Islands (bracelets, 10th/9th century BC) and in high status burials in Slovenia (neck-rings, 9th century BC). In other areas of Europe, ring jewellery did not play a particularly significant role during the introduction of iron.

Knives

As explained in the previous chapters, knives are predominant among the earliest iron artefacts in many of the areas discussed. Indeed, outside the Near East, it is almost possible to sketch the progress of the introduction of iron metallurgy by considering knives alone (see Figure 64). Iron knives, both one-edged and two-edged, are conspicuous among the earliest iron finds in the following regions:

- Cyprus (12th and first half of the 11th century BC)
- Levantine coast (between Cilicia and Palestine; late 12th and 11th century BC)
- Central and southern Aegean (second half of the 12th and first half of the 11th century BC)
- Northern Aegean (Thasos; 11th and 10th century BC)
- North of the Black Sea (between the Carpathian Mountains and the Dnipro; second half of the 11th and 10th century BC)
- Forest steppe (late Chernoles and Bondarikha cultures; 10th/9th century BC)
- Volga/Kama region (Maklasheevka culture; before the second half of the 9th century BC)
- North Caucasus (ca. 900 BC)
- Central Transcaucasia (12th and first half of the 11th century BC)
- Head of the Adriatic (western Slovenia; second half of the 11th/10th century BC)
- Sicily (10th century BC)
- Portugal (11th and 10th century BC)
- Andalusia (8th and 7th century BC)

- Spanish Levante (later 8th and 7th century BC)
- South-west France (later 8th and 7th century BC)
- Carpathian Basin (10th century BC)
- Northern Germany and south-west Poland (9th century BC)
- Xinjiang (see below; 10th/8th century BC)

Although they played a predominant role, the knives were not the only artefacts manufactured during the initial stages of iron use in these regions. In Cyprus, for example, other artefacts of simple design are found in early contexts, in particular spatulae. As explained above, in the coastal Levant, in central Greece and in Sicily, the find spectrums are dominated by both knives and ring jewellery. In the northern Caucasus, the initial horizon of iron use is marked by iron knives together with bimetallic (bronze and iron) daggers. The situation in northern Germany and Poland is somewhat similar: here, the knives and swords which dominate the spectrum of early iron artefacts often have a bimetallic construction, which can presumably be understood as an indication of their high social value.

In other areas, the present state of research makes it difficult or impossible to discern the initial stages of the introduction of iron. This is certainly the case for Bulgaria, where the knife from Sava-Tsonevo might well represent the earliest iron artefact from a significant archaeological context. The introduction of iron in Central Europe is also surprisingly difficult to assess. Whereas iron finds are abundant in the 9th century BC, earlier iron objects are rare and seem to be scattered over a wide area. Nevertheless, here again knives are relatively well represented during the 10th century BC; but they become much more common in the following century (see Figures 46 and 48). In Italy, although a clear 'knife horizon' cannot be discerned, nevertheless, the earliest iron artefact known from central Italy, from a grave of the late 10th century BC at Osteria dell'Osa, is a knife, and iron knives (including bimetallic examples) are a conspicuous feature in the élite burials of the Este and Golasecca cultures during the 8th century BC.

The prevalence of knives among the earliest iron artefacts is certainly notable and, in my opinion, highly significant. It could be argued that the large number of early iron knives simply results from the preference of knives as grave goods in many different cultures. However, in the area north of the Black Sea knives are the predominant iron artefacts both in graves and settlements. The same is true in the Iberian Peninsula, where the prevalence of knives among the earliest iron objects has repeatedly been emphasized by Portuguese and Spanish authors. In the other areas discussed, while the earliest iron knives have often been found in graves, they are also known from settlements – for example in Cyprus and on the Levantine coast. For this reason, it seems very likely that in many areas iron was, indeed, at first mainly used to manufacture knives. This can surely be explained by the simple flat shape of the knife, which – for a blacksmith with rudimentary skills – would be relatively easy to make. As argued in Chapter 7.1, the manufacture of knives can be regarded as the 'default setting': if iron did not possess a traditional symbolic meaning, as it did in Mesopotamia and the Levant, then knives represented the obvious choice as the most suitable (easiest) artefacts for the first blacksmiths to make.

While it might seem that the knife was the obvious choice for inexperienced blacksmiths to make, there is another feature of the early knives which demands consideration. In fact, in some areas the tanged one-edged knife was an innovative form of implement at the time of the introduction of iron. This is true for the area north of the Black Sea (Bilozerka culture) and for the Iberian Peninsula; in both areas, two-edged cutting implements were customary at the end of the Bronze Age. Even in Cyprus, during the 13th century BC the (bronze) one-edged knife was still a novelty, and two-edged knives were still used alongside one-edged examples during the 12th century BC. The important aspect to remember is that in certain areas not only the new metal, iron, but also the one-edged knife design was an innovation – this observation is significant for the question of how knowledge of iron was transmitted.

Daggers and dirks

The importance of the dagger as a status symbol in the Near East during the Bronze Age is abundantly clear from numerous cuneiform texts, and also from archaeological finds. We need only consider the daggers with blades of meteoritic iron from the 'Royal Tombs' at Alaca Höyük from the mid-3rd millennium BC (one example with a gold hilt) and from the tomb of Tutankhamun from the 14th century BC (with a gold hilt and a pommel of rock crystal). Richly decorated daggers with iron blades are mentioned in the dowry of the daughter of Tušratta, king of Mitanni in the 14th century BC, and iron daggers were valued gifts from Hittite kings and princes (Hattušili III; Zulannu, Prince of Carchemish) in the 13th century BC. Some finds from the southern Levant show that iron daggers and dirks continued to play a role in the Early Iron Age: from Tell el-Far'ah (S), Grave 542 (with a bronze hilt); Megiddo, hoard from Area Q (with an ivory hilt); and from Tell es-Sa'idiyeh (Figure 6).[4]

The adoption of iron daggers and dirks as status symbols in warrior graves in Cyprus and the central and southern Aegean around the mid-11th century BC (see Table 6) represents a quantum leap in the conceptualization of iron in these two regions – not only concerning the social value, but also in the understanding and appreciation of the technological potential of the new metal. The bimetallic dirk from the tomb of Psusennes I at Tanis in the Nile Delta is another clear indication of the high status of these weapons (Figure 17: 2). However, these new weapons from Cyprus and the Aegean are not related typologically to Levantine daggers. Instead, they are related to similar bronze weapons from the central Mediterranean, indicating the existence of a network of relationships during the second half of the 11th and the 10th century BC operating between southern Italy, southern Albania, the central and southern Aegean, and Cyprus (see Chapter 4.3).

This trend towards shorter weapons in the post-Mycenaean period (after the end of LH IIIC) and away from the longer cut-and-thrust swords, is widespread in the central and eastern Mediterranean and clearly reflects a change in methods of combat in favour of fighting with spears, together with dirks or daggers (for the warriors with a high social status) used for stabbing at close quarters. Discussing this change of combat in southern Italy during *Bronzo Finale 2*, Marco Pacciarelli argued that this increased importance of the spear reflects the extension of arms-carrying to broader sections of society coinciding with the transition to new forms of political-territorial and socio-economic organization. The dirk remained an important status symbol during the 10th and 9th centuries BC in southern Italy, as the bimetallic examples from Calabria and Basilicata and the ivory fittings on weapons from Torre Galli indicate. Further north, in Campania and Etruria, dirks were the first weapons made of iron in the mid-/second half of the 9th century BC, which underlines their role as markers of status.

The analysis of the dirks and daggers in Chapter 4.3, together with our conclusions concerning ring jewellery and knives, show that the central Mediterranean (particularly southern Italy and southern Albania) was part of a network of contacts also involving the Aegean and the East Mediterranean. This is important for our study, as it provides a culture-historical context for the introduction of iron in the central Mediterranean during the second half of the 11th century BC.

It is worth mentioning that daggers and dirks are otherwise not found among the early iron artefacts in southern Europe. The early iron and bimetallic daggers and dirks from the Caucasus and south of the Caspian Sea (Marlik) represent different traditions, apparently not related to the developments in the central and eastern Mediterranean.

Artefacts combining iron and bronze

As described above, and in Chapters 2 and 4, highly prized artefacts such as rings and daggers made of iron combined with other precious metals are known both from archaeological finds and from textual

[4] The piece from Tel Dor (Area G), with a bone handle, is more difficult to interpret: while the cross-section is clearly two-edged, the asymmetrical shape of the blade seems more appropriate for a one-edged knife. See Ben Basat 2018: 265 fig. 26.4: 9.

sources from the Near East and the Aegean during the Bronze Age. In the post-palatial period, artefacts combining iron and bronze are a characteristic feature of the archaeological record in certain regions during the earlier stages of iron use. The artefacts can be divided into three main categories:

Iron decoration on bronze artefacts

This practice seems to be typical for the stage when iron was not yet used for utilitarian artefacts, and was still more valuable than bronze. There are two main regional traditions: i) In the area north and north-west of the Alps, bronze solid-hilted swords, spearheads and bracelets with inlaid iron decoration, and bronze pins with iron applications are a feature of the later Urnfield period, approximately dating to the 9th century BC (see Figure 48). Similar kinds of decoration are also seen somewhat later in northern Italy (see, for example, Figure 59: 1). – ii) In the areas north and south of the Caucasus Mountains, inlaid iron decoration is found on bronze belt-hooks, shaft-hole axes and daggers.[5] In western Georgia and in the Koban culture, certain bronze artefacts (especially belt-hooks) with this kind of decoration represent the earliest evidence for iron. Iron 'incrustations' are also found on the openwork hilts of bronze daggers, for example from Serzhen Yurt in Chechnya; the similar bronze dagger with iron 'incrustations' from Gamów (Silesia) was presumably imported from the northern Caucasus.

Iron knives with bronze rivets

Iron knives with bronze rivets, dating to the 12th and 11th centuries BC, have been found most frequently in Cyprus, the Levant, and the central and southern Aegean (see, for example, the knives from Enkomi and Tel Miqne: Figure 9: 2; 41: 1). It is generally accepted that (most of) these early knives from the Aegean and the Levant were imported from Cyprus (see Chapter 3.5).[6] A similar interpretation might also apply to the iron knives with bronze rivets from Kakavijë in southern Albania and Budapest-Békásmegyer in Hungary, although this is by no means certain.[7] Knives with bronze rivets are also found quite frequently in the Iberian Peninsula and south-west France. These might also have been obtained through trade, but as they are not documented before the 9th century BC, they would most likely have been manufactured in Phoenician trading posts or colonies.

These brief comments show that the iron knives with bronze rivets potentially provide important information on the introduction of utilitarian iron in a number of areas. However, reliable conclusions must await future archaeometric studies, which might be able to demonstrate the provenance of the iron or bronze used in the manufacture of the knives (for Lead Isotope analyses of the bronze rivets on some knives in Israel, see Chapter 2.3).

Artefacts with integral parts made of bronze and iron

In my terminology, this constitutes true bimetallism: larger, utilitarian artefacts in which the iron blade is provided with a solid-cast bronze hilt/handle, a bronze tang, or a bronze socket. The most common

[5] For an excellent photograph of a shaft-hole axe with an inlaid iron snake from Klin-Yar, Grave 362, near Kislovodsk, see Belinskij and Härke 2018: pl. 2.

[6] See especially Waldbaum 1982; Sherratt 1994a.

[7] Note that one of the earliest iron objects in Transcaucasia might be another example of a knife with bronze rivets. Beshtasheni, Grave 13 in central Georgia apparently contained a flat iron (knife?) fragment with "two small bronze nails". See Chapter 7.1.

artefacts are daggers, dirks and swords;[8] followed by one-edged knives;[9] two-edged knives;[10] spearheads;[11] and, finally, an axe and a chisel.[12]

The bimetallic construction of these objects apparently reflects the desire of the blacksmiths to create innovative versions of bronze artefacts, at a time when they were not yet capable of manufacturing objects with such a complex design entirely of iron. Take, for example, the iron dirks, swords and knives provided with a flat bronze tang (e.g. Figure 17: 2; 25: 1; 29: 2; 57: 1.2). The cast-on join between the tang and the blade could hardly have been strong enough for effective use, and the main priority of the craftsmen must have been to integrate iron into an innovative version of a traditional bronze artefact – even though it might have been unsuitable for practical use.

Bimetallic artefacts were manufactured in many regions discussed in the previous chapters, and the bimetallic construction seems to have been an obvious technological solution for early craftsmen. As they were innovative and technologically demanding, the bimetallic artefacts probably had a high social value. From this point of view, the solid-hilted knife with a complex handle (in German: *Phantasiegriffmesser*) from the rich tumulus grave of the 9th century BC at Saint-Romain-de-Jalionas (Dép. Isère), which was made entirely of iron (with inlaid bronze ornamentation), must have been especially highly prized, as this level of blacksmithing skill was quite exceptional at that time in eastern France (see Chapter 9.3).

The bimetallic artefacts reinforce a general observation concerning the early iron artefacts: as far as we can tell, they were mainly manufactured locally, by indigenous craftsmen. The most important exceptions have already been discussed. Iron one-edged knives, which were an innovative form in some regions, were sometimes imported; and the same is very likely true for the early iron rings from Rhodes. It seems that trade in finished products was a feature of the earliest stage in the introduction of iron; thereafter, iron artefacts were almost always manufactured by local smiths.[13]

Iron billets and the iron trade

As explained in the previous paragraphs, it seems that the early iron artefacts found in Europe were mainly manufactured locally, whereas imported finished products were the exception. Paul Reinecke came to the same conclusion almost 100 years ago, in an article which is still well worth reading.[14] Reinecke believed that the diffusion of the technology of iron extractive metallurgy through Europe proceeded slowly. According to him, smelting iron ores at a significant scale began in the Aegean sometime before 1000 BC, then spread to southern Italy (9th century BC), central Italy (8th century BC), northern Italy and the north-west Balkans (6th/5th century BC), southern Germany (3rd/2nd century BC), and finally reached northern Germany and southern Scandinavia in the 1st century AD. He argued that the iron artefacts which were in circulation before the onset of local iron smelting must have been manufactured from raw material (iron billets) which had been obtained by trade from other regions in which iron

[8] Daggers, dirks or swords: with a flat tang (e.g. Figure 17: 2; 57: 1.2). — With a flanged tang (e.g. Figure 25: 1). — With a solid-cast hilt: these weapons are especially common in western and north-western Iran, in Transcaucasia and in the northern Caucasus; 'pre-Scythian' weapons of related types are also found in the area north of the Black Sea and in Central Europe (see Figure 53); further weapons with solid hilts are discussed in Chapter 2 (Tell el-Far'ah), Chapter 8 (examples in Albania and the north-west Balkans), Chapter 9 (e.g. Most, Mörigen, Neudegg, Nadarzyn, Schwaan) and Chapter 10 (e.g. Figure 56; 59: 5).

[9] One-edged knives: with a solid-cast handle (e.g. Figure 29: 1; 59: 2.4); further examples from Transylvania, northern Germany and Poland are mentioned in Chapter 9. — With a socket (Aurich, Tellingstedt, see Chapter 9). — With a short rod-shaped tang (Saint-Aubin-Sauges, Teugn, see Chapter 9). — With a flanged tang (Figure 29: 2), see also Kouvaras (Chapter 4).

[10] Two-edged knives: with a short rod-shaped tang, typical for the Bilozerka culture (e.g. Figure 27: 1-5). — See also the bronze solid-cast handle on the knife/dagger from Molino della Badia (Figure 58: 3).

[11] Spearheads: with a socket (Figure 57: 3.4), see also Chapter 9 (Nidau).

[12] For the chisel with a bronze socket from Baiões, see Figure 61: 10. — For the axe with a bronze socket from Brežec (Slovenia), see Chapter 8.

[13] In some rare cases, the bimetallic construction might possibly represent the repair of a broken (imported?) iron artefact. See, for example, the dirk from the tomb of Psusennes I at Tanis (Figure 17.2); the knife from Kouvaras in north-west Greece (Chapter 4.2); and the socketed axe from Brežec in Slovenia (Chapter 8.2). For tin alloy used to repair a broken iron fibula at Osteria dell'Osa in Latium, see Chapter 10.4.

[14] Reinecke 1926: 87: "Fast ausnahmslos gehören [die Formen der frühen Eisenfunde] dem bodenständigen Formenvorrat an, sie sind also zweifellos in den verschiedenen Gebieten in der Regel von einheimischen Metallarbeitern geschmiedet worden."

extractive metallurgy had already been established.[15] Enrico Lehnhardt, who has studied the evidence for the introduction of iron extractive metallurgy systematically, came to a similar conclusion: in Central and northern Europe, the production of iron by smelting iron ores was only introduced slowly, much later than the manufacture of the first iron artefacts.[16]

However, it should be emphasized that during the early stages in the introduction of iron there is little direct evidence either for trade in iron as a raw material, or for the smelting of locally occurring iron ores. In Chapter 2.1, it was explained that there is clear evidence that iron was exchanged as a raw material in the Near East, for example the request of the Assyrian king for 'good iron' from Hittite Kizzuwatna, or the mention of two talents of iron in an inventory from the house of the merchant Yabninu at Ugarit (both dating to the 13th century BC). Later, after the downfall of the palaces, evidence is scant. A rare mention of trade was discussed in Chapter 10.6: a passage in the *Odyssey* describing how the Taphians sailed to southern Italy with 'shining iron', which they exchanged for copper. On the other hand, there is metallographic evidence for the smelting of local ores in central Portugal reaching back to the 10th or 11th century BC (see Chapter 11.3). Local smelting of iron ores is also indicated by the characteristic tongue-shaped billets found in Romania as early as the second half of the 10th century BC (see, for example, Figure 45: 4).[17] For regions in which iron had replaced bronze for the manufacture of the whole range of utilitarian implements, we must also assume that the inhabitants were capable of producing iron, and local iron ores were being systematically exploited. For example, this is surely the case in the area of the Basarabi culture from the late 9th century BC onwards (see Chapter 9.4).

We may conclude from the examples mentioned above that the technique of iron smelting could, given favourable conditions (such as the availability of easily smelted ores, intensive contact with craftsmen from more advanced regions), be learned quickly. While it seems very likely that iron was also traded as a raw material, it is true that this has left very little traces in the archaeological record. However, for the following reasons it appears plausible that the early iron trunnion axes served as iron billets, at least in some regions: i) As mentioned in Chapter 4.4, copper or bronze ingots in the shape of trunnion axes were sometimes used in the central Mediterranean during the 11th and 10th centuries BC; ii) Trunnion axes are found especially frequently in eastern Bulgaria, where many of them seem to have come from hoards made up exclusively of iron trunnion axes; this suggests that these objects had a special role, considering that iron tools are otherwise rare at this time in the eastern Balkan Peninsula; iii) The scattered distribution of early iron trunnion axes – between Spain and Ukraine – is surely a result of trade.[18] iv) At a time when iron was such a rare commodity in these far-flung regions, it is hardly likely that they were all used as simple tools. If, during the early stages of its introduction, iron was traded over long distances as a raw material, perhaps the iron billets were sometimes in the shape of trunnion axes.

Conclusions

The supra-regional treatment of the introduction of iron in Europe and Western Asia has shown the importance of particular and specific forms of artefacts during the earliest stages of ironworking. These forms are encountered in distinct regional horizons, which reflect different conceptualizations of iron and different ways in which the new metal was introduced (see Figure 64).

The commonest and most significant forms are ring jewellery and knives. The 'ring horizon' in the Near East can already be detected in the 13th century BC. The use of iron specifically for rings can presumably

[15] Reinecke 1926: 95: "Alle die Eisengegenstände, die aus Zeiten vor dem Aufkommen heimischer Eisengewinnung in den einzelnen Gebieten stammen, sind dann eben aus einem Rohmaterial hergestellt, das im Handel aus anderen, damals schon Eisen produzierenden Teilen des altweltgeschichtlichen Kreises bezogen worden ist, um im Lande selbst verarbeitet zu werden."
[16] See Lehnhardt 2019: 237 f.; 296 f.; 330 f.; 346.
[17] These billets reproduce the traditional form used for copper/bronze ingots in Central Europe during the Late Bronze Age; see Chapter 6.3 (Lozna) and Chapter 9.1 (Cernat, Teleac).
[18] See the following trunnion axes: Leskovac, Serbia (Chapter 8.4); Pećina na Gradini, Istria (Chapter 8.1); Cernat, Transylvania (Chapter 9.1; Figure 45: 5); Bârlad, Romanian Moldavia (Chapter 6.3); Nedilyska, Galicia, Ukraine (Chapter 6.3); El Berrueco and Campotéjar, Spain (Chapter 11.4).

be explained by the rings still retaining some of the traditional symbolic meaning known from precious rings earlier in the 2nd millennium BC. Iron knives were introduced slightly later, in Cyprus at around 1200 BC. The choice of knives can probably be explained by the simple flat form of these implements, which made them relatively easy for the early blacksmiths to manufacture.

