

ELSLEY ZEITLYN LECTURE
ON CHINESE ARCHAEOLOGY AND CULTURE

Cultural Interaction between China and Central Asia during the Bronze Age

JIANJUN MEI
Needham Research Institute, Cambridge

Introduction

THE CULTURAL RELATIONSHIP between China and Central Asia¹ during the Bronze Age of the second and early first millennia BC is a subject of great interest to scholars in the study of early China and Eurasia (Watson 1971, 1997; Jettmar 1981; Jacobson 1988; Bunker *et al.* 1997; Mair 1998). Over the past several decades various views have appeared on whether early Chinese civilisation was related to other early cultures in the west. Until the mid twentieth century it was widely held among western scholars that 'early Chinese civilisation had developed through, and in large part because of, influence from West Asia' (Puett 1998: 699–700). Archaeological finds since the 1950s, however, have gradually revealed clear evidence showing the existence of a number of Neolithic and Bronze Age cultures in central northern China, which led K. C. Chang (1963) to argue for an internal growth of Chinese civilisation from a nucleus in the Yellow River valley. The argument for the indigenous autonomy of Chinese civilisation became widespread during the 1970s and early 1980s, with great

Read at the Academy 24 October 2002.

¹ In this paper, the term 'China' is loosely used in the sense of cultural history. For the period of the second millennium BC, it refers to the areas covering the Central Plains of China and surrounding regions that include parts of Gansu and Qinghai provinces in Northwest China; while the term 'Central Asia' is defined as the area that covers Xinjiang, the largest provincial region in current Northwest China, as well as Kazakhstan, Uzbekistan, Kirghizia, Altai, and southern Siberia.

emphasis being put on the independent invention of copper-based metallurgy in China (Cheng 1974; Ho 1975: 177–221; Barnard and Sato 1975; Sun and Han 1981; Barnard 1983).

While the notion that Chinese civilisation is generally of indigenous origin seemed to have been well established,² there has been a growing body of archaeological evidence since the late 1980s, showing signs of early cultural contacts between the Central Plains of China and cultures in the contiguous regions, or even areas as far away as Central Asia (Lin 1986; Mair 1990; Bunker 1993; Fitzgerald-Huber 1995). Consequently, some scholars are inclined to claim western origins for such significant technological innovations as bronze metallurgy, chariot and iron making in China (Shaughnessy 1988; An 1993; Tang 1993). Now the need for a re-evaluation of the role of outside influences in the early development of Chinese civilisation has been widely appreciated both in China and outside, stimulating a new trend of research that focuses on the early cultural interaction between China and Central Asia within a

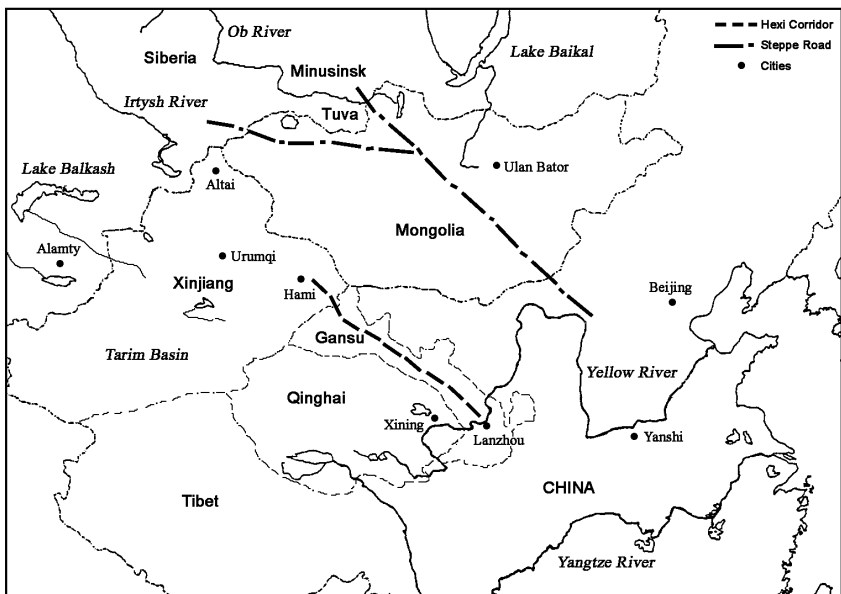


Figure 1. A map of northern China and eastern Central Asia.

² Keightley (1983: xx) stated that 'there is now little doubt that, whatever the origin of a few particular elements, the complex of culture traits that we refer to as Chinese civilization developed in China'.

wider Eurasian context (Fig. 1; Linduff 1998, 2002; Di Cosmo 1999: 902–6; Mei 2000: 58–71).

