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.

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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.