Iron weapons appear somewhat later, during the 11th century BC, in the Levant, Cyprus, the Aegean, Transcaucasia and northern Iran. In the following century, production of iron weapons spread to further regions in south-east Europe (especially the northern Aegean, the eastern Balkan Peninsula and southern Italy). The local production of weapons (daggers, dirks, swords, spearheads) often began with bimetallic forms, in which the iron blade was provided with a hilt, tang or socket of bronze. Finally, in some areas, iron seems to have been treated as a precious metal, used to decorate bronze weapons and items of jewellery. This practice is typical for the Urnfield culture north and north-west of the Alps, and in regions north and south of the Caucasus.

In many regions of Europe and Western Asia, the earliest iron artefacts indicate a pronounced preference for one or two of these specific forms. In the archaeological record, this is reflected in distinct 'horizons' (Figure 64). The situation in Central Europe, with its scattered distribution of small iron objects, appears to be an exception to this rule and requires further comment (see Chapter 9.2 and the scatter of 'miscellaneous objects' in the area north of the Alps on Figure 65). Although small iron rings are encountered quite frequently, these often come from early discoveries lacking precise documentation.[19] In the case of the iron rivets reported on five bronze artefacts dating to the 11th or 10th century BC, the identification as metallic iron needs to be confirmed by modern scientific analysis.[20] Finally, our discussion of the small rod-shaped objects ('awls', 'chisels', 'pin-fragments', etc.) showed that these artefacts should be treated with caution.[21] As explained above, many of the rod-shaped objects are exceptionally, indeed suspiciously early. While they could be the result of one-off production of small amounts of iron, it is more likely that many of them are actually much more recent, and do not belong to the early contexts. In summary, many of the earliest iron artefacts from Central Europe are difficult to interpret; further detailed research will hopefully clarify the situation in the future.[22]

12.2 Summary of the main trends in the introduction of iron

The following pages provide a brief resumé of the results of the present study. It must be emphasized that the interpretation of the available evidence is often difficult, and this summary should be understood as an introduction to the arguments discussed in detail in the preceding chapters. The introduction of ironworking in the Near East has already been summarized in Chapter 2.4, and only a brief outline is offered below.

Meteoritic iron

The available archaeometallurgical analyses make it likely that the earliest known iron artefacts were made from meteoritic iron. These objects were clearly very valuable: they are often combined with gold and other precious materials, and frequently come from richly furnished graves. The iron artefacts and their contexts have been discussed in the previous chapters: from Egypt, Anatolia, Mesopotamia and the Levant (Chapter 2.2);[23] from the Yamnaya and Catacomb cultures in the Pontic-Caspian steppe (Chapter 6); from the Minoan and Mycenaean Aegean (Chapter 4.1); and from the hoard of gold and silver vessels from Villena in south-east Spain (Chapter 11.1). The artefacts of meteoritic iron range widely in date.

[19] See the examples from Champigny, Babenhausen, Bad Nauheim, Jenišovice and Maškovice.
[20] From Han-sur-Lesse, Custines, Bad Nauheim, Buchlovice and Horní Lideč.
[21] In Central Europe from: Kitzbühel, Völs, Staňkovice and Sopron-Krautacker.
[22] Compare the case of France, where detailed archival research has recently shown that the early dating of some iron objects is incorrect or unreliable. See Jambon et al. 2022.
[23] In a recent publication, it has been argued that the bead from the rich Early Bronze Age tomb at Umm el-Marra in Syria was made from a piece of iron meteorite. See Jambon 2024 and Chapter 2.2

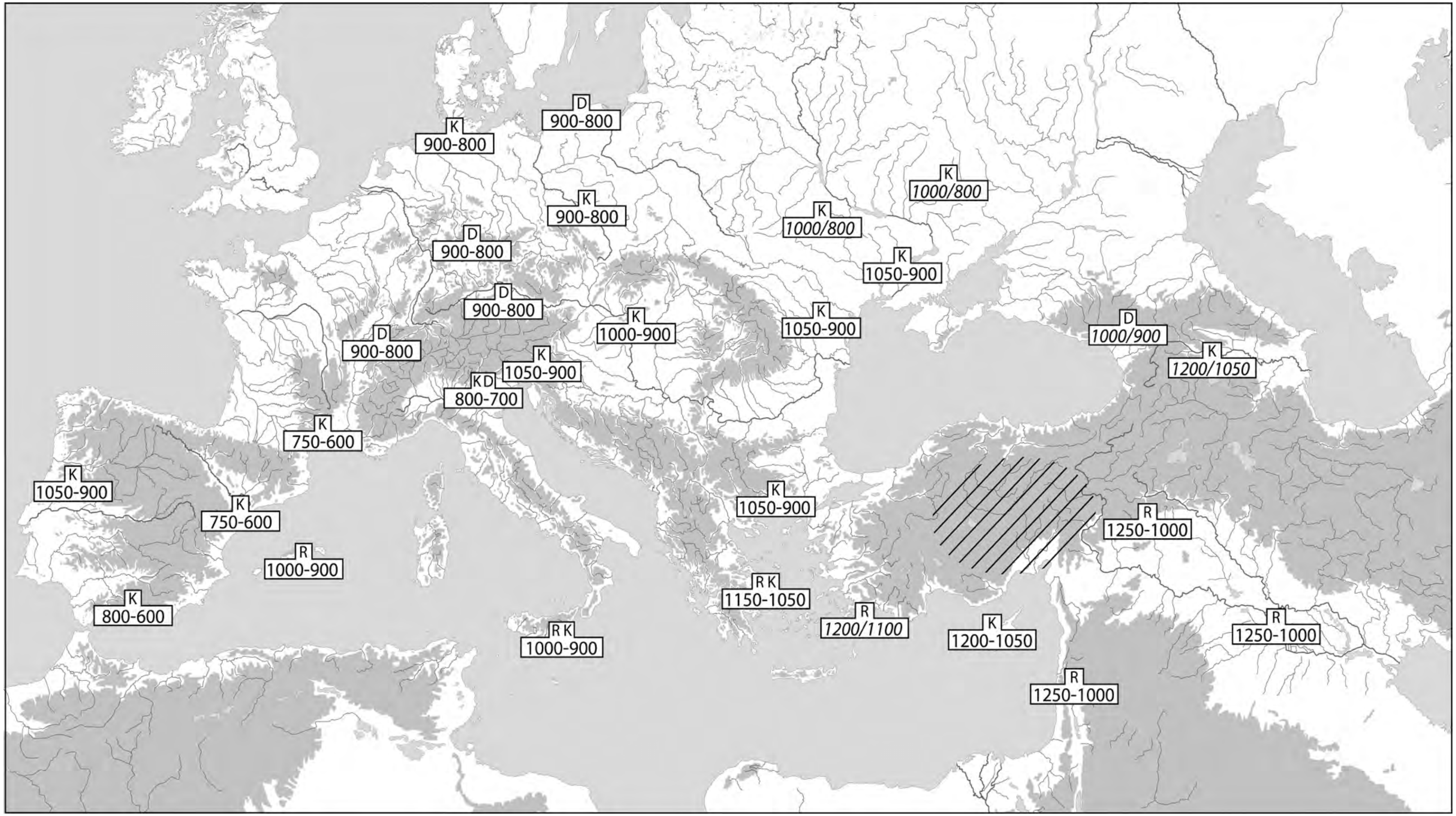

Figure 64. Before the use of iron as a general-purpose metal for making a diverse range of artefacts, iron was often used to manufacture a restricted range of specific and singular types of artefacts. In the archaeological record, this practice is visible as 'ring horizons' (R), 'knife horizons' (K) and in the form of iron used as a decorative metal on bronze artefacts (D). The approximate duration of the horizons is indicated in centuries/half-centuries; for cases where the chronology is especially uncertain, the dates are printed in italics. The approximate area where iron production began is shown by oblique hatching.

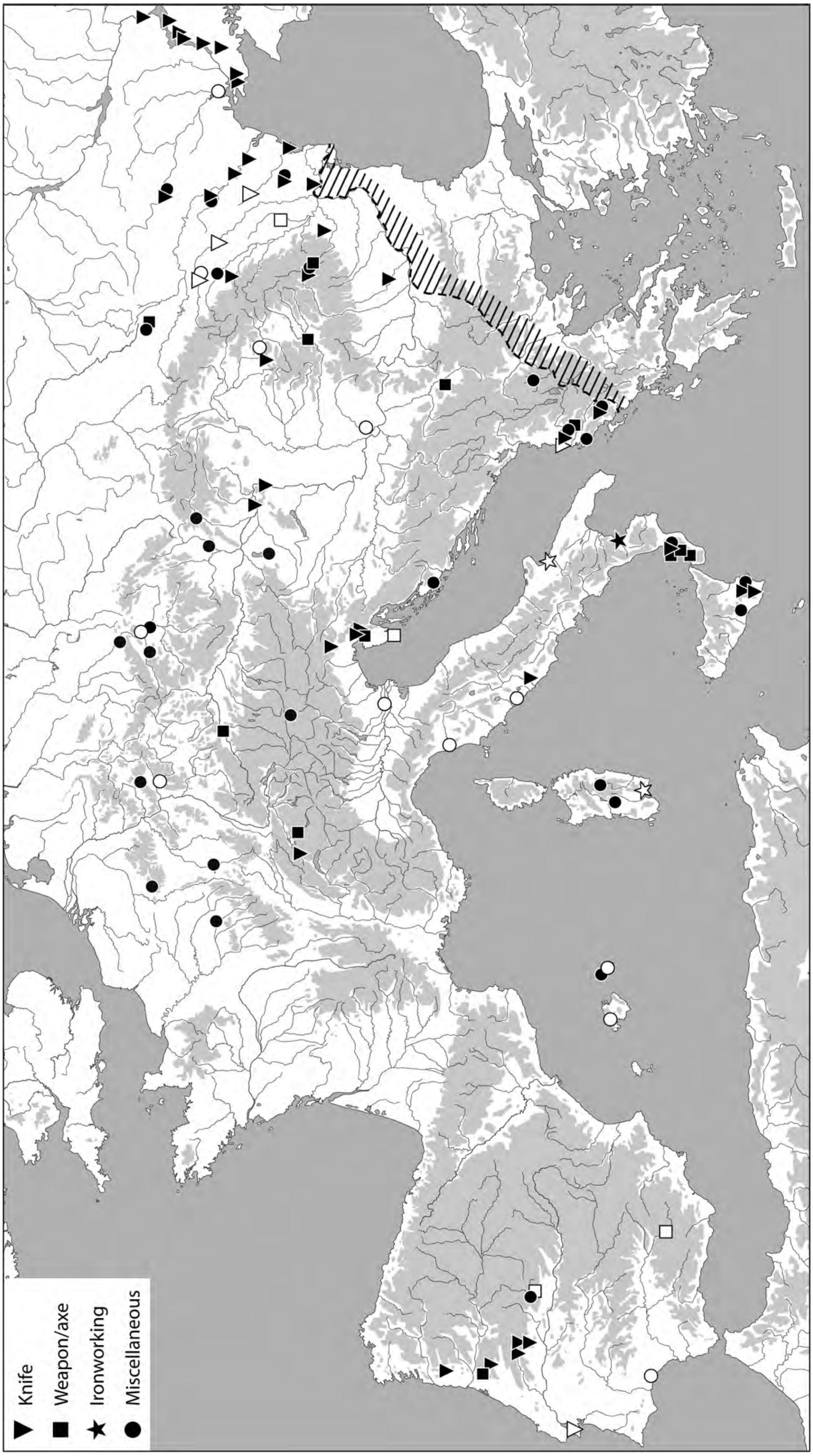

Figure 65. Distribution map of iron artefacts in Europe dating between ca. 1200 and ca. 900 BC. In the regions to the south-east of the hatched border, there is evidence for intensive ironworking already in the 10th century BC. — Empty symbols: uncertain objects.

While the earliest reach back to the second half of the 4th millennium BC (el-Gerzeh, Egypt), the latest reliably dated examples belong in the 14th century BC.[24]

The descriptions of various items in cuneiform texts written between the 20th and the 14th century BC from Kültepe, Mari, Sippar, Susa and Qatna show how iron was treated as a precious metal.[25] Other Anatolian and Mesopotamian texts make it clear that iron was weighed in tiny units, and was much more valuable than silver and even gold (see Chapter 2.1). The special value accorded to iron can presumably be explained by the belief, expressed both in Egyptian and Hittite texts, that iron came 'from the sky'; indeed, this belief in the celestial origin of iron was probably widespread in the Near East. This goes some way to explain the use of iron as a metaphor to express qualities such as durability, strength and legitimacy in the Hittite and Egyptian written sources.

The origins of wrought iron production

The main evidence for the introduction of wrought iron (smelted in the bloomery furnace) is the increased quantity of iron in circulation, i.e. the transformation of iron from a precious to a base metal. The large amounts of iron mentioned in the written sources of the 13th century BC show that wrought iron was available in some regions of the Near East at that time. The 'Inventory of Gifts from Tušratta' could be interpreted as evidence for smelted iron in the kingdom of Mitanni already in the mid-14th century BC;[26] otherwise, written evidence for an earlier introduction of smelted iron derives exclusively from the Hittite kingdom.

Some Old and Middle Hittite texts seem to indicate the introduction of wrought iron before the 13th century BC. The amounts of iron objects mentioned in a variety of contexts (regal insignia, gifts at religious festivals, used in ritual foundation depositions) appear too large for rare meteoritic iron. Furthermore, it seems unlikely that the specialist craftsmen ('iron makers') mentioned in the texts only worked with meteoritic iron. It is plausible, therefore, that iron smelting had been introduced in the Hittite kingdom at some time before the later 14th century BC – perhaps already around the middle of the 2nd millennium BC.

The earliest definite artefact of smelted iron comes from a workshop in the palace at Kamid el-Loz in Lebanon, dating to the mid-14th century BC. A finger ring and chisel from Boğazköy/Hattuša are probably somewhat earlier; however, the stratigraphic context is not beyond doubt.

As this brief summary indicates, we know next to nothing about the discovery and initial stages of iron extractive metallurgy. However, it is certain that iron ores were smelted in the 14th century BC, and most likely that the production of wrought iron was already established in the Hittite kingdom from around the mid-2nd millennium BC.

There is another aspect which is highly significant. The fact that iron has hardly ever been found during excavations at Hittite sites indicates that the technologies of smelting and blacksmithing must have been restricted to workshops dependent on the palatial élite, and the circulation of iron was tightly controlled. Indeed, iron finds remain uncommon in the whole of the Near East even during the 13th century BC. The apparent contradiction between the relatively numerous iron objects mentioned in the texts, and the paucity of iron finds, suggests that (wrought) iron still had a special status, even though it no longer had a celestial origin. The situation began to change with the 'ring horizon' (see below).

[24] In two cases, a date in the 13th century BC is possible: while it seems certain that the hoard from Villena is earlier than ca. 1200 BC, it could equally well date to the 13th or 14th century BC; a signet ring from the citadel of Mycenae could date either to LH IIIA or IIIB (ca. 14th-13th century BC). — For later artefacts made of meteoritic iron from Switzerland and Poland, see Chapter 9.2 (for new analyses of ornaments made of meteoritic iron from Early Iron Age Poland, see Jambon et al. [in press]).
[25] For the etymology of the common terms for iron (*parzillum*, AN.BAR), see Table 3.
[26] In the 'Inventory', the use of two terms for iron (AN.BAR and *habalkinnu*) could indicate the presence of both meteoritic and smelted iron. Furthermore, the quantity of iron objects seems rather large for meteoritic iron.

The 'mid-13th century' hypothesis

The available evidence suggests that there was a marked increase in iron production after the middle of the 13th century BC, and the manufacture of iron spread to most parts of the Near East in the course of the second half of the century.

Large quantities of iron artefacts are first documented in Hittite texts – administrative inventories, tax lists, descriptions of cult images – during the reigns of Hattušili III and Tudhaliya IV (ca. 1267-1209 BC), and most of the inventories can be dated to the second half of the 13th century BC. Further evidence for the increased use of iron during the second half of the 13th century BC comes from Mesopotamia and Syria (Assur, Tell Sheikh Hamad, Ugarit), where iron was now treated as a base metal.

The 'Hattušili letter', written in about 1265 BC, belongs to a time when iron was much less common. The Assyrian king, Adad-nirari I, was apparently unable to obtain iron in his own kingdom. And Hattušili's statement that he was unable to obtain good iron must have been plausible, if not entirely convincing. Furthermore, Hattušili's gift of a single iron dagger blade suggests that iron was still a rare and prized commodity. Whether there was a Hittite 'monopoly' controlling the supply of wrought iron, and how long it might have functioned, is uncertain. However, it does seem to be true that the technology of iron production spread quickly after the mid-13th century BC. This took place at the time of the decline of the Hittite kingdom in the face of external threats, which were particularly severe during the reign of Tudhaliya IV, and undermined the hegemonial position of the centralized Hittite state.

Unfortunately, the available archaeological sources do not supply substantial information concerning the 'mid-13th century' hypothesis. Although the quantity of iron artefacts doubtless increased during the 13th century BC, especially in the form of iron ring jewellery, it is hardly ever possible to date the artefacts more closely to either before or after the mid-13th century BC.[27]

The 'ring horizon'

The 'ring horizon' has been described in detail in Chapters 2.3 and 12.1, and only a few brief comments are necessary here.

Iron rings represent the first regular use of iron detectable in the archaeological record. During the 12th and 11th centuries BC, ring jewellery is the predominant form of iron artefact known from the Near East, and finds from a number of sites in Mesopotamia and the Levant indicate that the 'ring horizon' already began in the 13th century BC.[28] It is notable that utilitarian artefacts are very rare during the 'ring horizon' and, when found, are confined almost exclusively to the coastal Levant (for a schematic map, see Figure 7). It seems that for a period of more than two centuries, the early Near Eastern blacksmiths concentrated on producing ring jewellery, and little else.

The rings were made of wrought iron and have a simple, plain design (for examples, see Figure 3). The 'ring horizon' seems to reflect a low level of technology in non-specialist workshops. The extremely wide distribution of iron rings points to a decentralized, sub-élite organisation of production. According to the 'mid-13th century' hypothesis, the technology of iron production apparently escaped the palaces during the second half of the century: the de-centralized production of the 'ring horizon' stands in stark contrast to the highly centralized control of the iron supply in the Hittite kingdom. The spread of iron production throughout the Near East was probably encouraged by increased mobility and migration from the second half of the 13th century BC onwards, portents of the collapse of the Late Bronze Age palatial system .

[27] But note the stratigraphy at the Middle Assyrian site of Tell Sabi Abyad in northern Syria (Chapter 2.3); and the 'chisel' from the Mycenaean palace at Thebes in Boeotia (Chapter 4.1).

[28] See Chapter 2.3: Babylon, Assur and Tell Sabi Abyad in Mesopotamia; Tel Nami, Megiddo and a burial cave in the Baq'ah Valley in the southern Levant.

Cyprus and the first 'knife horizons'

Iron knives play an important role in the diffusion of iron during the 12th and the first half of the 11th century BC; they were first manufactured in Cyprus, and then spread to the Aegean and the Levant coast.

In Cyprus, the first iron artefacts appear in the archaeological record around 1200 BC, and there can hardly be any doubt that the technology of iron production was brought to the island during the Crisis Years by immigrant smiths from Anatolia or the Levant. Apart from a single bimetallic (iron and gold) finger ring, iron first appears in the form of implements with a simple design: one-edged and two-edged knives, spatulae, 'chisels' and a dress-pin (Figure 9). The spectrums of artefacts found in tombs and from settlement contexts hardly differ, indicating that iron production was, indeed, at first restricted to these kinds of object, which were relatively easy for the blacksmiths to make. The knives represent the dominant category of artefacts during the 12th and the first half of the 11th century BC (LC IIIA-B): the total number of knives from Cypriot tombs and settlements exceeds 26; when examples with uncertain chronology are included, the number reaches almost 40 knives and blade fragments.

In Cyprus, two-edged knives were the typical cutting implement during the Late Bronze Age. Bronze one-edged knives had been introduced in the 13th century BC, and the one-edged form became predominant when knives were manufactured from iron (see above, Chapters 3.1 and 12.1). When preserved, the rivets on the iron one-edged knives are always made of bronze in LC IIIA and IIIB. These early iron implements have a special importance, as they show that Cyprus was probably the main producer of utilitarian iron implements during the 12th century BC. Because of the dynamic development in the production of utilitarian implements, and especially knives, Cyprus plays a paramount role in the diffusion of iron towards the end of the 2nd millennium BC.

As we have seen in the discussion of the 'ring horizon', iron was mainly used for manufacturing ring jewellery in the Near East at this time. The iron knives which appear along the coast of the Levant towards the end of the 12th century BC mark an important departure (see Figures 5 and 7). It is highly likely that the early knives, often with bronze rivets, were manufactured in Cyprus; however, as Lead Isotope analyses have demonstrated, iron knives were certainly manufactured locally in the southern Levant during the first half of the 10th century BC, and production may have started considerably earlier.