The present paper is intended to offer some preliminary observations on the early cultural relationship between China and Central Asia in the light of the most recent archaeological discoveries from Northwest China. Rather than examining all relevant aspects of the subject, it will focus the discussion on three major issues: the role of outside influences in the beginnings and early development of bronze metallurgy in China, the two-way traffic of cultural influence along the prehistoric ‘Silk Road’, and the shift to the ‘Steppe Road’. It aims to show that early cultural interaction between China and Central Asia was the crucial impetus for the growth of civilisations in both regions.

Early copper-based metallurgy in China: old question, new perspective

The origins of bronze metallurgy in China are among the central issues in current studies of early cultural interaction between China and Central Asia. Whether metallurgy was introduced into China or invented independently has been hotly debated among scholars over the past fifty years and still remains disputed.³ The focus of the debate is how to evaluate metal finds from China dating as early as the fourth and third millennia BC, which include two brass objects from the Yangshao culture (*c.*5000–2500 BC) sites in Shaanxi province, two brass rods from a Longshan culture (*c.*2600–2000 BC) site in Jiaoxian, Shandong province, two tin bronze knives from the sites of Majiayao and Machang cultures (*c.*3000–2000 BC) in Gansu province (Figs. 1 & 2: 1, 2), and dozens of copper and bronze objects from the Qijia culture

³ Max Loehr (1949: 129) assumed that metallurgy was introduced into China from the outside because ‘primitive stages have, in fact, nowhere been discovered in China up to the present moment’. This view has been challenged since the 1960s by many scholars who argue, on the basis of new archaeological evidence, that metallurgy in early China was of indigenous origin (Barnard 1961; 1983; Barnard and Sato 1975: 1–16; Cheng 1974; Ho 1975: 177–221; Sun and Han 1981; Ko 1986: 2; Su *et al.* 1995: 48–9). However, the noted scholar, Cyril S. Smith (1977: 81), remains in favour of the diffusion theory and ‘finds it impossible to believe that the basic ideas of metallurgy were so easy to come by *ad novo*’. William Watson (1985: 335), too, points out that ‘so far metal use in north China has not differed much from that of the Turkmenian cultures’, and hints at the existence of possible contact between China and Central Asia since the third millennium BC. For an excellent review of the debate of diffusion vs. independent invention, see Wagner 1993: 28–33. For English translations of Chinese papers relating to the debate, see Linduff *et al.* 2000.

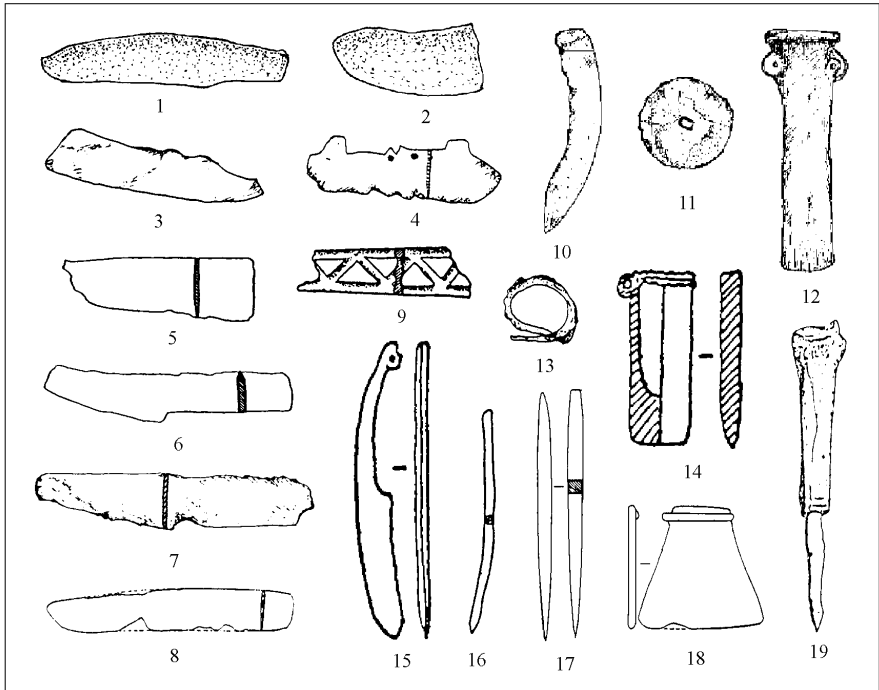


Figure 2. Early copper and bronze artefacts found in Gansu and Qinghai: 1. knife from the Linjia site of the Majiayao culture; 2. knife from the Jiangjiaping site of the Machang culture; 3–19. artefacts of the Qijia culture (1, 2. drawings after photos in Sun and Han 1997: 76, figures 1, 3; 3–19. after Debaine-Francfort 1995: 86, figure 49; 104, figure 61; 119, figure 71).