The situation in the Aegean is comparable with the Levant. During the 12th and the first half of the 11th century BC, the find spectrum in central Greece, the Cyclades and Crete is dominated by knives – the main exceptions being the ring jewellery from Rhodes, which seems to be related to the Near Eastern 'ring horizon', and the Submycenaean finger rings (Figures 13 and 15). The first knives appear in the Aegean during the second half of the 12th century BC; the rivets, when preserved, are made of bronze. Once again, it is most likely that the early knives were imported from Cyprus.

These early iron finds have long been the object of academic discussion. Susan Sherratt has argued that the coastal centres of Cyprus were at the vanguard of a "commercial revolution", practising a new kind of decentralized, entrepreneurial trade, with the iron knives being one of the new commodities which were exported from Cyprus to the Levant and the Aegean since the second half of the 12th century BC. However, there are other possible explanations for the intensive contacts with Cyprus, particularly in the Levant. Cyprus suffered profound upheavals at the LC IIIA/B transition, and there is considerable evidence for Aegean and Cypriot immigration in the Levant in the later 12th century BC. Whatever explanatory model should be applied (entrepreneurial commerce or mobility/migration), the early 'knife horizons' in Cyprus, the Aegean and the coastal Levant represent a crucial milestone in the diffusion of iron.

The 'maritime horizon'

The 'maritime horizon' denotes a time when the use of iron spread rapidly to many coastal areas of southern Europe – between Portugal in the west and Ukraine in the east. This massive geographical expansion in the use of iron can be appreciated, for example, just by considering the new 'knife horizons': in the northern Aegean, in the area north of the Black Sea, on the east coast of the Ionian Sea, around the head of the Adriatic and in Portugal (see Figure 64).

In view of the wide geographical scale of this stage in the diffusion of iron, it is very unlikely that it can be explained by the activities of seafarers and traders from a single region, such as Cyprus. It is more plausible that iron and ironworking were transmitted through a network of exchange relations involving a multitude of partners. Following this reasoning, it is unlikely that the massive expansion of the use of iron could have taken place before local production of iron was established in central Greece, during the second quarter of the 11th century BC.[29] Accordingly, the 'maritime horizon' probably started around the second quarter or the middle of the 11th century BC.

This was a crucial moment in the development of ironworking in the Mediterranean. Around the mid-11th century BC there was a very significant increase in the range of iron artefacts produced in Cyprus, now including daggers/dirks, spearheads, arrowheads, roasting spits, fibulae, etc. Furthermore, Cyprus and central Greece were in very close contact, as demonstrated by the furnishings in warrior graves (see Table 6). The fact that iron was now used for weapons in Cyprus and in the central and southern Aegean must have been a very significant boost for the *renommé* of the new metal.

As explained in previous chapters, at the time of the 'maritime horizon' there is a considerable amount of evidence for trading contacts linking the coastal areas involved, including amber beads of Tiryns and Allumiere type, glass beads made with the 'mixed alkali' recipe, and various artefacts made of ivory.[30] In some areas we see the introduction of the first fibulae.[31] And the one-edged knife with rivetted tang, itself, was an innovation which was adopted in certain regions at this time (especially north of the Black Sea in the Bilozerka culture, and in the western Iberian Peninsula). In view of this relatively close network of sea-borne contacts, it is likely that knowledge of the new metal spread rapidly. However, the available evidence for iron during the second half of the 11th and the first half of the 10th century BC is sparse and sporadic, and heavily dependent on the level of excavation and publication in the various areas. The archaeological record probably only gives us a very incomplete picture of the 'maritime horizon'. In the following paragraphs the most important evidence for the 'maritime horizon' will be summarized briefly.

The Aegean, the east coast of the Ionian Sea, southern Italy and Sicily were in close contact at the time of the 'maritime horizon', as the adoption of new types of weaponry and methods of combat in all these areas around the mid-11th century BC indicates (see Chapters 4.3 and 12.1). Iron was produced in southern Italy at Broglio di Trebisacce (Calabria), where the locally produced pottery has parallels in the Peloponnese and in Cyprus. And in Sicily, the specific selection of the earliest iron grave furnishings – finger rings and knives – is similar to Submycenaean Greece, suggesting that the two areas were in contact during the 11th century BC (see Chapter 12.1).

Further north, the two knives dating to the second half of the 11th or the 10th century BC from western Slovenia are the earliest reliable iron finds from the head of the Adriatic. Iron finds of the 11th century BC are known from Sardinia, from the *tombe dei giganti* at Bidistili and Motrox 'e Bois. The latter tomb also contained amber beads of Tiryns and possibly Allumiere type, which are also encountered at other sites with finds of the 'maritime horizon'.

The early iron knives from Portugal, dating to the 11th and 10th centuries BC, are the most impressive evidence for long-distance trading contacts in the 'maritime horizon'. As explained in Chapter 11.3, this

[29] Note also the eight blacksmiths' hearths uncovered at Phocaea which, according to the excavators, date to the Submycenaean period (see Chapter 4.2).
[30] Tiryns and Allumiere amber beads, see Chapters 6.2 and 10.3; 'mixed alkali' glass beads, see Chapter 6.1-2; ivory, see Chapters 4.2 and 10.5-6.
[31] Arched fibulae, see Chapters 6.1 and 7.1; two-looped fibulae with a triangular outline, see Chapters 5.2 and 6.1; early two-looped fibulae in the Iberian Peninsula, see Chapter 11.3.

surely reflects the strong demand for metals (gold, silver, tin), which were all available in the southern and south-western Iberian Peninsula. As mentioned above, the one-edged knife design represents an innovation at this time, and there is much more evidence for contact with distant trading partners in the central and eastern Mediterranean (see Figure 63). In view of this sea-borne traffic to south-west Iberia, it is not unlikely that iron was also adopted in the Balearic Islands during the 'maritime horizon' (see Chapter 11.4).

Turning to the east, the earliest iron artefacts from Hordiivka, a bimetallic knife and a fragmentary rivetted knife handle, are particularly important. The former piece is closely related to two bimetallic knives from Thasos (Figure 29). The amber beads of Tiryns and Allumiere type, the 'mixed alkali' glass beads, and the earliest fibulae (Figure 28) are material remains of the coastal trade passing from central Greece to Thasos, the mouth of the Danube and the region north of the Black Sea (Bilozerka culture, Hordiivka). This forms the backdrop to the 'knife horizon' between the Carpathian Mountains and the Dnipro, which probably started around the middle of the 11th century BC (Figure 26).[32]

The evidence for the 'maritime horizon' has been discussed in detail in previous chapters. There can be little doubt that the second half of the 11th and the first half of the 10th centuries BC mark a crucial turning point in the introduction of iron in southern Europe. Unfortunately, little is known how, exactly, iron and ironworking were transmitted. The finds from central Portugal are an exception: in this case, recent archaeometallurgical research was able to demonstrate that the early knives were made of iron smelted from local ores, showing that a true transfer of technology had taken place. In other areas, it is possible that iron billets were carried on ships along the coast, as illustrated by the tale in the *Odyssey* of the Taphians sailing to Temesa (see Chapter 10.6).

The question of Transcaucasia

Against the background of the discussion in the last two sections (the earliest 'knife horizons', and the 'maritime horizon') the case of the introduction of iron in central Transcaucasia is potentially very important. As explained in Chapter 7.1, according to the widely used, 'conventional' chronology, two stages can be distinguished. The first iron artefacts appear between the second half of the 13th and the first half of the 11th century BC, in the form of at least four one-edged knives.[33] Then, from the middle of the 11th century onwards until sometime in the second half of the 10th century BC, iron was used alongside bronze for tools and weapons (swords, dirks, daggers, socketed spearheads, arrowheads, etc.; also, bimetallic weapons).[34] This result is particularly significant, because it mirrors the very similar and contemporary developments in the Aegean and Cyprus. At first sight, one might think that the parallel development in central Transcaucasia cannot be coincidental. However, the similar and contemporary development of ironworking in these areas can be explained in two different ways:

1. In the diffusionist scenario, the innovation of ironworking was somehow transmitted to Transcaucasia from the Aegean. Perhaps the earliest knives were imported, alternatively there was a transfer of technology, or the foreign seafarers just brought the idea of manufacturing iron one-edged knives. The intensification of iron production following the mid-11th century BC could likewise be explained by contact with the Aegean. And in this case, there is corroborating evidence for such contact, because the first fibulae were introduced to Transcaucasia at just this time (the arched fibulae with unthickened bow, see Figure 35), an innovation which can only be explained by long-distance, sea-borne relations with the western Black Sea, and ultimately the Aegean. This transfer of technological impulses by contact with seafaring Aegean traders around the mid-11th century BC would consequently be part of the 'maritime horizon'.

[32] The state of research is less advanced in Bulgaria. However, the early two-looped triangular fibulae, for example, show that eastern Bulgaria was involved in supra-regional exchange (see, for example, Figure 20: 1.2). And the iron knife from Sava-Tsonevo might well date to the 11th century BC (see Chapter 5).

[33] Late Bronze Age III and the Early stage of the Transitional phase in central Georgia.

[34] The Fully Developed stage of the Transitional phase in central Georgia, and Iron Age 1A in Armenia.

2. In the alternative scenario, the parallel developments in Transcaucasia and the Aegean are understood as a case of convergent evolution. The blacksmiths' decision to make iron knives did not require an external impulse: because of its simple, flat shape, it was the easiest artefact for the fledgling smiths to manufacture (the 'default setting'). And the technology of iron smelting could have spread to Transcaucasia from Mesopotamia rather than the Aegean. As for the intensification and diversification of ironworking in the second half of the 11th century BC, this might not be as exceptional as it seems. It is true that this production of iron tools and weapons in central Transcaucasia appears to be more advanced than in most areas of the Near East. However, iron weapons (including spearheads and daggers) were apparently produced during the 11th century BC south of the Caspian Sea at Marlik, and only slightly later in north-west Iran, Luristan and northern Mesopotamia (see Chapter 2.3). Furthermore, the absolute chronology of the Samtavro culture in central and eastern Georgia is open to doubt: the production of iron weapons and tools could have started later than envisaged in the conventional chronology.

Unfortunately, the present state of research does not allow reliable conclusions about these two scenarios. It remains an open question whether there existed a privileged relationship between Transcaucasia and the Aegean. The relative and absolute chronology of the contexts containing early iron finds, particularly in central Georgia, urgently requires new research (including a programme of radiocarbon dating). The problem is exacerbated by the fact that we know so little about the development of ironworking in surrounding areas, such as Azerbaijan and eastern Turkey; and the imprecise chronology of the relevant period in north-west Iran also makes it impossible to gain a detailed understanding of how ironworking developed. These comments raise the more general question of the transition to using iron for utilitarian artefacts after the 'ring horizon' in the Near East. While we know that iron was used for a wide range of utilitarian artefacts during the 9th century BC in most parts of the Near East, the evidence for the start of production of iron tools and weapons during the 11th and 10th centuries BC is patchy, and the chronological resolution is often unsatisfactory.

Intensification and diversification of iron production during the 10th century BC

In the East Mediterranean and the Aegean, the use of iron was increasing during the second half of the 11th and the first half of the 10th centuries BC, but most of the artefacts were still small in size and simple in design. The restricted spectrum of iron artefacts in circulation during Iron I in the southern Levant was described in Chapter 2.3 (for example at Khirbet Qeiyafa and Megiddo). In Cyprus and the Aegean, larger iron artefacts are mainly found in élite burials. This is the case for Cyprus during Cypro-Geometric I, where dirks and daggers, spearheads and roasting spits were manufactured for high-status individuals (e.g. Figure 11). And Ian Morris has argued that iron was still a prestigious metal in the Aegean during the Early and Middle Protogeometric period (see Chapter 4.5).

In the course of the 10th century BC the situation changed. Naama Yahalom-Mack and Adi Eliyahu-Behar have described the onset of intensive iron production, and the structural change in its organization, during the second half of the 10th century BC in the southern Levant (see Chapter 2.3). And after the mid-10th century, iron was used much more widely in Cyprus and the Aegean. Iron was now the main metal for making weapons – not only for the dagger-bearing élite, but also for the rank-and-file spearmen. Iron was also used for a wider range of utilitarian implements, such as axes and horse bits.[35] The manufacture of iron swords, found in large numbers particularly in the area between Macedonia, Thrace and the Lower Danube, is another new development in the 10th century BC (see Figure 24). Iron sword production seems to have started in the earlier 10th century BC in the south (Vergina) and later in the north (northern Bulgaria), where the transition from bronze to iron took place at some point during the second half of the century. In view of the large number of these swords, it is likely that they were made from metal which was smelted in these regions.

[35] The broader spectrum of artefacts can be illustrated by the contents of two tombs: the Toumba tomb at Lefkandi (Euboea) contained a sword, a spear, a razor, a knife, four iron pins, and two horse bits made of iron; Marmaro Tomb 44 at Ialysos (Rhodes) was furnished with a dirk, a dagger, a spear, a ferrule, a knife, a 'sickle', and a roasting spit of iron. See Chapter 4.4.

As they were used as cutting tools, presumably for woodworking, the iron trunnion axes can be considered as emblematic for the diversification of iron production during the 10th century BC. The transition from bronze to iron axes probably took place sometime around the mid-century both in the East Mediterranean and in the Aegean. It is particularly interesting that early forms of trunnion axes are found in considerable numbers in eastern Bulgaria (for examples, see Figure 19). In Chapter 12.1, it was argued that alongside their primary function as tools, trunnion axes could also have served as billets for the exchange of iron as a raw material. This would explain the scattered distribution of early forms of iron trunnion axe, reaching southern Serbia, Moldavia, Transylvania, Galicia (western Ukraine), Istria and the Iberian Peninsula (Andalusia and the north-west Meseta). The tongue-shaped billets found at three sites in Transylvania and Moldavia are further evidence that iron was exchanged as a raw material during the second half of the 10th century BC (see Chapters 6.3 and 9.1). At this time, there is much less evidence for iron further west, in the Carpathian Basin; and further east, north of the Black Sea, the use of iron was much more restricted, mainly confined to producing knives (see Figures 26 and 46).

Viewed at a European scale, the intensification of iron production in the Aegean and the eastern Balkan Peninsula during the 10th century BC is clearly of great importance. But the production of utilitarian iron artefacts (especially weaponry) also increased greatly in western Greece and southern Albania, as shown by sites such as Stamna, Liatovouni and Lofkënd. This represents a massive change compared to the situation in the 11th and early 10th century BC, when iron artefacts were still uncommon outside the central and southern Aegean (compare Figure 16).

The north-west Caucasus and the 'pre-Scythian horizon'

In the regions north of the Caucasus, iron was still a rare and prized commodity during the 11th and 10th centuries BC; it was occasionally used as a decorative metal, for example as an inlay on belt-hooks or daggers. According to the general academic consensus, the situation changed abruptly around 900 BC. In the area between the Kuban River, Chechnya and South Ossetia, iron was introduced at this time for utilitarian implements. Initially, the new metal was apparently mainly used for manufacturing one-edged knives and bimetallic daggers. In the course of the 9th century BC, ironworking developed rapidly, particularly in the regions to the north-west of the Caucasus Mountains (see Figure 30: the Western group of the Koban culture, and the Eastern group of the Proto-Maeotian culture). For a number of reasons, it is most likely that the technology of iron production reached these areas from Transcaucasia, where iron tools and weapons were already manufactured much earlier.

The rapid development of ironworking in the north-west Caucasus has a special significance, as it represents an important element in the emergence of the pre-Scythian phenomenon. At this time, similar types of artefacts, especially 'Pontic-Caucasian' harness components and iron and bimetallic weapons, were distributed throughout a vast area. The pre-Scythian phenomenon involved technological, economic, cultural and ideological innovations which galvanized the steppe. This transformation, marking the start of the Early Iron Age, seems to have combined two separate developments. On the one hand, environmental change in the North Pontic steppe between the 12th and 10th centuries BC had led to the adoption of a mobile, nomadic lifestyle and the birth of an equestrian, steppe-orientated identity.[36] On the other hand, a profound change in social and economic organisation occurred at the transition from the Final Bronze Age to the Early Iron Age in the area north-west of the Caucasus. At this time, extensive flat inhumation cemeteries were established, with a distinctly new material culture. And in the Caucasian Mineral Waters region (in the Western group of the Koban culture), large settlements were founded in the lowlands, now practising an agricultural rather than a pastoral economy. This structural transformation in the north-west Caucasus seems to have acted as the trigger for the pre-Scythian transformation, and innovations from the Caucasus now spread rapidly through the steppe, reaching the Carpathian Basin and even the area north-east of the Alps.

[36] For a typical harness element, developed in the area between the Prut and the Danube Delta in the west, and the Dnipro in the east, see Figure 40.

The most likely explanation for the preeminent role of the north-west Caucasus is its advanced level of technology, particularly in the production of metals. Apart from the onset of intensive iron production in the 9th century BC, there was apparently also a significant development in bronze production. Sabine Reinhold notes that tin-bronze was adopted at the transition from the Final Bronze Age to the Early Iron Age, replacing the locally available arsenic or antimony alloys which had been used previously. This development must have required the intensification of long-distance trade with regions south of the Caucasus. Accordingly, it seems likely that there was a transfer of metalworking technology from Transcaucasia, involving both bronze and iron, at the start of the Early Iron Age in the northern Caucasus.

The Bronze/Iron transition along the Danube, in the Urnfield culture and in the Atlantic Zone (ca. 1000-800 BC)

In Chapter 9 it was explained that the onset of intensive iron production in the eastern Balkan Peninsula in the 10th century BC, along with the influx of Pontic-Caucasian metallurgical expertise into the Carpathian Basin during the 9th century BC, led to a profound reconceptualization of bronze in a vast area of Europe, including the Fluted Ware *koinè* in the Carpathian Basin, the Urnfield culture north of the Alps and the Atlantic Zone in France and Britain. One of the most significant elements of the Bronze/Iron transition is the cessation of the deposition of bronze tools and weapons in hoards. The following paragraphs provide a broad outline of the argument.[37]

As explained in Chapter 5, iron artefacts were already manufactured in Bulgaria since the beginning of the 10th century BC (if not earlier); knowledge of ironworking must have been transmitted through contact with the Protogeometric Aegean. During the 10th century BC, the growing influence of the innovative Thracian iron-using communities led to the formation of the Stamped Pottery complex, cultural reorientation in the region between northern Serbia, the Lower Danube and Moldavia, and the concomitant decline of the Fluted Ware *koinè*, which had previously been dominant in these areas.

The demise of the Fluted Ware *koinè* reflects the loss of influence of an economic and value system based on the production, exchange and display of bronze, which had its epicentre in the Gáva culture in the north-east Carpathian Basin. The formation of the Post-Fluted Ware cultures reflects a break with the past, a profound economic and cultural disjunction (Figure 43). This cultural change is reflected in the cessation of the deposition of hoards with bronze utilitarian artefacts between ca. 1000 and ca. 900 BC, which can be observed first around the Lower Danube and in the central Balkans, and then in the lowland plains of the Carpathian Basin (Figure 54). In these areas, the Fluted Ware *koinè* disintegrated at the same time as the cessation of bronze hoarding.

The fact that tools and weapons made of bronze were no longer deemed suitable as offerings to the gods indicates a change in the conceptualization of the social value of bronze. At the same time, there was a more general impoverishment in bronze production in large parts of the Carpathian Basin: by the end of the 10th century BC, the manufacture of bronze swords and other significant élite accoutrements made of bronze had come to an end (see, for example, Figure 50). This tendency of impoverishment happened in parallel with the decline and demise of the Fluted Ware/Gáva *koinè*.

Around 900 BC the lowland plains of the Carpathian Basin experienced a system collapse. The previously existing power structures dependent on bronze production and distribution ‘imploded’, leaving a void. The Mezőcsát culture appeared (Figure 43), there was a transition to nomadic or semi-nomadic ways of life, and new kinds of pre-Scythian horse-gear and weaponry indicate the introduction of innovative methods of equestrian warfare and an influx of mounted steppe-nomadic warriors (see, for example, Figure 53). During the 9th century BC, for the first time iron was used widely for utilitarian artefacts in this area; iron implements were also introduced to the area north-east of the Alps (see, for example, Figure 48).

[37] See also the discussion in Chapter 12.3 (Late Bronze Age collapse) and Chapter 12.4.

Further to the west and north (in eastern France, Switzerland, Germany, Upper Austria and Poland), the situation during the 9th century BC was very different. Here, iron was still only available in small quantities, and was treated as a high-status metal. Iron was mainly used as a decorative metal on bronze artefacts, and to manufacture elaborate and prestigious bimetallic weapons and implements.

The high status associated with the new metal eventually undermined the social value of bronze. Around 800 BC, this reconceptualization led to the virtual disappearance of utilitarian bronze hoards over a vast area – including the Urnfield culture between central France and Moravia/Lower Austria, and the Atlantic Zone in western and north-western France and Britain (see Figure 55). Clearly, bronze was no longer deemed suitable for social transactions or as a means of communication with the gods. The cessation of utilitarian bronze hoarding within a short space of time, around 800 BC, indicates an abrupt change of a cultural norm in this vast area. Previously, during the Late Bronze Age (i.e. prior to the disjunction at ca. 800 BC), obtaining, exchanging and displaying bronze was vitally important for both economic production and social reproduction. Bronze had a convertible material value and came to be used as a kind of currency. According to the Standard Bronze hypothesis, bronze was the foundation of a social value system which relied on a widely shared attitude to bronze, a cultural norm. The cessation of hoard deposition was caused by the abrupt depreciation of the social value of bronze as a means of social (and religious) communication. What makes this normative change particularly important is the fact that it is often accompanied by a wider cultural disjunction: a general crisis or system collapse, and a restructuring of the social order (see Chapter 12.3: 'Late Bronze Age collapse').

Italy and Iberia: stages in the adoption of ironworking

As the introduction of iron in Italy and the Iberian Peninsula was discussed in separate chapters, in the following paragraphs the two regions will be considered together, in order to highlight some interesting similarities and differences. Needless to say, both are dominated by great peninsulas, and so offer broadly analogous case studies, in which the spread of ironworking can be compared – for example large-scale spatial and chronological trends, the speed of the diffusion process, and the inertia or conservatism of individual areas or cultural groups. It is significant that both in Italy and in the Iberian Peninsula two broad stages in the adoption of ironworking can be distinguished.

1) In the earlier stage, there is only sporadic evidence for iron; ironworking had evidently not yet taken root.

In Italy, evidence for iron before the later 10th century BC is scant, and often uncertain. The forge pit from Broglio di Trebisacce (Calabria) is especially important, whereas the chronology of the early iron finds from Castellace (Calabria) and Frattesina (Veneto) is rather uncertain. In Sardinia, the 'stiletto' from Motrox 'e Bois and the bracelet from Bidistili probably date to the 11th century BC. The most significant artefactual evidence hails from Sicily, in the form of the iron knives and finger rings from Madonna del Piano, which can be assigned to the 10th century BC. As explained above, the spectrum of iron objects from Madonna del Piano recalls the iron finds from the Aegean during the Submycenaean period, and this selection of knives and finger rings may have imitated Aegean practices.[38] The amount of iron dating to the 11th and 10th centuries BC in Italy is much smaller than in contemporary southern Albania and western Greece (e.g. Epirus, Aetolia). While no significant regional concentrations can be detected, nevertheless it is clear that most of the early evidence for iron comes from southernmost Italy, Sicily and Sardinia.

In Iberia, the earlier stage lasted longer, spanning the period between the 11th and 9th centuries BC. In the Balearic Islands, there are iron bracelets, 'clamps' and pendants from burial caves in Menorca and Mallorca; in central Portugal, a collection of knife- and saw-blades, and two chisels; and from the Cerro del Berrueco (Salamanca), a hoard containing two razors, two chisels, an awl, and a ring made of iron.

[38] See the section on the 'maritime horizon'; and the discussion of ring jewellery and knives in Chapter 12.1.

The iron trunnion axes from the latter site and from Campotéjar (Granada) also probably date before the end of the 9th century BC. As explained in Chapter 11, recent metallographic analyses have demonstrated that some of the Portuguese knives were made from locally occurring iron ores. The authors of the study emphasize that the blacksmiths only had rudimentary skills, and in the case of many of the knife-blade fragments it is questionable whether they would have functioned well as cutting implements.[39] The distribution of the iron finds seems to reflect contact with seafaring traders, who probably sailed westwards as far as the Tejo estuary. The main focus of this sea-borne trade was presumably the south-west of the Iberian Peninsula, where there are rich deposits of gold and tin.

Taken together, the sporadic evidence for the earlier stage in the adoption of iron in Italy and Iberia can be understood as part of an innovation horizon, which was dependent on more or less intensive contacts with seafarers from the Aegean and/or the East Mediterranean, and reflects the commercial interests and requirements of the foreign traders. Considering the geography of the two peninsulas, we can identify two definite points in the trading network: the Strait of Otranto (a crossing of 71 km), between Albania and the heel of Italy; and the passage between the Balearic Islands and Cape Nao (80 km). As explained above, this transfer of innovations started in the 'maritime horizon', and increased in strength after the second half of the 10th century BC.[40]

2) In the later stage, ironworking became firmly established. From this time onwards, there was an unbroken, indigenous tradition, with the manufacture of a characteristic range of iron artefacts.

In Italy, the key site is Torre Galli (Calabria), where iron artefacts, including weapons, are already found quite regularly in graves of the later 10th century BC (see Table 7). In the following two centuries, cemeteries in Basilicata and Calabria illustrate the continuous development of iron production and the gradual replacement of bronze by iron for utilitarian artefacts. Local ironworking started somewhat later in the Villanova culture in Campania and Etruria, where the first iron weapons date to the second half of the 9th century BC. Judging from the cemeteries of Osteria dell'Osa (Rome) and Fossa (L'Aquila), ironworking was well established in Latium and Abruzzo in the first half of the 8th century BC.[41] In northern Italy, iron seems to have been completely unknown during the 10th and 9th centuries; iron artefacts are first encountered during the 8th century BC, mainly in richly furnished graves of the local élites. This northward diffusion process through the peninsula clearly took place between the later 10th and the earlier 8th century BC.

In Iberia, local production of iron commenced in the late 9th century or around 800 BC in coastal Andalusia, in both Phoenician and indigenous settlements. Significantly, iron was previously practically unknown in this region, and the start of iron production coincided with the foundation of permanent Phoenician colonies. Subsequently, the process of diffusion displays a clear geographical trend: in the course of the 8th century BC, ironworking spread from coastal Andalusia to the Guadalquivir Valley, the Levante and Catalonia, and then, during the 7th century, to the interior and the north of the peninsula. It is characteristic for this production that, initially, knives represent by far the most frequent artefact category, both in settlements and in cemeteries.

In the earlier stage, it seems that the transfer of technology to the central and western Mediterranean generally did not have long-lasting consequences. To give just one example: after the production of the diverse artefacts in the hoard from El Berrueco, iron apparently fell out of use in the western Meseta during the 9th and 8th centuries BC. But in the later stage, both in Italy and Iberia, once ironworking gained a permanent foothold – in the later 10th century in Calabria and around 800 BC in Andalusia – there followed an indigenous, 'peninsular' dynamic, an unbroken tradition of production and a coherent

[39] For the narrow, two-edged blade fragments, see the illustrations in Vilaça 2006.

[40] For the "opening of the Mediterranean" after the second half of the 10th century BC, see Gilboa 2022. According to Ayelet Gilboa, it is unlikely that Phoenicians were involved in long-distance trade before the second half of the 10th century BC. — For the Phoenician trading posts at Heulva (Gulf of Cádiz) and La Rebanadilla (Bay of Málaga), see Chapter 11.2.

[41] For the cemetery of Fossa, see now Acconcia 2019.

process of diffusion. Clear geographical trends are visible: a chronological gradient from east to west (earlier in the central than in the west Mediterranean), and from south to north (earlier in the southern parts of the peninsulas, and later further north).

During the later stage, the range of iron products in the two peninsulas is very different; nevertheless, in both cases the 'canonical' selection of artefacts reflects local choices and requirements, rather than being dependent on the influence of foreign craftsmen or traders. When ironworking became firmly established in the Iberian Peninsula, the blacksmiths concentrated on manufacturing knives. In Italy, by contrast, the craftsmen made a wide range of artefacts, including weapons, implements and ornaments. Both in southern and central Tyrrhenian Italy, it is noticeable that dirks, the "symbol *par excellence* of prestige and political-military authority", are prominent among the early iron artefacts, indicating that the new metal enjoyed a high social value.[42] This disparity in the choice of artefacts is a clear indication that the conceptualization of iron was very different in Iberia and Italy.

It is obviously significant that in both areas the start of the later stage corresponds to the start of the Iron Age in the conventional schemes of periodization (*Primo Ferro*: late 10th century BC / *Primera Edad del Hierro*: ca. 800 BC). This coincidence between the establishment of local ironworking and the start of the Iron Age is not self-evident. In fact, in normal academic practice there is generally only a tenuous link between the start of the Iron Age (in conventional terminology) and the introduction of iron artefacts or the technology of iron production (see Chapter 12.3).

This paradox is clearest in the case of Italy, where iron was unknown in most of the peninsula at the start of the Early Iron Age. Indeed, Torre Galli is the only cemetery in Italy in which iron objects were used regularly as grave furnishings at the beginning of the Iron Age; and even there, only 10% of the artefacts in the first Iron Age phase were made of iron (see Chapter 10.1). In the conventional periodization, the start of the Iron Age in Italy is marked by other, much more fundamental changes. This is most clearly visible in the Villanova culture (in Etruria, and with further important centres in Campania, Emilia-Romagna and the Marche region), where a major transformation of social organisation, involving demographic, economic, political and military centralisation, took place around 900 BC.[43] In southern Iberia, in conventional scholarly practice the start of the Iron Age is marked by the foundation of permanent Phoenician colonies. This is understood as a much more fundamental turning point than the onset of local iron production.

In conclusion, in Italy and Iberia the establishment of ironworking does not define the start of the new 'Age'; instead, the establishment of ironworking is concomitant with a very significant moment of transformation, involving social, political, economic and technological change at the dawn of protohistory.[44]

Finally, it should be noted that the start of the later stage is associated with an intensification of contact with the East Mediterranean, not only in Andalusia (with the foundation of Phoenician colonies), but also in Calabria. The grave furnishings at Torre Galli include ivory objects, faience beads, four Egyptian or 'Egyptianizing' scarabs, and seven hemispherical bronze cups, which certainly originated in the East Mediterranean, and most likely were brought by sea-borne traders, possibly from Phoenicia. The transfer of ironworking technology might well have taken place in this context.

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[42] For the quotation, see Pacciarelli and Quondam 2020: 45.
[43] For a convenient introduction to centralisation processes in the Villanova culture, see Pacciarelli 2017. — While clearest in the Villanova (and Latial) cultures, centralisation processes can also be observed in the Early Iron Age in the Veneto and Calabria (especially at Torre Galli and in the Sibaritide).
[44] See the discussion of the concept of an 'Iron Age' in Chapter 12.3.

The introduction of iron in Central Asia and China

The summary of the main trends in the introduction of iron in the previous pages has shown that the rate of diffusion increased dramatically during the 12th, 11th and 10th centuries BC. After the 12th century, with the 'ring horizon' in the Near East and knives and other simple artefacts in the Aegean and East Mediterranean, ironworking spread to new areas during the 11th century. The production of iron weapons began around the middle of the 11th century in Cyprus, the Aegean, central Transcaucasia and probably south of the Caspian Sea in northern Iran. At the same time, in the 'maritime horizon', the manufacture of iron artefacts began in a number of regions on the southern fringe of Europe between Portugal and Ukraine. The finds from the destruction layer at Hasanlu show that there was an intensive production of iron during the 9th century BC, indicating that there was already a significant development in ironworking in north-west Iran in the 10th century BC.

While it is clear that the 11th and 10th centuries BC saw a phenomenal geographical expansion of ironworking in Europe and Western Asia, the rapid diffusion of ironworking becomes even more impressive when the developments in Central Asia and China are considered, as the following paragraphs will attempt to show (see Figure 66).

Southern Central Asia

The question of the introduction of iron in southern Central Asia has been discussed by a number of authors, including Vadim Masson, Anatoliy Sagdullaev, Bertille Lyonnet, Vladimir Ruzanov and Johanna Lhuillier.[45] In the Late Bronze Age, iron was not used in this region for utilitarian implements. Only two doubtful occurrences of iron have been mentioned in the literature: some 'iron' beads found in a rich grave from Namazga-depe (Turkmenistan) and 'iron' rivets on a bronze knife discovered in the settlement of Dzharkutan (Uzbekistan); however, in the absence of archaeometallurgical analyses, it is uncertain whether the beads and rivets were made of metallic iron. Occasional iron objects appear at the end of the Early Iron Age (Yaz I, 15th/14th – 11th centuries BC), including an iron 'plaque' from Shashtepe (Tashkent, Uzbekistan) and an iron finger ring from Dzharkutan.[46] It is interesting that a finger ring is one of the earliest iron artefacts in Uzbekistan, recalling the identical situation in Hasanlu (north-west Iran) and the Near Eastern 'ring horizon'.

Iron only became more frequent in the early 1st millennium BC (Yaz II; late Chust phase in the Ferghana Valley), for example an iron knife from Dal'verzin-tepe and a sickle from Kyzylcha 6 in Uzbekistan, and the axes from Yaz-depe in Turkmenistan. Most authors have suggested that knowledge of iron spread to southern Central Asia from northern Iran.[47]

In northern Central Asia (Kazakhstan), iron came into general use later than in areas further to the south. In the earlier part of the Tasmola culture of central and northern Kazakhstan (8th/7th century BC), for example, iron objects were still exceptional.[48] For this reason, the craft quarter of Alat, next to the large 'proto-urban' settlement of Kent (Karaganda Oblast), belonging to the Begazy-Dandybay culture, is possibly quite exceptional. Excavations in 2004-2007 uncovered two phases of metalworking activity. In the lower layer there were traces of bronze production, whereas in the upper layer there were in addition remains of four smelting furnaces and finds of iron ore and iron slag.[49] Sagyndyk Žauymbaev assigns the metalworking activity of the second phase to the transition from the 2nd to the 1st millennium BC and an even earlier date, not later than the 12th century BC, has been proposed by Viktor Varfolomeev et al.[50]

[45] See Masson 1959: 40 f.; 105; Sagdullaev 1982: 229 ff.; Lyonnet 1997: 103; Ruzanov 2005: 149 ff.; Lhuillier 2013: 31 f.
[46] For the iron ring from Dzharkutan, see Bendezu-Sarmiento and Mustafakulov 2013: 227 fig. 15. — The iron sickle from Anau does not come from a reliably stratified context; see Sagdullaev 1982: 229; Lyonnet 1997: 103.
[47] For example, Koshelenko 1988: 172.
[48] See for example Bendezu-Sarmiento 2007: 53 f.; 92.
[49] Žauymbaev 2013: 435 f.; Varfolomeev 2014: 155; Varfolomeev et al. 2016.
[50] Žauymbaev 2013: 435; Varfolomeev et al. 2016: 6; 10.

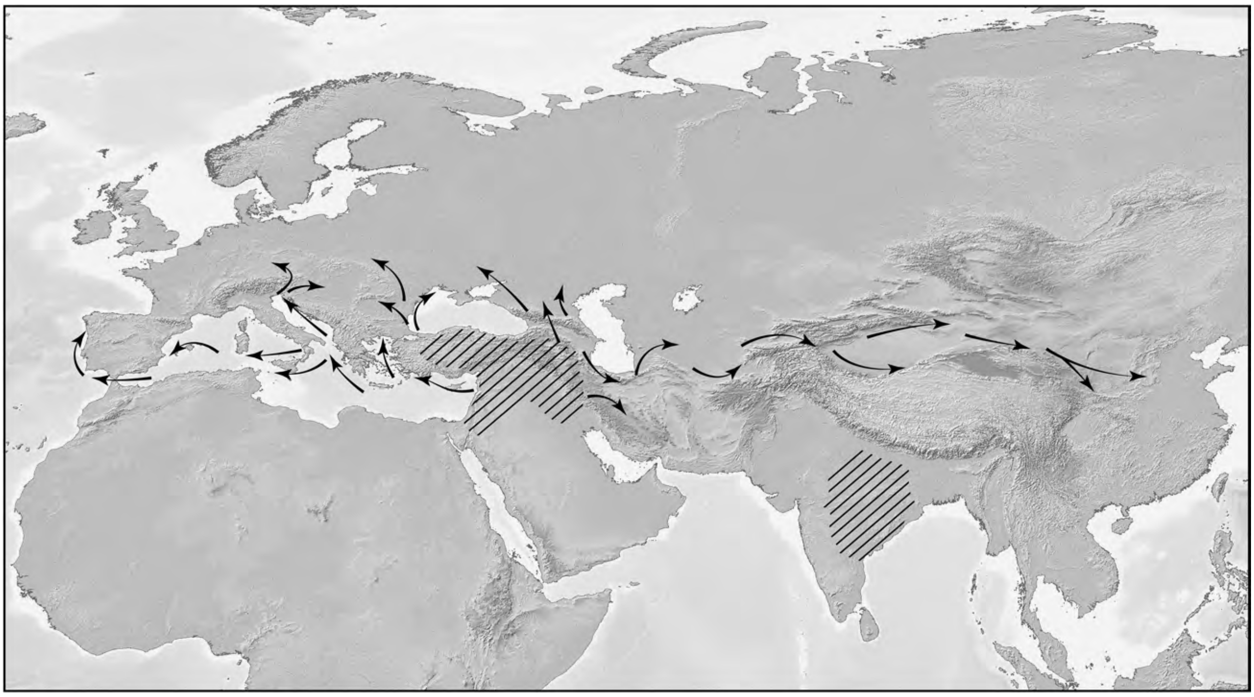

Figure 66. Schematic representation of the expansion of iron use in Eurasia between ca. 1200 and ca. 800 BC.

The early date for iron production at Kent-Alat stands in stark contrast to other evidence for the introduction of iron in northern Central Asia, which indicates a date several centuries later. Until full publication of the excavations, the possible evidence for exceptionally early iron production at Kent-Alat should be treated with caution.[51] As for southern Central Asia, iron certainly came into use around the transition from the 2nd to the 1st millennium BC. In comparison to northern Iran, it is noticeable that much less metal – whether iron or bronze – is known from the early 1st millennium BC in south Central Asia. This is doubtless due to the small number of excavated cemeteries, which are much less frequent in the Iron Age than in the former area. It is therefore more difficult to estimate the scale of iron usage in southern Central Asia than in contemporary north and west Iran.

China

The introduction of iron in China has been treated at length in a recent monograph by Donald Wagner.[52] Useful discussions by Jianli Chen et al. and Jianjun Mei et al. also deserve mention.[53] It is clear that iron was first known chiefly in its meteoritic form. A number of bimetallic daggers and axes using meteoritic iron are known from northern China in the late Shang and early Western Zhou periods (14th-10th centuries BC).[54] These are clearly high-status objects used in élite contexts. An exceptional find has been reported from the cemetery of Mogou (Gansu Province), where over 1500 burials belonging to the Qijia culture have been excavated. Small iron artefacts have been reported from two tombs: an iron 'rod' or 'pin' ca. 7.5 cm long, and an amorphous 'lump' ca. 1.5 cm long. The former artefact has been shown analytically to be made of smelted iron. The two graves are dated by radiocarbon to the 15th/14th century BC.[55] In view of the fact that iron artefacts are otherwise unknown in this large cemetery, it is conceivable that they do not represent evidence for the introduction of iron smelting and smithing at this early date. The

[51] Note that Enrico Lehnhardt (2021: 35 f.) doubts the evidence for early iron smelting at Kent-Alat.
[52] Wagner 2008: 83-114.
[53] Chen et al. 2009: 3042 ff.; Mei et al. 2015: 226.
[54] See Wagner 2008: 98 ff.; pl. 12-14; Chen et al. 2009: 3042 table 3.
[55] Chen et al. 2012; Mei et al. 2015: 226.

amorphous 'lump' might not consist of metallic iron; and the 'rod' or 'pin' could be an intrusive piece of thick iron wire.

Otherwise, the earliest evidence for wrought iron comes from Sanmenxia (Henan Province), in royal tombs of the late Western Zhou period (ca. 827-771 BC). The six artefacts from Sanmenxia are bimetallic short-swords, dagger-axes and spears. In three cases, the iron blades are made of meteoritic iron, the other three examples are of wrought, smelted iron. The bronze hilts and sockets are decorated with inlaid jade and turquoise.[56] Smelted iron became more common in the Spring and Autumn period (ca. 770-665 BC), for example in rich graves from Jingjiazhuang (Gansu Province) and Liangdaicun (Shaanxi Province), with bimetallic bronze/iron swords, knives and dagger-axes. The iron swords with inlaid gold hilts and the iron knives with golden ring-handles from Yimencun (Shaanxi Province) are slightly later.[57] It seems that iron was first employed to make valuable and prestigious items for élite use.[58]

The question of the introduction of iron in Xinjiang is particularly interesting. Most authors believe that iron use began before the regular production of iron in 'China proper', at some time between the 10th and the 8th centuries BC.[59] Iron most frequently occurs in the form of small iron knives in burial contexts, for example from Chawuhugou, Luishui, Qiongkeke, Qunbake, Yanbulake, etc.[60] According to the majority view, knowledge of iron smelting spread to Xinjiang from Iran or southern Central Asia, for example via the Chust culture of the Ferghana Valley.[61] From Xinjiang, the new technology was then transmitted along the Hexi Corridor (Gansu Province) to the middle reaches of the Yellow River and the North China Plain.[62] So iron would have arrived in the Plain of China via the Silk Road, passing through the Tarim Basin either north or south of the Taklamakan Desert, and ultimately from southern Central Asia. Although this diffusionist view is dominant in the specialist literature, it has recently been noted that the early production of bloomery iron in Xinjiang relies on radiocarbon dates, which should not be accepted uncritically.[63] There remains a degree of uncertainty whether iron smelting began earlier in Xinjiang than in the north-western China Plain.