(c.2200–1800 BC) site in Gansu and Qinghai provinces (Fig. 2: 3–19).⁴ While those who favour the idea of independent invention take these finds as signs of primitive stages of Chinese metallurgy (Sun and Han 1997), others either cast serious doubt on the early brass pieces (An 1981, 1993) or see the early metals from Gansu as an indication of contact with the west (Watson 1985: 335).⁵

⁴ For detailed information about the early metal finds in China and their cultural contexts, see An 1993: 1110–13.

⁵ As Muhly (1988: 16) puts it, ‘... the beginnings of metallurgy in China have now been shown to be not so much different from what can be seen elsewhere throughout the ancient world. This neither proves nor disproves the independent invention of metallurgy in east Asia, but it does move the argument into a more comprehensible frame of reference and should eliminate once and for all the argument that Chinese metallurgical technology developed in ways totally different (and thus apart from) anything known in the West.’

Indeed, for a better understanding of the early metals recovered within the present borders of China, it is helpful to separate the early Gansu finds from those found in the Central Plains of China. This is not just because the number of the early Gansu metals is large but also because their geographical location is significant. In light of the most recent archaeological evidence from Xinjiang, west of Gansu, it has become quite clear that Northwest China (which includes Gansu, Qinghai, and Xinjiang provinces, see Fig. 1) should be considered as a distinct region in terms of early copper-based metallurgy. This does not suggest that the early metallurgy in the Central Plains of China has nothing to do with the developments in Northwest China. On the contrary, my intention is to approach the beginnings and early development of metallurgy in China from a new perspective, that is to seek a better understanding of regional developments as well as their interrelations. I do not claim that this approach will immediately determine how the centres of metallurgy developed in central China, but I suggest this is a practical and constructive way to move towards a fuller understanding of this issue.

Now, let us turn to the north-western region of China and see what fresh ideas such a perspective may provide. In comparison with the situation in the mid-1980s, there are at least three major advances that have dramatically influenced our understanding of early metallurgy in Northwest China. Firstly, numerous early metal finds have been made in Gansu and Qinghai provinces, dating to the late third and early second millennia BC. Secondly, a significant number of arsenical copper objects have been identified scientifically among the early Gansu metals. Thirdly, a large number of tin bronze and arsenical copper objects dating to the first half of the second millennium BC have been discovered in eastern Xinjiang. The early Xinjiang metals are worthy of special attention because they provide the first concrete evidence for a connection between the early metals from Gansu and Qinghai and those from sites further west.

New finds of early metals from Gansu and Qinghai

The new finds of early metals that have come to light in Gansu and Qinghai provinces since the mid-1980s are as follows:⁶

⁶ For a general account of Neolithic and Bronze Age cultures in Gansu and Qinghai provinces, such as Machang, Qijia, and Siba, see Chang 1986: 138–50; 280–5; An 1992.

- (a) an awl and a fragment, both belonging to the Machang culture (c.2300–2000 BC), were recovered respectively at the sites of Zhaobitan and Gaomuxudi in Jiuquan, western Gansu in 1987 (Li and Shui 1988);
- (b) four pieces of ornament were unearthed at the Zongri site of the Zongri culture (c.2500–2000 BC) in Tongde county, Qinghai (Fig. 3: 1–3; OCR 1998: 14);
- (c) four knives (two with bone handles) and two awls with bone handles were found at the Zongzhai burial site of the Qijia culture (c.2200–1800 BC) in Huzhu, Qinghai (Fig. 2: 19; QTC 1986: 314);
- (d) a spearhead of extremely unusual form and size (61 centimetres in length) was recovered at the Shenna site of the Qijia culture in Xining, Qinghai (Fig. 4: 1; EC 1997: no. 38);
- (e) six hemispherical objects (2 centimetres in diameter), five rings (about 6 centimetres in diameter) and a knife fragment were found at the Xinzhuangping site of the Qijia culture in Jishishan county, Gansu (Fig. 3: 4–6; Jia 1996: 51);