According to the information available, it is most likely that ironworking spread eastwards from north-west Iran (11th/10th century BC) to southern Central Asia (11th/10th century BC), Xinjiang (10th/8th century BC) and finally to the North China Plain (ca. 800 BC). It is interesting that iron first appears in the archaeological record in forms of artefacts which we have also met in the initial stages of iron use in Europe and Western Asia (see Chapter 12.1): the iron finger ring from Dzharkutan (Uzbekistan), the knives from Xinjiang, and the bimetallic weapons from high-status burials in the North China Plain.

Viewed together, the evidence from the Near East, southern Europe, Central Asia and China indicates the rapid diffusion of the new technology, with the geographical range apparently increasing exponentially between the 12th and 9th centuries BC (see Figure 66). Perhaps it should be emphasized: this interpretation of the spread of iron production corresponds to the general consensus in the specialist literature, and is not a way-out example of extreme diffusionism.[64] There is an interesting exception to the diffusionist model, which should be mentioned at this point. In southern India, wrought, smelted iron was apparently introduced around the middle of the 2nd millennium BC in a Neolithic/Chalcolithic context. At present, there is no evidence for a relationship between the introduction of iron in the Indian sub-continent and the areas further north (Iran, Central Asia, China).[65]

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[56] Wagner 2008: 100 f.; pl. 16-21.

[57] See Wagner 2008: 101 ff.; pl. 22-26; Chen et al. 2009.

[58] However, iron has also been reported from settlements, for example Tianma-Qucun (Shanxi Province); see Wagner 2008: 104; Chen et al. 2009: 3039 ff.

[59] See for example Guo 2009: 107 ff. (9th/8th century BC).

[60] See Guo 2009; Wagner 2008: 96 fig. 43; Wagner et al. 2011.

[61] For example, Mei 2003: 27 f.

[62] See for example Wagner 2008: 91 ff.; Mei et al. 2015: 226.

[63] Chen et al. 2014: 369 ff.

[64] Possible reasons for the rapid adoption of iron are discussed in Chapter 12.3 ('The Iron Age as a technological stage and the rationale behind the adoption of iron').

[65] For early iron in India, see for example Tewari 2003; Johansen 2014; Tripathi 2015. — For earlier dates for iron, see Rajan 2022: 554.

Conclusions

The dramatic story of the spread of ironworking can, in essence, be appreciated by comparing the situation at two points in time. The letter sent by Hattušili III to the Assyrian king Adad-nirari I in about 1265 BC shows that iron was a rare and valuable metal. Iron production (extractive metallurgy) was strictly controlled by the palaces, particularly in the kingdom of the Hittites. Shortly afterwards, iron escaped the palaces, and by ca. 800 BC ironworking had spread through the vast area between the Iberian Peninsula and the North China Plain. Taking the evidence as a whole, it is clear that there was an exponential geographical expansion of ironworking between the second half of the 13th and the 9th centuries BC.

The rapid dissemination of iron in the Near East after the mid-13th century BC happened at the time when the hegemony of the palaces was eroding, anticipating the Crisis Years around 1200 BC. At the time of the Late Bronze Age collapse, iron artefacts (especially ring jewellery) are already found in sub-élite contexts throughout Mesopotamia and the Levant. From the 12th century BC onwards, the development of ironworking in Cyprus and the Aegean can be distinguished in considerable detail. From around the middle of the 11th century BC, iron was used to manufacture weapons in Cyprus and the Aegean, and these regions seem to have played a crucial role in the spread of iron to southern Europe (the 'maritime horizon'). The diffusion of ironworking within Europe – for example north-westwards along the Danube, northwards through the Italian and Iberian Peninsulas – is also reasonably clear. The diffusion of ironworking from northern Iran to southern Central Asia, Xinjiang and the North China Plain between the 11th and 9th centuries BC also seems highly plausible.

While the broad outlines of the diffusion of ironworking can be distinguished fairly clearly, it must be emphasized that developments in some crucial regions are still very poorly understood. This is the case for most of the Near East, where – with few exceptions – the development of ironworking following the 'ring horizon' remains obscure. The paucity of reliably dated evidence for the production of iron utilitarian implements and weapons in most regions of the Near East during the 11th and 10th centuries BC is difficult to explain, and might simply reflect a lack of research. It is particularly unfortunate that almost nothing is known about the development of ironworking in Turkey between the 12th and 10th centuries BC. Furthermore, the poor state of research in eastern Turkey and Azerbaijan is perhaps the reason why the precocious development of ironworking in central Transcaucasia seems so exceptional. Further research in Iran, Azerbaijan, Iraq, Turkey and Syria will hopefully clarify the situation in the future. The early evidence from southern India, where the trajectory of the development of iron production seems to have been very different to Western Asia, also requires more detailed study.

12.3 Iron and the Iron Age

This section of the book deals with the important question of the concept of an 'Iron Age'. In current academic usage, the term can have two quite different meanings. In the following pages, the technological stage model and the culture-historical version of the concept of an 'Iron Age' are analysed in detail. After examining the Late Bronze Age collapse in the Near East and the Aegean, and in Central and north-west Europe, attention turns to the Bronze Age/Iron Age transition in the regions around the Mediterranean. In the concluding summary of the discussion, four major areas are identified in which the Bronze Age/ Iron Age transition is especially significant: 1) System collapse in the Near East and the Aegean at the time of the downfall of the palaces; 2) The onset of the Iron Age in the Mediterranean; 3) The pre-Scythian phenomenon in the North Pontic steppe; and 4) The collapse of the Standard Bronze system at the transition from the Urnfield to the Hallstatt period in Central Europe.

The Iron Age as a technological stage and the rationale behind the adoption of iron

As every Archaeology student learns, the Three Age system was devised by Christian Jürgensen Thomsen in the early 1820s, as he prepared the archaeological exhibition in the newly founded Danish National Museum in Copenhagen. In a publication from 1836, Thomsen explained the reasoning behind his chronological system. It is worth quoting the section on the Iron Age:

> "The Iron Age is the third and last period of the pagan era, in which iron was used for those objects for which that metal is eminently suited, and in the manufacture of which it came to be employed as a substitute for bronze. Such things, which they would especially endeavour to manufacture from hardened iron, of course included all cutting weapons and tools. On the other hand, bronze was used in [the Iron Age] just as much as earlier, but in a different form: for ornaments, handles, and various sorts of domestic utensils such as spoons and the like. It is therefore by no means possible to infer from such bronze objects that they belong to [the Bronze Age], unless their form and ornamentation point to this period. ... The antiquities seem to show that there was a transitional phase in which iron was more precious than copper; during this phase, it was used very sparingly ... Once people had become aware of iron ore, which is found so frequently in Norway and Sweden, and its usefulness, iron must soon have replaced the metal which had been used previously."[66]

Thomsen's Three Age model is based on the technical improvement of tools and weapons by means of the introduction of new raw materials. The use of the term 'hardened iron' shows that he was aware of the different varieties of iron, and understood that carburization and heat treatment were necessary in order to produce a metal (steel) which could hold a better edge than bronze. Hardened iron was used preferentially for utilitarian artefacts ("cutting weapons and tools"). By contrast, bronze could still be used during the Iron Age for items such as jewellery and handles, for which hardness and sharpness were not essential. Finally, he postulated a transitional phase when iron was first introduced: during this time, iron was still a rare commodity and was highly valued, more precious than copper or bronze. Iron replaced bronze when its two advantages were appreciated: the abundant availability of local ores and the advantageous properties of hardened iron for utilitarian implements. Thomsen's definition of the Iron Age was far-sighted, and is still important today.

A refinement of Thomsen's system was published in the early 1980s by Anthony Snodgrass, who proposed a 'three-stage' scheme for the introduction of ironworking (see Chapter 4.5). Essentially, the 'three-stage' scheme hardly differs from Thomsen's account of the replacement of bronze by iron. However, the start of the 'full Iron Age' is defined more precisely as the time when iron was used more frequently than bronze for utilitarian purposes.

It is important to understand that Thomsen's recognition of the replacement of stone by bronze, and then bronze by iron, was based on empirical observation.[67] He defined his three Ages by studying the combinations of artefacts associated together, and the contexts (especially graves) in which the artefacts had been found: stone artefacts in Megaliths with inhumations; bronzes with cremations in pottery urns; and iron artefacts from tumulus burials. From his observations, he devised a stage model, typical for the Classical Evolutionism of the 19th century.[68] The weakness of stage models is their extreme simplification, obscuring variation and complexity. As we have seen, it is impossible to define universal stages in the introduction of iron; instead, we can discern 'horizons' of artefacts, which reflect different conceptualizations and applications of the new metal in their regional and cultural contexts. And it seems somewhat arbitrary to pinpoint an exact moment of transition from the Bronze to the Iron Age. In the Aegean, for example, should the start of the Iron Age be defined (i) by the first use of iron utilitarian

[66] Thomsen explained his Three Age system in a Danish publication in 1836. My English version of the text is derived from the German translation published in 1837 and the English translation published in 1848. See Thomsen 1837: 60-61; 1848: 67-68.
[67] See Hansen 2001: 12.
[68] Compare for example Lewis Henry Morgan's stages in the development of social complexity: Savagery, Barbarism, Civilisation. For a discussion of stage models, see Haas 1998.

implements (imported knives); (ii) by the start of local manufacture of iron artefacts (finger rings); (iii) by the manufacture of high-status iron weapons (daggers and dirks); (iv) by the use of iron for all offensive weapons (including swords, spearheads, arrowheads, etc.); (v) by the use of iron (rather than bronze) for all utilitarian artefacts; or (vi) by the onset of local production of iron (extractive metallurgy)? In reality, the establishment of an iron-based economy was a process lasting centuries, following trajectories which could differ markedly from region to region.

Thomsen's explanation of the replacement of bronze by iron was simply a process of rationalisation: the rationale behind the succession of stone-bronze-iron was, of course, the principle of technological progress. Thomsen's belief in progress was typical of Classical Evolutionism, and the rationalisation of the Bronze/Iron transition was, essentially, speculative. As explained above, Thomsen accounted for the introduction of iron by reference to two intrinsic properties of the metal: the potential to make hardened iron, and the potential to produce iron from locally occurring ores. In practice, however, the precise reasons for adopting iron are often far from clear.

Harder and sharper? The available metallographic analyses of early iron utilitarian artefacts do not indicate that they were necessarily 'better' (harder, sharper) than contemporary bronzes. This has been explained above for Cyprus in Late Cypriot III and Cypro-Geometric I (Chapter 3.4), the southern Levant and Cilicia (Chapter 2.3), early knife blades in Portugal (Chapter 11.3) and the so-called East European or Steppe tradition of ironworking of the Bilozerka culture in Ukraine (Chapter 7.2). Summarizing the evidence from the Near East, Nathaniel Erb-Satullo concludes that carburization and heat treatment were not "driving factors in the initial surge of iron adoption".[69] The number of metallographic analyses is still rather restricted, and more research is obviously necessary to test these results; nevertheless, according to the information presently available, we cannot assume that 'hardness' was necessarily a crucial factor when people chose to adopt iron.

Local availability? In previous research, most authors have cited the technical advantages of hardened steel as the reason for the conquest of bronze by iron. However, there are exceptions. It is interesting that Gordon Childe, in his discussion of the Bronze Age/Iron Age transition, emphasized the paramount importance of the easy availability of iron, as opposed to bronze, which required long-distance trade to procure copper and tin, and entailed centralized economic coordination and political control.[70] For Childe, hardness was not a decisive factor. Research by Naama Yahalom-Mack and Adi Eliyahu-Behar provides a recent example of this point of view, based on the results of archaeometallurgical analyses from the southern Levant. They showed convincingly that the massive upsurge in iron production in Israel starting in the second half of the 10th century BC (early Iron IIA) was driven by the necessity of increasing the supply of metals and at the same time maintaining complete local control of the production process; technically, the iron artefacts were no better than bronzes (see Chapter 2.3).

However, as a reason for the adoption of iron, the advantages of local availability cannot simply be applied for all case studies. To profit from the available iron ores, the local population first had to learn the craft of smelting, requiring a transfer of the technology of extractive metallurgy. The problem here is that reliable evidence for iron production (ore roasting hearths, smelting furnaces, smelting and reheating slag) is extremely rare in the early stages of the introduction of iron, and it is generally impossible to be sure whether or when local iron production (extractive metallurgy) had become established. This has been explained above, in the discussion of iron billets and the iron trade (see Chapter 12.1). However, in view of the rapid diffusion of ironworking between ca. 1250 and ca. 800 BC, reaching the Iberian Peninsula in the west and China in the east, it is clear that the technology of extractive metallurgy must have been transmitted through this vast area relatively quickly; trade alone cannot account for the rapid geographical expansion exhibited by the diffusion process. This provides some support for the

[69] Erb-Satullo 2019: 559.
[70] Childe 1946: 30 f.: iron was obtainable "independent of kings and chieftains ... a technology based on a metal so easily available could work under relations of production different from those indispensable when copper or bronze was the basis".

hypothesis that 'local availability' was a significant motivation for the adoption of iron. Furthermore, even if a community did not produce iron itself, iron may have been easier to obtain ('less expensive') than bronze.

Social value? The previous two reasons for adopting the new metal are based on advantageous intrinsic properties of iron. The third reason concerns the conceptualization of iron, for example its exoticness, novelty or social prestige. Typically, this motivation could exist when iron was still a rare and valuable metal, as postulated in Thomsen's 'transitional phase'. For example, in some areas iron was first used for making high-status, prestigious artefacts, or as ornamentation on bronze artefacts – illustrating the importance of the social value of iron. It should also be recalled that people presumably first became acquainted with the new metal in the form of imports or gifts from regions with a more advanced ferrous metallurgy. The desire for iron may have been roused long before the technical properties of the metal had been fully appreciated, and the first attempts to smelt local iron ores. The demand for the new metal could initially have been driven by the desire to emulate more advanced, iron-producing cultures.

As our discussion has revealed, the motivations for adopting iron are often unclear, and it is very likely that reasons varied. To an extent, this undermines the validity of the concept of the Iron Age as a technological stage, as we are generally unsure which (if any) of the intrinsic technical properties of iron were appreciated and desired. However, future scientific research will hopefully provide more information on the technical properties of early iron implements (the level of carburization and heat treatment), the question of the provenance of iron artefacts, and the extent of trade in raw material (iron billets). These questions are made even more urgent in view of the 'exponential' acceleration of the diffusion of iron through Eurasia (see Chapter 12.2): the rapid spread of iron seems to have been unavoidable, almost like the spread of an epidemic.[71] The speed of diffusion shows that iron was so desirable that (most) people were unable to resist the advantages which the new metal had to offer.

According to the present state of research, it seems that the advantageous technical properties of hardened steel did not necessarily play a major role in the spread of iron; the adoption of iron might initially have been motivated by its social value (prestige). Later, the easier availability of iron probably led to the replacement of bronze. Clearly, these questions require further research and in view of the poor present state of knowledge, generalized explanations for the introduction of iron do not seem appropriate. Indeed, it is equally likely that iron could have been adopted in different ways and for different reasons. For example, some communities could have manufactured iron artefacts which, technically, were no improvement compared to bronzes, and from raw material which had been imported, contradicting the rationale proposed by Thomsen. Apart from the intrinsic properties of iron, it is therefore also necessary to consider different conceptualizations of the new metal.

In conclusion, in current archaeological practice the Iron Age can be defined as the stage when iron had replaced bronze for the production of (most) utilitarian artefacts. Thomsen's account of the Bronze/Iron transition is the most important single contribution to our understanding of the subject, and the questions he raised 200 years ago are still the focus of research. The motives for the adoption of iron probably varied from region to region, and the manner in which the new metal was introduced was doubtless far from uniform.

Late Bronze Age collapse

The subject of 'collapse' has played a significant role in our discussion of two very large regions: the downfall of the palatial system in the Near East, the East Mediterranean and the Aegean; and the radical disjunction at the time of the demise of the Standard Bronze value system in Central and north-west Europe. In both cases, there is a link between the collapse and the diffusion of iron. A comparison of the phenomenon of collapse in these regions aims to shed light on our understanding of the Bronze/Iron

[71] Colin Renfrew sarcastically called this the 'Infection Model'. See Renfrew 1978: 91 ff.

transition. The discussion will also raise some more general questions about the concept of a 'Bronze Age', and highlight the different meanings of the term 'Iron Age' in conventional academic practice.

We will start with the downfall of the palaces during the Crisis Years before and after 1200 BC. For many years, the archaeological and textual evidence has been studied intensively, and many different ideas explaining the downfall have been explored, including natural disasters (earthquakes, volcanic eruptions, climatic deterioration/drought), famine, epidemics, internal strife ('class struggle'), internecine wars or attack from outside.

It is highly significant that no consensus has yet been reached: no single cause can offer a satisfactory explanation for the downfall of the palatial system. For this reason, the most enlightening model to account for the profound changes ca. 1200 BC is 'system collapse'.[72] Colin Renfrew, who first used the model in an archaeological context, explained that there is no single, obvious cause for system collapse; it happens when: "the failure of a minor element started a chain reaction that reverberated on a greater and greater scale, until finally the whole structure was brought to collapse".[73] Or, in the words of Malcolm Levitt, in a systems collapse "adaptive systems, developed to cope with certain circumstances, become inflexible and cannot meet new challenges; positive feedbacks between destabilising factors induce a catastrophic chain reaction."[74] Put simply, the 'system' itself lacked resilience. General features of the system collapse of the palatial system include: 1) collapse of the centralized political and economic organization; 2) downfall of the traditional élite class; 3) disintegration of the settlement structure and population decline; 4) disruption of complex long-distance trading networks; 5) increased mobility, migration and invasion from the periphery (e.g. the Sea Peoples and various nomadic groups); 6) following the collapse, an innovation horizon which included the diffusion of ironworking, the widespread dissemination of the alphabet, and the introduction of new commercial practices spearheaded by the coastal urban centres of Cyprus and the Levant (see Chapters 2.4, 3.4 and 4.5).

Two factors – highly developed political and economic centralization and mutual interdependence – are crucially important in the model. As Mario Liverani concludes: "The particular concentration in the Palace of all the elements of organization, transformation, exchange, etc. – a concentration which seems to reach its maximum in the Late Bronze Age – has the effect of transforming the physical collapse of the Palace into a general disaster for the entire kingdom".[75] And the high degree of interconnectedness between the palatial centres made the system as a whole vulnerable to disruption. As Ken Dark concludes, the problem of over-connectivity occurs when the parts of the system become so dependent upon each other that "change in any part produces instability in the system as a whole".[76] Specialisation in services, manufacturing and agriculture increased the interdependence between the palaces and their surrounding territories, and the palatial élites themselves depended on long-distance trade for the supply of essential commodities such as metals and prestige goods.

As explained in Chapter 2, in the case of ironworking the disintegration of the palace-based economies was a crucial turning point in the innovation process, because till then the centralized economic and political organisation of the Bronze Age palaces (specifically in Hittite Anatolia) seems to have inhibited the widespread use of iron. It hardly needs emphasizing that the metal iron played little or no part in causing the downfall of the palaces.

The collapse of the palatial system is associated with the initial dissemination of iron in the form of the 'ring horizon'. This does not correspond to the start of the 'Iron Age' technological stage in the generally accepted sense as defined by Christian Jürgensen Thomsen and Anthony Snodgrass; in fact, in the Near East iron was not used more frequently than bronze for utilitarian implements until the 10th century

[72] This has been discussed very well by Eric Cline (2021: chapter 6) in his recent monograph on the Crisis Years.
[73] Renfrew 1979: 497.
[74] Levitt 2019: 7.
[75] Liverani 1987: 69.
[76] For the quotation by Ken Dark, see Cline 2021: 176.

BC. Nevertheless, in conventional scholarly usage, the start of the Iron Age has traditionally been set to correspond with the Late Bronze Age collapse ca. 1200 BC.[77] Clearly, in Near Eastern archaeology the start of the Iron Age can have two quite different meanings: as the start of a new historical conjuncture following the collapse of the palatial system, and as the start of a new technological stage.

The Late Bronze Age collapse does not refer to the end of a technological stage, it refers to the demise of the centralized, palatial political and economic system which encompassed Mesopotamia, Anatolia, the Levant, the East Mediterranean and the Aegean. The roots of this system can be traced back to the emergence of a network of long-distance trade (an early form of 'globalization'), which by the mid-3rd millennium BC already reached as far west as the Aegean and as far east as the Indus. The long-distance trading network is documented, among other things, by the use of weights and sealings, and involved commodities such as silver, gold and precious stones (e.g. lapis lazuli and carnelian).[78]

The use of tin for alloying with copper was uncommon in the Near East and East Mediterranean, but was gradually becoming more regularly used after ca. 2600 BC. As tin was, at that time, imported from Afghanistan and/or Iran, it is clearly another commodity which required long-distance trading relations. It seems that tin-bronze was at first used to manufacture high-status artefacts such as metal vessels, and was probably valued for its near-golden colour. Apparently, the initial adoption of tin-bronze was first and foremost an aesthetic choice, and not based on its technical advantages for making utilitarian implements.[79] In the past, the importance of tin-bronze has been much exaggerated by Near Eastern archaeologists: in the Near East, tin-bronze did not play a major role in the production of utilitarian artefacts during the 3rd and much of the 2nd millennium BC. We should not forget that the term 'Bronze Age' was conceived for Europe, and the concept of a 'Bronze Age' as a technological stage is not readily applicable to the Near East.[80]

Turning to Europe, where the Three Age scheme was first devised, the regular use of tin-bronze in Central and northern Europe started somewhat later than in the Near East, in the final quarter of the 3rd millennium BC, probably as a result of influence from the Aegean or, more generally, the Balkan Peninsula. But soon, the trajectory of tin-bronze took a very different course than in the Aegean and the Near East. From around 1800 BC onwards, practically all metal artefacts were made of copper alloyed with at least 5% tin ('Standard Bronze'), even when it was unnecessary from a technological viewpoint.[81] For this reason, it seems that the exclusive use of Standard Bronze should be understood as a cultural rather than as a technological choice, a choice which was made possible by the relatively close proximity of the tin ores of Cornwall, Brittany and the Erzgebirge (Ore Mountains) between Saxony and Bohemia. Considering the range of artefacts made from tin-bronze, including jewellery and other costume accessories, it seems that the technical properties of the alloy (tensile strength, hardness, advantages for casting) cannot be the only explanation for its prevalence. As in the Near East, it is quite likely that the near-golden colour of bronze alloyed with at least 3%-5% tin was a significant factor in the choice.[82]

[77] For a useful introduction to the use of the term 'Iron Age' in the Levant, see Pedrazzi 2013. Note that the terminology derived from the Three Age system (specifically the Bronze Age/Iron Age transition) is not used widely in Mesopotamian archaeology (Pedrazzi 2013: 141). — For the start of Iron Age I corresponding to the Crisis Years ca. 1200 BC, see the following examples from Anatolia, Syria and the southern Levant: Hittite/Neo-Hittite: e.g. Seeher 2018: 5 Tab. 1; Summers 2017; Weeden 2023: 918 (Boğazköy); Frangipane et al. 2020: 76 Tab. 1 (Arslantepe). — North Syria: e.g. Harrison 2021: 329 f.; 341 table 1 (Tell Afis, Tell Tayinat). — Israel: e.g. Bürge 2021: 304 Tab. 9.2 (Modified Conventional Chronology).

[78] See Rahmstorf 2022: 680-694.

[79] For the importance of the near-golden colour of tin-bronze alloyed with at least 3%-5% tin, see Pernicka 1998: 136 f.; Rahmstorf 2017: 191; 199.

[80] For the introduction of tin-bronze in the Old World, see Rahmstorf 2017. — For the problems caused by the use of the European Three Age system in the archaeology of the Levant, see Pedrazzi 2013. — For a critical discussion of the role of metals (copper, tin, silver, gold) as a primary factor in the rise of craft specialisation, conspicuous consumption, social hierarchisation and long-distance trade in the Aegean and north-west Anatolia around the mid-3rd millennium BC, see Mina 2018.

[81] The area in which Standard Bronze was '*de rigueur*' reached from the Atlantic coast in the west to the Carpathian Mountains in the east, and from southern Scandinavia and the British Isles in the north, southwards as far as northern Iberia and northern Italy. See Pare 2000: 27 fig. 1.14.

[82] For the importance of the colour of tin-bronze, see for example Pare 2000: 27 f.; Meller 2019.

From ca. 1800 BC onwards, in a large part of Europe reaching from the Atlantic coast in the west to the Carpathian Mountains in the east, obtaining, exchanging and displaying tin-bronze was vitally important. Bronze exchange and display became the norm, part of a value system in which Standard Bronze had a convertible material value and came to be used as a kind of currency – as metal which could be weighed, exchanged, melted down or recycled (see Chapter 9.6). This essential importance of bronze lends the concept of a 'Bronze Age' in Central and northern Europe its special, indeed unique significance.[83] This is the feature which makes the European Bronze Age so fascinating: a value system based on the alloy of two metals, copper and tin, which almost everywhere were not locally available. The system, which lasted for about 1000 years (ca. 1800-800 BC), obviously required a functioning network of long-distance trade.

The collapse of the Standard Bronze system has been described most insightfully by Stuart Needham, in an article entitled *800 BC, The Great Divide*: "The logic of the bronze system depended on its interconnectedness and general observance over large areas. This inevitably meant that any destabilising tendencies would have knock-on effects down the line; a chain reaction that could not have been rebuffed by any single cultural group even if particular responses to it were potentially quite varied."[84] As it relied on widely shared attitudes to bronze, the Standard Bronze system was inherently vulnerable to normative change. The clearest evidence for the reconceptualization and abrupt devaluation of Standard Bronze as a means of social and religious communication is the cessation of the deposition of hoards of bronze utilitarian artefacts. This is encountered around 900 BC in the Carpathian Basin (Figures 49 and 54), and about 100 years later both in the Urnfield culture between central France and Moravia/Lower Austria, and in the Atlantic Zone in France and Britain (Figure 55). Simultaneous with the cessation of bronze hoarding, production of 'Urnfield' swords came to an end: solid-hilted and flange-hilted swords in the Carpathian Basin (Figure 50), and solid-hilted swords in the late Urnfield culture between central France and the area north of the Alps.

These changes were accompanied by a profound and far-reaching cultural and socio-economic rupture. In the Carpathian Basin, the Gáva/Fluted Ware *koinè*, dependent on metal production and distribution, disintegrated in the years around 900 BC. The subsequent Post-Fluted Ware cultures display a radical cultural reorientation, which is most clearly evident in the case of the inhumation cemeteries of the Mezőcsát culture (Figure 43). The introduction of pre-Scythian weaponry and horse-gear at this time indicates the influx of warlike equestrian-nomadic groups from the North Pontic steppe (e.g. Figure 53). Approximately 100 years later, the Urnfield culture between central France and Bohemia (the area of the subsequent West Hallstatt culture) was visited by a comparable disjunction.[85] This is shown most clearly by the abandonment of large settlements at the transition from Ha B3 to Ha C. In the early Hallstatt period, only small settlements are known; the great hillforts and lake-side settlements of the later Urnfield period no longer existed. It is significant that in both these two regions, the cultural disjunction was followed by an innovation horizon: in the Carpathian Basin ca. 900 BC with the advent of Pontic-Caucasian weapons and horse-gear; and in the area of the West Hallstatt culture ca. 800 BC (Ha C1a) with the adoption of weaponry developed in the Atlantic Zone.[86]

These fundamental changes in economic and social organisation and cultural orientation have been discussed in detail in Chapter 9. It should, by now, have become apparent that the system collapse model fits well with the situation at the end of the Bronze Age in Central and north-west Europe. The Standard Bronze value system, reliant on long-distance trading networks and a high degree of interconnectedness and interdependence, was obviously vulnerable to disruption. The supply of copper and tin was coordinated by local élites, whose status depended to a significant degree on an economic and value

[83] Andrew Sherratt reached similar conclusions. See for example Sherratt 1993: the prime material value of bronze was central to circulation and long-distance exchange (p. 36 f.); the introduction of bronze created a "chaining effect which linked regions in a consistent pattern of demand" (p. 43); the replacement of bronze as the main medium of circulation had profound consequences for the social structures which were based upon it (p. 41).
[84] Needham 2007: 60.
[85] It is interesting that the area of the East Hallstatt culture, around the eastern Alps, did not suffer such a major disruption.
[86] For the area of origin of the Gündlingen sword type, see Milcent 2008: 241 fig. 11.

system based on the production, exchange and display of bronze. The crises ca. 900 BC in the Carpathian Basin and ca. 800 BC further west entailed the disintegration of the Late Bronze Age settlement structure and population decline. In the case of the former area, there is clear evidence for increased mobility and invasion. Finally, there is evidence for horizons of innovation after the collapse.

The relevance of the system collapse model becomes even more apparent in view of the fact that there are no obvious causes to account for the radical changes which took place over such a vast area, between the Carpathian Mountains and the Atlantic. A variety of different explanations have been proposed, including ecological degradation, climate change, famine, epidemics and invasions of warlike equestrian nomads. For example, the rapid climatic deterioration associated with the so-called 'Homeric Grand Solar Minimum' could explain some of the changes at around 800 BC.[87] And it is very likely that the influx of pre-Scythian warrior bands from the North Pontic steppe created disruption and strife in parts of the Carpathian Basin. But these factors are insufficient to explain the Late Bronze Age collapse in Central and north-west Europe in all its dimensions.

The advent of iron is a further potential cause for the collapse of the Standard Bronze system. This was suggested by Georg Kossack, who proposed that the introduction of iron may have been responsible for the disintegration of the Late Bronze Age communication system in the Carpathian Basin. And Stuart Needham argued that in the Atlantic Zone the social value of Standard Bronze was undermined by the arrival of iron. Furthermore, in my five-stage scenario for the introduction of iron in south-east and Central Europe the sequence of consecutive structural changes which proceeded along the Danube between the 10th and 8th centuries BC formed a chain of events which were all linked to the adoption of iron and/or the rejection of bronze (see Chapter 9.7).

According to these propositions, the introduction of iron could be understood to have acted as an agent which contributed to historical change – an example of disruptive innovation. However, in the framework of the system collapse model, lack of resilience and vulnerability to disruption were the crucial factors in the downfall of the Standard Bronze value system. The collapse probably had a multiplicity of causes; one of which being the introduction of iron.

In most areas, the collapse of the social value system based on Standard Bronze happened at a time when iron had hardly started to replace bronze for the manufacture of important implements such as tools and weapons. This indicates that the collapse of the Standard Bronze value system was essentially a normative rather than a technological change, caused by the reconceptualization of bronze rather than the replacement of bronze by iron for the production of utilitarian artefacts. Nevertheless, in conventional scholarly usage, the start of the Iron Age is normally located at the time of the collapse of the Standard Bronze system, despite the fact that iron was still an uncommon metal at that time, and was hardly used for manufacturing tools and weapons. For example, in the central Balkans in the Kalakača phase (the Earliest Iron Age as defined by Rastko Vasić) only a few iron rings and knife fragments have been found (see Chapter 8.4); in the Carpathian Basin, the first evidence for the systematic local production of iron tools and weapons dates to the late 9th century BC, in the area of the Basarabi culture (the Bâlvăneşti-Vinţ series of hoards); in eastern France and the area north of the Alps, the use of iron was mainly confined to high-status artefacts in the late Urnfield and early Hallstatt periods; and in the Atlantic Zone, iron was still extremely rare at the time of the Late Bronze Age collapse. In summary, in conventional archaeological usage the term Iron Age does not correspond to the start of a technological stage in Central and north-west Europe. Instead, it is used to denote a radical disjunction – system collapse – which was only loosely associated with the diffusion of iron.

In our discussion, the collapse of the Standard Bronze system has been depicted as taking place in two stages, at ca. 900 and ca. 800 BC. These suspiciously round numbers indicate that our model is a

[87] The Homeric Grand Solar minimum (or '2.8 ka event') is associated with the Hallstatt Plateau in the radiocarbon calibration curve. — See, for example, research on the laminated sediments of the Meerfelder Maar (Rheinland-Pfalz): Martin-Puertas et al. 2012.

severe oversimplification of a historical situation which was certainly much more complex. At present, the details of the progression of the collapse and the precise chronology are unclear. Nevertheless, it is certain that massive changes occurred across Central and north-west Europe, starting earlier in the east and later in the west. The system collapse model helps to understand the historical processes and, fittingly, emphasizes these radical transformations over a vast geographical area.

The discussion of system collapse in the Near East and Aegean helps understand the collapse of the Standard Bronze value system in Central and north-west Europe. The model is important, because it involves vast areas, reaching from the Aegean to Mesopotamia, and from England to Transylvania. In neither of these vast regions can the Late Bronze Age collapse simply be equated with the end of the Bronze Age or the start of the Iron Age in the sense of a technological stage, as defined by Thomsen and Snodgrass. The collapse denotes the disintegration of a system, not the end of a technological stage. Indeed, it has become apparent that in conventional archaeological practice the term Iron Age can be used in two different ways: to denote a technological stage, and to denote radical culture-historical changes at the time of the diffusion of iron. This paradox will be discussed further in the following section.

The concept of an 'Iron Age'

'Bronze Age' and 'Iron Age' belong among the most frequently used terms in archaeological publications. Archaeologists evidently find the term 'Iron Age' extremely useful, even though they might not have a deep knowledge of the innovation process, and the stages in the introduction of iron are often difficult to understand. This curious paradox of academic usage was highlighted by Anthony Snodgrass 35 years ago: "The concept of an 'Iron Age' is one of the least analysed in European prehistory, though as an expression it is constantly on the lips of every prehistorian in Europe".[88] Consider the major chronological and cultural divisions in current use for the 2nd and 1st millennium BC in southern Europe and the East Mediterranean, assembled by Cyprian Broodbank in *The Making of the Middle Sea* (Table 8). The details of the periods and phases in the individual regions and their absolute chronology do not concern us here; the important point is the ubiquitous use of the terms '(Late) Bronze Age' and '(Early) Iron Age'.[89] It seems that the term 'Iron Age' has become indispensable, without its meaning necessarily being encumbered by the details of the introduction of ironworking.

In general archaeological practice the start of the Iron Age has an uneasy relationship with the introduction of iron. In conventional usage, the start of the Iron Age is not the same as the start of the technological stage as defined by Christian Jürgensen Thomsen or Anthony Snodgrass. In fact, in the commonly used systems of periodization, the Iron Age always begins considerably earlier than the replacement of bronze by iron for utilitarian artefacts (the Iron Age as a technological stage). Instead, the start of the Iron Age is associated, more or less closely, with the diffusion of ironworking. Take, for example, the case of the southern Levant, where the start of the Iron Age is either located after the Late Bronze Age collapse ca. 1200 BC (e.g. Amihai Mazar/Modified Conventional Chronology), or after the withdrawal of the 20th Dynasty of Egypt ca. 1130 BC (e.g. Israel Finkelstein); in both cases, the date of the start of the Iron Age was chosen without reference to the introduction of ironworking (see Chapter 2.3). Or consider the case of Italy, where ironworking was already practised in the south (Calabria) in the 10th century BC, when the first objects also reached Latium, whereas iron artefacts are completely lacking in the Villanova culture at the start of the Iron Age (*Primo Ferro*, see Chapter 10). In these examples, the Bronze Age/Iron Age transition is located at the time of important culture-historical transformations which took place roughly at the time of the introduction of iron: the Late Bronze Age collapse, the end of foreign rule in Canaan, and the emergence of 'proto-urban' settlements in central Tyrrhenian Italy.

[88] Snodgrass 1989: 22. — This observation is equally valid for Europe and the Near East.
[89] In Cypriot and Aegean archaeology, the term 'Bronze Age/Iron Age transition' is used less frequently. Instead, the transition from one Age to the next is expressed by using the terms 'Late Cypriot'/'Late Helladic'/'Submycenaean' for the Late Bronze Age, and 'Cypro-Geometric'/'Protogeometric' for the Early Iron Age.

Table 8. Major chronological divisions and cultural phases in southern Europe and the East Mediterranean. The start of the Iron Age is emphasized (heavy black line). — After Broodbank 2013: 14. — Permission to use this table was kindly provided by Cyprian Broodbank and Oxford University Press.

2500 BC — 2000 — 1500 — 1000 — 500 — 1

IBERIA	COPPER AGE	EARLY BRONZE AGE Argaric	MIDDLE BRONZE AGE	LATE BRONZE AGE Early Huelva	IRON AGE	PUNIC			
BALEARICS	UNIN-HAB-ITED	EARLY BRONZE AGE	MIDDLE BRONZE AGE	LATE BRONZE AGE Talayots	PUNIC				
SOUTHERN FRANCE	COPPER AGE	EARLY BRONZE AGE	MIDDLE BRONZE AGE	LATE BRONZE AGE	IRON AGE • Massalia				
SARDINIA/ CORSICA	COPPER AGE	EARLY BRONZE AGE	MIDDLE BRONZE AGE Early nuragic	LATE BRONZE AGE Nuragic climax	IRON AGE	PUNIC			
MALTA	TEMPLE PERIOD	? ?	EARLY BRONZE AGE Tarxien cemetery phase	MIDDLE BRONZE AGE	LATE BRONZE AGE	IRON AGE	PUNIC		
SICILY	COPPER AGE	EARLY BRONZE AGE	MIDDLE BRONZE AGE	LATE BRONZE AGE	EARLY IRON AGE	ARCHAIC–CLASSIC			
SOUTHERN ITALY	COPPER AGE	EARLY BRONZE AGE	MIDDLE BRONZE AGE	LATE BRONZE AGE	EARLY IRON AGE	ARCHAIC–CLASSIC			
CENTRAL/ NORTH ITALY	COPPER AGE	EARLY BRONZE AGE	MIDDLE BRONZE AGE	LATE BRONZE AGE	EARLY IRON AGE	ARCHAIC–CLASSIC			
EAST ADRIATIC	COPPER AGE	EARLY BRONZE AGE Cetina	MIDDLE BRONZE AGE	LATE BRONZE AGE	IRON AGE				
AEGEAN	EARLY BRONZE AGE	MIDDLE BRONZE AGE / LATE BRONZE AGE; Thera eruption; Minoan palaces; Mycenaean palaces; Post-pal.	EARLY IRON AGE	ARCHAIC	CLASSICAL • Salamis	HELLENISTIC • Alexander			
ANATOLIA	EARLY BRONZE AGE	MIDDLE BRONZE AGE Kültepe archive	LATE BRONZE AGE Hatti • Uluburun	IRON AGE Phrygia Lydia	PERSIAN	HELLENISTIC			
JAZIRA / NORTH MESOPOTAMIA	EARLY DYNASTIC	AKKAD	MIDDLE BRONZE AGE Mari archive • BABYLONIAN	LATE BRONZE AGE MITANNI MIDDLE ASSYRIAN	IRON AGE NEO-ASSYRIAN	NEO-BABYLONIAN	PERSIAN	HELLENISTIC	PARTHIAN
CYPRUS	EARLY BRONZE AGE	MIDDLE BRONZE AGE	LATE BRONZE AGE	IRON AGE	ARCHAIC	PERSIAN	HELLENISTIC		
LEVANT	EARLY BRONZE AGE • Ebla archive	MIDDLE BRONZE AGE	LATE BRONZE AGE Ugarit archive Qadesh •	IRON AGE David/ Solomon • Wenamun Israel/ Judah Assyria/ Babylon	PERSIAN	HELLENISTIC			

ROMAN IMPERIAL EXPANSION

2500 BC — 2000 — 1500 — 1000 — 500 — 1

The extremely common use of the term 'Iron Age', which makes it seems so indispensable for archaeologists, can be explained by the fact that the Bronze Age/Iron Age transition can have more than one function in academic practice. Apart from the use of the term to pinpoint a stage of technological innovation (the Iron Age as a technological stage), the term can also be used to denote a profound culture-historical change which happened approximately at the time when iron was being introduced.[90]

[90] See, for example, the case of the southern Levant, as explained by Tatiana Pedrazzi (142 f.): "La periodizzazione convenzionale individua in un preciso momento storico il passaggio dall'età 'del Bronzo' all'età 'del Ferro', ma i termini impiegati non funzionano come indicatori di un netto cambiamento tecnologico, fra una fase e l'altra, bensì fungono da 'etichette' indicanti l'avvento di più

The former function denotes a stage in technological evolution, the second denotes a socio-economic transformation of far-reaching historical significance. In the scholarly literature, the latter meaning is used much more frequently than the former. The reasons for the conspicuous and enduring popularity of the term 'Iron Age' will be discussed in the following paragraphs.

As explained above, the Iron Age, in the culture-historical sense of the term, has only a tenuous relationship with the introduction of iron. For this reason, our attention now turns to the concept of the 'Age' itself.[91] To divide time, archaeologists use a simple, hierarchical system composed of Ages, Periods, Phases and sub-Phases.[92] These chronological divisions are based on different principles of development. The Phases and sub-Phases can simply be divisions in relative chronology (for example referring to a stratigraphic sequence, or changes in pottery or fibula typology), which have no particular historical relevance and may only be of local or regional significance. On the other hand, the higher levels of periodization, Periods and Ages, embody important divisions in cultural classification, based on either culture-historical or evolutionist criteria. This hierarchical structure, expressing the level of importance and geographical scope of the chronological units, is fundamental for the systems of periodization which are currently in widespread use.

The 'Age' is used to designate the highest order unit of chronological division, which has supra-regional significance. Theoretically, the changes at the start of the Iron Age herald the coming of a new Era or Age, implying the onset of a new historical conjuncture characterised by new historical conditions and socio-economic relations. For this reason, after the transition, periodization starts anew (e.g. Iron Age I, II, III; Early, Middle, Late Iron Age).

According to this analysis, the conventional (culture-historical) usage of the term 'Iron Age' suggests that around the time of the diffusion of ironworking, 'epochal' changes took place in many regions of the Near East and Europe. This remarkable correlation demands an explanation.

There is a feature of the Bronze Age/Iron Age transition which is particularly revealing. The transitions in the conventional chronological periodizations, widely used in academic publications, exhibit a pronounced chronological trend: a gradient reaching from ca. 1200 BC in the Near East, down to ca. 800 BC in west and north-west Europe. To illustrate this, consider these examples taken from a selection of regions discussed in this book:[93]

- ca. 1200 BC – Levant: 'Iron IA' begins after the collapse of the palatial system in the Crisis Years.
- ca. 1050 BC – Cyprus: in analogy with the Levant, the Bronze Age/Iron Age transition could refer to the time of the Late Bronze Age collapse ca. 1200 BC; but normally the start of the Iron Age is set in the mid-11th century BC at the transition from Late Cypriot IIIB to Cypro-Geometric I.
- ca. 1050 BC – Greece: some authors set the start of the Iron Age in the central and southern Aegean at the time of the Late Bronze Age collapse ca. 1200 BC, but most scholars prefer the traditional date at the transition from Submycenaean to Protogeometric in the mid-11th century BC; the establishment of large cemeteries such as Vergina and Aghios Panteleimon in Macedonia or Stamna in Aetolia suggests that profound culture-historical changes occurred later in northern and western Greece (ca. 1000 BC).
- ca. 950 BC – Central and eastern Balkan Peninsula: the disintegration of the Fluted Ware complex, and the concomitant cultural reorientation around the mid-10th century BC, seems to reflect the increased influence of the Protogeometric Aegean.

ampi mutamenti di ordine sociopolitico e storico-culturale."

[91] For a general discussion of archaeological periodization, see Pare 2008a.

[92] See for example Eggert 2001: 42 ff.; 150; Schier 2013: 265 f. — Examples taken from Central Europe: Age (e.g. Palaeolithic, Bronze Age); Period (e.g. Middle Neolithic, Early Iron Age); Phase (e.g. Bronze Age C, La Tène B); sub-Phase (e.g. Hallstatt A1, La Tène D2).

[93] The chronological trend can also be seen on the table assembled by Cyprian Broodbank (Table 8); but note that some of the details of the relative and absolute chronology on the table are open to question.

- ca. 900 BC – North Pontic steppe and north-west Caucasus: the start of the pre-Scythian phenomenon.
- ca. 900 BC – Carpathian Basin: disintegration of the Gáva/Fluted Ware *koinè* and system collapse.
- ca. 950/800 BC – Italy: in the south (Calabria), the Iron Age begins in the second half of the 10th century BC; in the Villanova culture in Campania, Etruria and Emilia-Romagna at ca. 900 BC; and in northern Italy, centralized Iron Age proto-urban sites (especially in the Veneto) emerge during the 9th century BC.[94]
- ca. 800 BC – South-eastern and eastern Alps: the Iron Age in Slovenia begins with the establishment of large defended settlements surrounded by tumulus cemeteries at ca. 800 BC;[95] at this time, the onset of the Iron Age in the East Hallstatt cultures is marked by a process known as Hallstattization (*Hallstattisierung*).[96]
- ca. 800 BC – The Urnfield culture in the area north of the Alps and in central and eastern France, and the Atlantic Zone in north-west Europe: collapse of the Standard Bronze value system.
- ca. 800 BC – Iberian Peninsula: the foundation of Phoenician colonies in Andalusia in a Bronze Age context.

In the examples listed above, the chronological gradient between ca. 1200 and ca. 800 BC shows that the process leading to the start of the Iron Age possessed spatial directionality, broadly speaking proceeding from east to west and south-east to north-west. The diffusion of ironworking, which took place at approximately the same time, accompanied the Bronze Age/Iron Age transition. But the introduction of iron cannot be understood as itself causing the profound changes associated with these transitions. It might appear paradoxical, but the spread of ironworking technology should be understood as of secondary importance (epiphenomenal) for the start of the Iron Age: the innovation was just one element of the Bronze/Iron transition. However, this conclusion is hardly surprising. Considering that in normal usage the term 'Iron Age' has a culture-historical meaning, there is no reason to expect a purely technological (mono-causal) explanation for the complex socio-economic changes observed in each of the regional case studies.

Our discussion has led to the conclusion that the start of the Iron Age, in its culture-historical sense, can be understood as a process exhibiting chronological and geographical directionality, linking together regions through the Mediterranean and continental Europe. Evidently, the profound social, political and economic changes visible in most regions at the transition to the Iron Age did not happen in isolation; the transitions in the regions were somehow linked together as parts of a process. It is worth emphasizing, once again, that this conclusion is based on the analysis of the established scholarly use of the terms 'Bronze Age' and 'Iron Age'. Clearly, the Bronze Age/Iron Age transition is not just an academic convention, a convenient *terminus technicus*, it refers to a series of important supra-regional culture-historical transformations, which can be envisaged as a slow-motion chain of repercussions.

In summary, the discussion of the enduring popularity of the culture-historical usage of the term 'Iron Age' has led to two propositions. Firstly, the term 'Iron Age', in its culture-historical sense, has a very interesting connotation, which probably explains its popularity. Although this might not be appreciated fully by most archaeologists, the use of the terms 'Iron Age' or 'Bronze Age/Iron Age transition' entails a model recognizing a generalized correlation between two seemingly unrelated processes: the diffusion of iron and far-reaching, 'epochal' change in most regions between the Levant and southern Europe. Secondly, both the start of the Iron Age, in the culture-historical sense, and the diffusion of iron exhibit chronological and spatial directionality. In both cases, it appears that the processes started earlier in the east and seem to have emanated from the Levant or East Mediterranean.

[94] For a review of the chronology in Italy at the Bronze/Iron transition, see Pare 2008b.
[95] For Slovenia, see for example Teržan 1990b: 206 fig. 55.
[96] Pare 2021: 70 ff.

The Iron Age and the process of 'Mediterraneanization'

The interpretation of the chronological gradient and spatial directionality exhibited by the start of the Iron Age is complex and deserves much more scholarly attention and research. In the following paragraphs the discussion will focus on the regions surrounding the Mediterranean and the process of 'Mediterraneanization'.

An article by Antonis Kotsonas, discussing the use of the term 'Dark Age' in Aegean archaeology, offers an important insight to better understand the start of the Iron Age.[97] Kotsonas argues that the Early Iron Age "was the period when [the Mediterranean] was first conceptualized as a unity, and the time its inhabitants started sailing from one end of it to the other".[98] According to this view, the Iron Age was characterised by the emerging "connectedness of the Mediterranean basin and the fluidity of the movement of people, goods and ideas", a process which Ian Morris called 'Mediterraneanization'.[99] Similar ideas were developed by Jan Paul Crielaard, in his study of Mediterranean intercommunications during the second half of the 11th and the 10th century BC.[100] Creilaard describes how "prestigious metal items, raw materials and information of various kind 'surfed' back and forth over the Mediterranean and beyond via a series of interlocking regional networks, dominated by local élites." These interconnected networks gave rise to "a 'virtual community', a collective which has nothing to do with physical proximity, but which nonetheless has access to the same information and which shares similar ideas and values."

The concept of 'Mediterraneanization' is crucial for the interpretation of the start of the Iron Age. As we have seen from the above quotations, the process of Mediterraneanization is driven by mobility, communication and trade; new cultural and economic practices spread through the Mediterranean, leading to increased connectedness, economic integration and convergence.

An important aspect of Mediterraneanization were new, freelance trading practices, no longer under the control of Bronze Age palatial systems.[101] For Susan Sherratt, this represents a commercial revolution "which was to ensure that the centralised, bureaucratic, palace-based economies of the Bronze Age, in which economic and political control were very closely identified, could not successfully reemerge in the 1st millennium".[102] The new breed of traders could be of any ethnic group – it was only important that they shared in common the new entrepreneurial ideas and economic practices.[103] The 'oar-loving' Taphians can be taken as an example of these Early Iron Age freebooters. In the *Odyssey* they are depicted as pirates, slave-traders and merchant venturers active from the Levantine coast to the shores of the Tyrrhenian Sea (see Chapter 10.6). It hardly needs to be emphasized that such long-distance maritime contacts required effective methods of sailing.[104]

Connectedness and convergence are the two elements which are essential for Mediterraneanization. However, it is also true that the diffusion of accomplishments from the urban centres of the East Mediterranean and Levant played an important role. Apart from ironworking, these include materials such as ivory, and practices associated with a refined lifestyle, for example requiring the metal dining equipment associated with élite commensality.

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97 See Chapter 4.5.

98 See Kotsonas 2016; the quotation is on page 262. — Note that the introduction of ironworking does not play an important role in this interpretation of the start of the Iron Age.

99 For the introduction of the term 'Mediterraneanization', see Morris 2003; the quotation is on page 50 of Morris' article.

100 Crielaard 1998; the quotations are from pages 194 and 199.

101 See for example Broodbank 2013: 468: "more flexible, uncentralized and freelance trading practices largely in the hands of private individuals or consortia, decoupled from the political sphere and explicitly motivated by profit."

102 Sherratt 1994a: 85; and see Chapter 3.4.

103 For a discussion of the different forms of early Greek trade (*préxis* and *ergon* trade), see Crielaard 2012.

104 In the later 2nd millennium BC, important developments in maritime technology and methods of navigation became widespread in the East Mediterranean, especially the use of oared galleys with loose-footed, braided sails. And new navigation techniques allowed sailing on the open sea, at night navigating by the Pole Star (*Phoinike*). These innovations spread to the central and western Mediterranean in the late 2nd/early 1st millennium BC. See for example Broodbank 2013: 464 f.; 491 ff.; Emanuel 2015.

The discussion of Mediterreaneanization helps us to understand that the start of the Iron Age did not merely involve the introduction of a new metallurgical technology, it represents a fundamental economic and cultural transformation of the regions surrounding the Mediterranean – the creation of a geographical structuration centred on the Mediterranean Sea which became characteristic for the 1st millennium BC.[105] Therefore, we can formulate a third proposition: The process of Mediterraneanization was the context for the profound changes in southern Europe at the Bronze Age/Iron Age transition. For this 'processual' interpretation of the start of the Iron Age it is important to understand that Mediterraneanization was a process with an east-west chrono-spatial trend. Obviously, the diffusion of iron did not happen in a vacuum, it was an element of this process; indeed, it is probably one of the best indicators for the early (pre-colonial) stages of Mediterraneanization.

Considering this intimate relationship with the diffusion of iron, it is not surprising that important evidence for the process of Mediterraneanization has already been discussed in previous chapters. In the following paragraphs, the main developments will be summarized, and some of the implications of the Mediterraneanization model highlighted.

After the downfall of the palatial system in the area between the Near East and the Aegean, Cyprus was crucial for both the development of ironworking and the inception of long-distance sea-borne trade. Although Cyprus was less affected by the Late Bronze Age collapse than other regions, the 12th and the first half of the 11th century BC were troubled times, in which most larger settlements were destroyed or abandoned, and most cemeteries were only used for a restricted length of time. Very likely, these upheavals reflect a period of increased mobility and migration. Nevertheless, Cyprus remained much wealthier and more technologically advanced than any of the regions further west in the Mediterranean. The iron knives with bronze rivets in the Levant and the Aegean testify to the resurgence of Cypriot overseas trade after the Crisis Years; this trading activity can be regarded as the prelude to the process of Mediterraneanization.

Around the mid-11th century BC, the start of the Iron Age in conventional terminology, the political situation in Cyprus stabilized; from now on, burial and settlement evidence is concentrated in the vicinity of the centres which were to become the city-kingdoms named in texts of the Cypro-Archaic period.[106]

The Aegean experienced a protracted decline during the post-palatial period, reaching its lowest point during the Submycenaean period. The decline was reversed at the transition to Early Protogeometric, when influence from Cyprus can be detected both in pottery and metalwork.[107] During the second half of the 11th and the first half of the 10th century BC, high-status burials from Crete and central Greece display a remarkable degree of similarity with Cyprus, indicating that the Aegean élites were adopting practices from their Cypriot role models (see, for example, Table 6).[108]

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[105] The effect of the transformation of the Mediterranean has been described eloquently by Cyprian Broodbank (2013: 471 f.): "... the real victor to emerge from the changes on either side of 1200 BC was the Mediterranean, or more accurately, the hugely dynamic, volatile and potentially destabilizing power-diffusing cultural and economic practices that people living around and in it were able to promote, once interactions over its surfaces had reached a critical scale and velocity. Terrible as the crisis [ca. 1200 BC] undoubtedly was in the short term for many people, the Mediterranean emerged from this paroxysm to enjoy over the coming 1500 years its all-time greatest age of growth and relative ascendancy ... It was the Mediterranean that undid the unified Egypt of the New Kingdom ... the corrosive, marine effect could be generalized to encompass the overall eclipse of palace-focused economic, social and political structures, in favour of very differently constituted Iron Age polities. ... Mediterranean economies, demography and agriculture would flourish to unprecedented degrees under quite different political regimes during the Iron Age". — Note that the important role of the Mediterranean in the 1st millennium BC has been recognised by many authors since the 19th century, for example in the idea of the 'Thalassic Stage' introduced by the Hegelian philosopher of history Ernst Kapp. Kapp (1868: 90 ff.; 163 ff.; 247 ff.) envisaged three stages in the evolution of civilisation. In the Potamic Stage, civilisations were centred around major rivers (e.g. the Tigris and Euphrates in Mesopotamia, the Nile in Egypt, the Yangtze in China, the Indus and Ganges in South Asia). In the Thalassic Stage, the most 'historically important' civilisations were located around the Mediterranean, a closed sea (e.g. Classical Greece and Rome, Carthage, medieval Venice). The Oceanic Stage started with the expansion of the maritime powers of western Europe across the Atlantic in the 16th century.

[106] Including: Amathus, Idalion, Kition, Kourion, Lapithos, Palaepaphos, Salamis. See for example Iacovou 2008; 2012; Satraki 2012.

[107] For the pottery, see Ruppenstein 2009.

[108] See Crielaard 1998: 190 f.

The second half of the 11th and the first half of the 10th century BC saw the initial stage of the Mediterraneanization process. Jan Paul Crielaard discussed a range of high-status Cypriot artefacts which reached the central and western Mediterranean, apparently showing how local élites sought to emulate the refined lifestyle of their Cypriot trading partners. Crielaard emphasized the key role of Sardinia as an important node enabling the Cypriots access to regional exchange networks in the central and western Mediterranean; Cypriot craftsmen may even have been active on the island.[109] The substantial quantities of ivory at this time in southern Italy and Sicily must also have been brought by seafarers from the East Mediterranean. However, the most important evidence for long-distance contact with the East Mediterranean comes from the Iberian Peninsula, for example in the form of precision weights and items of imported dining equipment (see Chapter 11.3). The identity of the seafarers is uncertain, but it is possible that Cypriot traders acted as intermediaries in the trading networks reaching from the Levantine coast to the central and western Mediterranean. Many more bronze artefacts show that there was an active exchange network linking the south-west Iberian Peninsula with Sardinia, Sicily and southern Italy.

During the second half of the 11th century BC, the diffusion of iron reached a series of regions in southern Europe between Portugal and Ukraine (see Chapter 12.2: the 'maritime horizon'); as argued above, this is an important indicator for the initial stage of Mediterraneanization. And the introduction of the first fibulae, for example in the Iberian Peninsula, Ukraine and Colchis, must also be understood as an innovation transmitted in the context of this upsurge in long-distance sea-borne trade (see for example Figures 28; 35; 63: 5). It is often difficult to establish the identity of the seafaring traders. Considering the varied nature of the exchanged goods, and the vast distances involved, we can be sure that many different interlocking exchange networks were involved, maintained by a multitude of different regional actors. However, the trade along the western and northern coast of the Black Sea presumably involved seafarers from the Aegean (for the finds linking Elateia, Thasos and Hordiivka, see Chapter 6.1-2).

The process of Mediterraneanization intensified during the 10th and 9th centuries BC. From the second half of the 10th century BC onwards, there is growing evidence for the activity of Phoenician seafarers in the central and western Mediterranean. At the same time (Late Protogeometric), there is more evidence for Greek overseas trading exploits.[110] The trading posts at Huelva and La Rebanadilla in south-west Andalusia show that Phoenicians were regularly visiting the southern Iberian Peninsula by the first half of the 9th century BC. At Torre Galli in Calabria, local ironworking started in the second half of the 10th century BC, and the source of this technological innovation is perhaps indicated by the East Mediterranean (Phoenician?) imports from the cemetery, including ivory, faience beads, steatite scarabs and hemispherical bronze bowls.

Mediterraneanization can be understood as a process leading to the emergence of a new cultural and economic geographical structuration, whereby communities increasingly orientated themselves towards developments taking place throughout the Mediterranean. This can probably explain changes taking place in peripheral regions not directly involved in sea-borne trade. Consider the case of the eastern Balkan Peninsula, described in Chapter 5. The cultural reorientation in the eastern Balkans, which marks the transition from the Bronze Age to the Iron Age, was ascribed to the increasing importance of trade with and influence from the (Late Protogeometric) Aegean.[111] The Stamped Pottery complex emerged around the middle of the 10th century BC, reaching from the Thracian Plain to the Lower Danube and Moldavia.[112] The close links with the Aegean demonstrated by the iron trunnion axes and swords have been discussed in detail in Chapters 4 and 5 (see for example Figures 19 and 24). Furthermore, fibulae of Aegean type

[109] Crielaard 1998: 193; 197.
[110] See for example the bronze finds from Baiões (central Portugal), which demonstrate contact with Sardinia and the eastern Mediterranean (flesh-hook, hemispherical cups, and technical details of the 'wagon modes'). — For the increase in long-distance trade in the second half of the 10th century BC, see for example Pare 2008b: 95; Gilboa 2013: 326; 2022.
[111] In principle, the eastern Balkan peninsula was open to contact and exchange with both Greek and Phoenician traders. The literary sources inform us that Phoenicians, attracted by the gold mines, settled on Thasos and built a temple for Heracles; they also visited Lemnos and (less certainly) Samothrace. As for the Greeks, the Thermaic Gulf and Chalcidice had been colonized from the Protogeometric period onwards, mainly by Euboeans. See Tiverios 2008: 75; 110; for Thasos, see Herodotus II: 44; VI: 47; for Lemnos, see Homer, Iliad 23: 740-745. — See also the discussion of normative change in Pare 2015.
[112] Maya Kashuba has described this as a communication space orientated towards the Aegean. See Kašuba 2006: 233.

are found in large numbers in the eastern Balkan Peninsula.[113] And bronze hemispherical cups have been found in Transylvania and eastern Hungary, which suggest that novel drinking practices originating in the East Mediterranean were introduced during the 9th and 8th centuries BC. Similar cups are known, for example, from Cyprus, the Late Protogeometric and Early Geometric Aegean (e.g. Athens, Argos, Lefkandi and Knossos), central Portugal (Baiões), Sardinia (Matzanni) and Calabria (e.g. Torre Galli).[114]

The effects of this cultural reorientation in Thrace were felt in areas far afield in the European continental periphery.[115] It seems that the innovative role of Thrace, especially in the field of iron metallurgy, and the expansion of the Stamped Pottery complex, contributed to a sequence of radical changes proceeding along the Danube, leading to the disintegration of the Gáva/Fluted Ware *koinè* and system collapse in large parts of the Carpathian Basin at around 900 BC. According to this thesis, the demise of the Standard Bronze value system in the 9th century BC between the Carpathian Mountains and north-west Europe may have been a consequence of the profound changes taking place in the Mediterranean in the early 1st millennium BC.

According to our model, the changes at the Bronze Age/Iron Age transition in the Italic Peninsula should also be linked in some way to the process of Mediterraneanization. In conventional periodization, the start of the Iron Age in Italy is marked by fundamental political-territorial transformation and the emergence of new forms of centralised social organisation. Unfortunately, there is at present no scholarly agreement concerning the reasons for the radical changes at the start of the Iron Age (ca. 900 BC) in the Villanova culture – specifically the massive demographic concentration in so-called ‘proto-urban’ settlements. However, judging from the finds from the cemetery at Torre Galli, the richest site in Italy during the second half of the 10th and the first half of the 9th century BC, this process of economic, demographic and political centralisation seems to have started earliest in the south of the Italic Peninsula. It is quite plausible that contact with seafarers from the Aegean and the East Mediterranean contributed to the changes at the Bronze/Iron transition at Torre Galli. However, at present it is not clear to what extent these changes in Calabria affected the transformations further north, for example in Campania, Latium and Etruria.

Considering its position far in the west, it may seem surprising that the Iberian Peninsula offers a particularly convincing ‘paradigm case’ for the process of Mediterraneanization. However, this can be explained by the mineral wealth of the southern and south-western regions of the peninsula (gold, silver, tin), which attracted sea-borne traders from the central and eastern Mediterranean. We have seen that there is plentiful evidence for the ‘maritime horizon’ starting in the 11th century BC. There followed an intensification of trading activity during the 10th and 9th centuries BC, supported by the establishment of the first Phoenician trading posts. And finally, around 800 BC, the Phoenicians founded permanent colonies in Andalusia, marking the start of the Iron Age in the conventional (culture-historical) periodization.

The foundation of Phoenician and Greek colonies on the southern fringe of Europe from the 8th century BC onwards, eventually reaching from Andalusia in the west to Colchis in the east, brought urban culture to most of Europe’s southern flank. This represents the key milestone in the process of Mediterraneanization, and a veritable (‘urban’) revolution in European history. The example of the colonies is a useful reminder of the fact that the process of Mediterraneanization also encompassed the Black Sea (‘Pontusization’). The process is already evident during the ‘maritime horizon’ in the 11th century BC; however, coastal communication and trade along the Black Sea coast seem to have diminished or been interrupted during the 9th and 8th centuries BC at the time of the so-called pre-Scythian phenomenon in the North Pontic steppe.

It should be emphasized that while long-distance sea-borne trade was essential for the process of Mediterraneanization, it was by no means a completely new development. Trading networks of more

[113] These types of fibulae (so-called ‘Brad’ and ‘Mesambria’ types) are documented in the Aegean since the late 10th century BC. See Pare 2015: 286; 312 fig. 13: B.

[114] See Pare 2015: 304 ff. fig. 1; 3; 4; 5; 6; 7; 8; for the bronze *phialai* from Fizeşul Gherlii (Transylvania) and Sarkad (Hungary), see 304 fig. 1:A1; B1-4.

[115] See the five-stage model for the Bronze/Iron transition summarized in Chapter 9.7.

restricted extent certainly existed earlier, both before and after the destruction of the Near Eastern and Aegean palaces in the years around 1200 BC. For example, Reinhard Jung has recently discussed the close trading relationships between the Aegean, southern Italy (especially Apulia) and the eastern Po Plain in the post-palatial period.[116] Copper from the southern Alps (Trentino) supplied not only southern Italy, but also the Aegean and even reached the East Mediterranean. The trade seems to have peaked in the first half of the 11th century BC. In his important article, Jung described how this trading network disintegrated around the middle of the 11th century BC, leading to a crisis which affected both Apulia (e.g. Roca Vecchia) and the Veneto (e.g. Frattesina).[117] This change in the trading activities between the *Caput Adriae* and Greece seems to provide support for the Mediterraneanization model. Reinhard Jung argued that "mechanisms of uneven and combined development" led to this crisis in trans-Adriatic trade.[118] I agree that the concept of 'uneven and combined development', as used in the theoretical tradition of historical materialism, is very relevant in this context. But in my view, in line with the Mediterraneanization model, the disruption in the trade between the Aegean and the Adriatic in the mid-11th century BC was probably caused by confrontation with the innovative economic structures and practices which were being introduced from the East Mediterranean, i.e. with the Mode of Production centred in the Levant and Cyprus,

In summary, according to our hypothesis, the diffusion of iron is a very useful marker for the process of Mediterraneanization. The chrono-spatial trend exhibited by the growing integration of exchange networks throughout the Mediterranean (and in the Black Sea) is reflected in a sequence of profound economic and cultural transformations in southern Europe: the 'epochal' changes at the Bronze Age/Iron Age transition in the conventional culture-historical schemes of periodization.

12.4 Concluding remarks and perspectives for future research

In this section, some of the most important themes and arguments in previous chapters are revisited, summarized and discussed. Finally, the analysis of the culture-historical version of the concept of an 'Iron Age' is developed further, concluding with a framework for future research on the Bronze Age/Iron Age transition.

The first iron artefacts

Thanks to the results of archaeometallurgical research, it has become clear that the earliest known iron artefacts are made of meteoritic iron. Their wide and scattered distribution is remarkable: so far, objects made of meteoritic iron dating between the late 4th and the 2nd millennium BC are known from Egypt, Anatolia, the Levant, Mesopotamia, Iberia, the Aegean, the Pontic-Caspian steppe and China. In the majority of cases, the artefacts come from high-status contexts, especially burials, and it is not uncommon that they have an elaborate bimetallic construction. It is unclear why meteoritic iron was apparently not treated as a precious metal in Central Europe, where four artefacts are known from the Late Bronze Age and Early Iron Age in Poland and Switzerland (see Chapter 9.2).

It is very difficult to be at all precise about the earliest introduction of iron extractive metallurgy. My arguments, based on the written sources, support the traditional view that iron production first started around the middle of the 2nd millennium BC in the kingdom of the Hittites (and perhaps the Mitanni). However, at present there is very little archaeological evidence for smelted iron before the 13th century BC in the Near East, and iron finds remain extremely rare in Anatolia until the end of the 2nd millennium BC. The abundance of iron in the Hittite cuneiform sources is difficult to reconcile with the dearth of iron in the archaeological record. The explanation of this apparent contradiction requires a model in which the use of iron was tightly controlled by the royal palaces, and iron never came into general use. It seems that the situation in the Near East changed in the second half of the 13th century BC, when written

[116] Jung 2020.
[117] For the crisis around the mid-11th century BC and possible explanations, see Jung 2020: 185.
[118] See Jung 2020: 185.

sources and archaeological evidence for iron become much more common (the 'mid-13th century' hypothesis). The reconstruction of the innovation process in the 13th century BC put forward in this book is remarkable, indeed surprising: after being tightly controlled by the palatial administration for a long period (centuries), ironworking abruptly took a new trajectory and the diffusion process through Eurasia began. Considering the importance of this crucial stage of the innovation process, the 'mid-13th century' hypothesis should remain the focus of specialist philological and archaeological attention.

The diffusion of ironworking

Diffusionism has been the dominant explanation for the spread of ironworking in the Old World. In the course of the present research project, I also reached the conclusion that diffusionism is the strongest interpretative model. In the previous chapters, the evidence for and against the alternative, 'gradualist' model has been discussed in detail (for 'diffusionism' and 'gradualism', see the introduction to Chapter 2). The only exception to the diffusionist model is the case of southern India, where an independent centre of ironworking apparently developed in a Neolithic/Chalcolithic context already in the mid-2nd millennium BC.

As mentioned above, archaeological evidence for wrought iron becomes much more common in the Near East in the course of the 13th century BC. Iron was evidently first mainly used to make ring jewellery, which became widespread in the Near East during the 12th and 11th centuries BC. Between ca. 1200 and ca. 800 BC, ironworking spread from the Near East through Eurasia, in the west reaching the Atlantic coast and in the east the North China Plain. The evidence from these four centuries suggests an exponential rate of geographical expansion. Once ironworking became established, it seems that the spread of iron was irreversible.

Frequently occurring forms of artefacts

Thanks to the large-scale approach of the present study, taking account of the available published evidence from most of Europe and Western Asia, certain regularities during the earliest stages of innovation could be recognised. Not surprisingly, the earliest wrought iron artefacts are normally simple in shape, and relatively easy to make for blacksmiths with rudimentary skills. It is notable that iron at first mainly appears in the archaeological record in specific and singular, frequently occurring forms: especially ring jewellery and knives, but also in bimetallic artefacts, and in the form of decorative iron elements on bronzes.[119] According to the evidence from a number of regions in which these artefacts have been found in both funerary and settlement contexts, I have argued that craftsmen at first tended to concentrate on manufacturing specific artefact types, leading to a find spectrum dominated by one of two particular forms. In the archaeological record, these forms are encountered in distinct regional horizons, which reflect different conceptualizations of iron and different ways in which the new metal was introduced (see Figure 64). These 'horizons' are a very useful indication for the start of ironworking.

In the case of another form of artefact, the 'small rod-shaped objects' (interpreted in the literature as 'awls', 'pin fragments', etc.), it transpires that they often derive from suspiciously early contexts. As their shape is so unspecific, and their original function is uncertain, it seems likely that these are often intrusive artefacts, for example fragments of rusty wire or nails of much later (medieval or modern) date. This conclusion is important for the argument against the gradualist model for the introduction of iron.

Mechanisms and motivations in the introduction of iron

Considering the rapid, apparently irresistible, spread of iron through Eurasia between ca. 1200 and ca. 800 BC it may seem surprising that the reasons for adopting the new metal and the mechanisms of its transmission are by no means clear. The rapid diffusion of iron makes the question how the new metal was transmitted especially intriguing.

[119] For "iron objects of specific and singular types" as a stage before the use of iron for utilitarian purposes, see Yalahom-Mack and Eliyahu-Behar 2015: 289.

Although the corrosion of iron often means that the artefacts are badly preserved, it is nevertheless often the case that the typology of the early iron artefacts has a recognisable local character. Therefore, it seems that trade in finished products was rather uncommon. However, it is generally impossible to be certain whether the iron artefacts were manufactured from imported raw material (iron billets) or from iron produced by smelting local ores. This leads to the general hypothesis that blacksmithing was introduced early in the diffusion process; on the other hand, it is much more difficult to judge when the transfer of the technology of extractive metallurgy took place.

The question why the new metal was so desirable is surprisingly difficult to answer, especially as the motivation behind the adoption of the new metal doubtless varied from place to place. Obviously, the metal was attractive, and at first its allure might be explained by its novelty and exoticness; for example, this is presumably the case in regions where iron was used as a decorative element on bronze artefacts and was apparently treated as a precious metal. Furthermore, the different forms of artefacts manufactured, such as ring jewellery, knives, or weaponry, provide information on the conceptualization of the new metal, and go some way to explain the social value of the new metal.

From the earliest investigation of the introduction of iron 200 years ago, in Christian Jürgensen Thomsen's explication of the Three Age system, the rationale behind the introduction of iron has generally been assumed to be technological progress. Today, this interpretation of the Iron Age as a technological stage has become rather less straightforward.

Attempts to explain the adoption of iron have concentrated on its two potentially advantageous intrinsic properties: (i) the potential of producing a metal (steel) harder and sharper than bronze, through carburization and heat treatment; and (ii) the potential of exploiting locally available iron ores, which would make iron much easier to obtain than copper and tin for making bronze. We cannot assume that these potential advantages were generally appreciated and exploited at the time when iron was first being adopted.

In the case of the production of hardened steel, the available results of archaeometallurgical research suggest that in the early stages of the introduction of iron, the blacksmiths only had rudimentary skills, and carburization and heat treatment were not widely practised. In the case of the ring jewellery, which is predominant among the earliest artefacts of wrought iron, these techniques were obviously unnecessary. And in the case of the earliest iron knives, we cannot assume that they were necessarily 'better' (harder, sharper) than bronze examples.

The question whether iron was produced by exploiting locally occurring iron ores is – with rare exceptions – difficult to answer. Unfortunately, there is very little evidence for extractive metallurgy anywhere in Eurasia during the early stages of ironworking. However, the 'exponential' geographical expansion of iron use in Eurasia shows that the technology of extractive metallurgy must have been transmitted relatively quickly. This leads to the hypothesis that the potential advantages of producing iron locally were probably already widely appreciated during the early stages of the diffusion process.

To advance our understanding of these questions, further scientific research is required, for example archaeometallurgical studies to investigate the technical qualities of artefacts, provenance studies, and systematic study of slags deriving from smelting and smithing.

Disentangling the concept of an 'Iron Age'

One of the most interesting aspects arising from our study of the introduction of iron is the question of the concept of an 'Iron Age'. It has become apparent that there is a contradiction in the use of the term 'Iron Age'. As explained in Chapter 12.3, the start of the Iron Age can have two very different connotations. In my opinion, this observation has far-reaching consequences:

(i) The Iron Age can be understood as a technological stage – the triumph of iron over bronze. In this version of periodization, the Iron Age began when iron replaced bronze for the production of most tools and weapons. The replacement of bronze by iron is traditionally associated with the rationale of technological progress and the Three Stage system devised by Christian Jürgensen Thomsen.
(ii) In conventional academic practice, the start of the Iron Age is normally defined in a completely different way: in a culture-historical sense. In this version of periodization, the transition to the Iron Age is used as a label to emphasize the importance of a series of socio-economic disjunctions or transformations which occurred approximately at the time of the diffusion of ironworking, i.e. during the initial stages of the adoption of iron and before iron became the predominant metal for manufacturing tools and weaponry. The Iron Age in this widely used, culture-historical sense has only a tenuous relationship with technological developments and does not correspond to a stage model.

In my opinion, the enduring popularity of the culture-historical version of periodization shows that the term 'Iron Age', in the second sense of the term, is not just a convenient and basically meaningless *terminus technicus*; the ubiquitous use of the term in archaeological publications is an indication that it contains a significant meaning. Some of the consequences of this conception of the 'Iron Age' have been discussed in Chapter 12.3 and will be summarized briefly in the following paragraphs.

Four great, over-arching areas have been identified, in which significant changes took place at the Bronze Age/Iron Age transition. In each of these areas, the start of the Iron Age has a distinctly different meaning:

Late Bronze Age collapse in the Near East

In conventional terminology, the start of the Iron Age is equated with the downfall of the 'Bronze Age' palatial system in the Crisis Years ca. 1200 BC. The diffusion of iron coincided with the disintegration of the palaces' hegemonial position; the 'ring horizon', which seems to correspond to a decentralized, sub-élite level of production, was the crucial turning point in the diffusion process.

Mediterraneanization

The downfall of the palaces in the Near East and the Aegean set the scene for the emergence of new economic practices in the East Mediterranean. Susan Sherratt described this new decentralized, entrepreneurial trading activity as a 'commercial revolution'. The gradual amplification of long-distance trade led to increased connectivity and convergence, in a process described as 'Mediterraneanization'. The process seems to have initiated in Cyprus and the Levant, and then spread to the Aegean and the central and western Mediterranean. According to my arguments, the developments at the Bronze Age/Iron Age transitions in the various regions were linked together by the process of Mediterraneanization. The process led to a new cultural and economic geographical structuration, whereby communities increasingly orientated themselves towards developments taking place throughout the Mediterranean. The diffusion of iron is a useful marker of the earliest stages of the Mediterraneanization process.

Late Bronze Age collapse in Central and north-west Europe

The start of the Iron Age in Central Europe is traditionally equated with the transition from the Urnfield to the Hallstatt period. In this study, this transition has been set in the context of the Late Bronze Age collapse throughout a vast area, including three cultural regions: the Carpathian Basin; eastern France and the area north of the Alps; and the Atlantic Zone in north-west Europe. In the Late Bronze Age, all these regions shared an economic and value system based on the production, exchange and display of Standard Bronze, which was vitally important for both economic production and social reproduction. The supply of bronze required long-distance exchange networks, generating a high degree of interconnectedness and interdependence over large areas. The abrupt depreciation of the social value of bronze led to the disintegration of the Standard Bronze system, and a general crisis or system collapse ca. 900 BC in the

Carpathian Basin and ca. 800 BC further to the west. The introduction of iron was probably one of the factors contributing to the Late Bronze Age collapse.

The pre-Scythian phenomenon in the North Pontic steppe

In conventional terminology, the start of the Iron Age is equated with the onset of the pre-Scythian phenomenon around 900 BC. At this time, there was a sudden burst of innovation, communication and mobility over a vast geographical expanse reaching from the Great Hungarian Plain to the Caucasus, and the 9th century BC saw the widespread distribution of iron and bimetallic weapons of Pontic-Caucasian type. The emergence of the pre-Scythian phenomenon seems to have been the result of a combination of factors: technological and economic innovation in the area north-west of the Caucasus Mountains; the development of an equestrian-nomadic lifestyle and warrior ideology in the North Pontic steppe west of the Dnipro; and possibly impulses from horse-riding cultures far to the east in the Eurasian steppe.[120]

The sheer size of these four areas underlines the importance of the changes at the Bronze Age/Iron Age transition, and this probably explains the enduring role of the culture-historical conception of the Iron Age. In each of the areas, the changes occurring between ca. 1200 and ca. 800 BC anticipate the historical relations which became characteristic for the 1st millennium BC; indeed, the profound difference between the 2nd and 1st millennium BC can only be understood by taking account of these transitions at the start of the Iron Age.

As we have seen, use of the term 'Iron Age' in its culture-historical sense draws attention to a series of important ('epochal') political, social and economic changes at the time of the diffusion of ironworking between ca. 1200 and ca. 800 BC. The introduction of iron certainly did not cause all the changes at the start of the Iron Age, instead the diffusion of iron and the start of the Iron Age accompanied each other. As these are *prima facie* unrelated phenomena, the question arises why the diffusion of iron should have been accompanied by such fundamental socio-economic change.

As explained above, it is difficult to draw general conclusions about the reasons for adopting iron. Whether or not the potential technical advantages of iron were immediately appreciated by the adopting communities, it is clear that the innovation could only be transmitted through social contact, and the allure of the new metal may primarily have been its novelty and exoticness, and its social value may have derived from the desire to emulate iron-producing cultures. For this reason, it follows that the diffusion of iron is first and foremost an indicator of social contact between communities, cultures and regions, for example in the context of exchange relationships. And, as the term implies, the diffusion process involves directionality: the geographical expansion of the innovation of ironworking over time.

It is especially significant that between ca. 1200 and ca. 800 BC not only the diffusion of iron, but also the fundamental changes at the start of the Iron Age exhibit a pronounced chronological trend: a gradient reaching from ca. 1200 BC in the Near East, down to ca. 800 BC in west and north-west Europe (see the discussion of the concept of an 'Iron Age' in Chapter 12.3). This chrono-spatial trend makes it likely that the fundamental disjunctions and transformations at the start of the Iron Age form a sequence or chain of events, in which the developments in the individual regions were somehow linked together. The coincidence between the chrono-spatial trends in the diffusion of iron and in the Bronze Age/Iron Age transitions suggests that both involved contact and interdependence between regions. This has been suggested in various places in the previous chapters:

(i) The Late Bronze Age collapse in the Near East was a precondition for the onset of the process of Mediterraneanization.

[120] For a very accessible introduction to the rise of horse-riding and equestrian warfare, particularly focusing on Mongolia, see Taylor 2024: chapters 6-8. — Unfortunately, the causes of this radical transformation could not be discussed in detail in the present study; however, some comments and ideas are to be found in Chapters 6 and 7.2.

(ii) Mediterraneanization exhibits a chrono-spatial trend: the process emanated from the East Mediterranean and involved successively the Aegean, the central and the western Mediterranean.
(iii) Mediterraneanization led to changes in peripheral regions, especially in the Iberian, Italic and Balkan Peninsulas. For example, around the mid-10th century BC a cultural reorientation can be observed in the eastern Balkan Peninsula, evident in the formation of the Stamped Pottery complex. There is growing evidence for contact and exchange between Thrace and the Protogeometric Aegean which led, among other things, to the development of an intensive and diversified level of iron production.
(iv) The effects of this cultural reorientation in the eastern Balkans were felt far afield. It seems that the innovative role of Thrace, especially in the field of iron metallurgy, and the expansion of the Stamped Pottery complex, contributed to a sequence of consecutive structural changes which proceeded along the Danube between the 10th and 8th centuries BC (see the 'five-stage' model summarized in Chapter 9.7). The onset of intensive iron production in the eastern Balkan Peninsula in the 10th century BC, along with the influx of Pontic-Caucasian metallurgical expertise into the Carpathian Basin during the 9th century BC, could be understood as an example of disruptive innovation, triggering a profound reconceptualization of bronze, and a general Late Bronze Age collapse.

The final section of this book concentrates on the culture-historical conception of the term 'Iron Age'. The analysis of the concept led to the development of a processual model, which I believe helps us to understand the sequence of 'epochal' changes at the end of the 2nd and the start of the 1st millennium BC in many parts of Europe and Western Asia: the idea that the changes at the Bronze Age/Iron Age transition did not happen in isolation, but were somehow linked together as parts of a process. In my view, the interpretation of the profound disjunctions and transformations which took place in the period between ca. 1200 and ca. 800 BC requires a large-scale, supra-regional approach. Clearly, this is a massive subject, and the Bronze Age/Iron Age transition demands much more discussion and detailed research in the future.

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