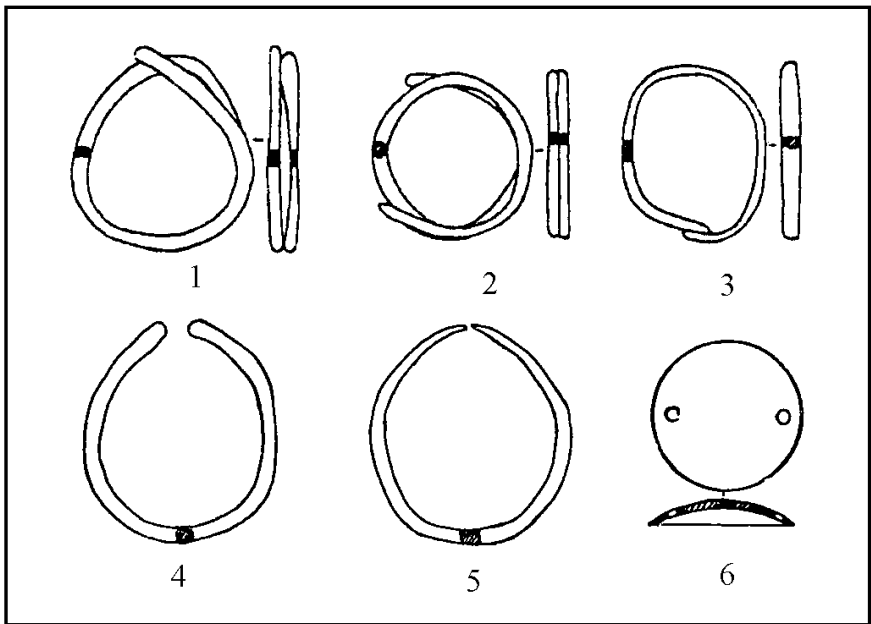


Figure 3. Copper and bronze ornaments found in Qinghai and Gansu: 1–3. rings from the Zongri site of the Zongri culture in Qinghai; 4–6. rings and a button from Xinzhuangping site of the Qijia culture in Gansu (1–3. after OCR 1998: 14, figure 35; 4–6. after Jia 1996: 51, figure 6).

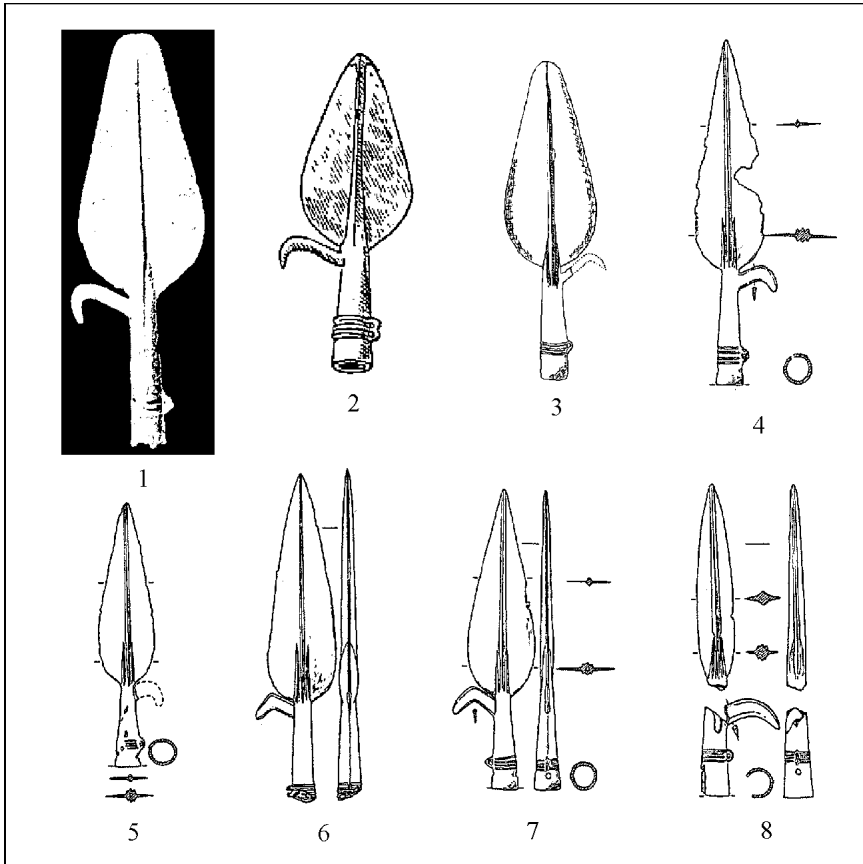


Figure 4. Copper and bronze spearheads found in China, Altai, and Siberia: 1. from Xining, Qinghai; 2. from Shaanxi; 3. from Shanxi; 4–7. from Rostovka, southern Siberia; 8. from Charysh, Altai (1, 2, 4–8. after Takahama 2000: 122, figure 3; 3. drawing after a photo in Zhang and Li 1999: 18).

- (f) a socketed axe and a back-curved knife were recovered at the Xinglin site of the Qijia culture in Minxian, Gansu (Fig. 2: 14, 15; Yang 1985: 979);
- (g) more than seventy metal objects were unearthed at the sites of Donghuishan and Xihuishan in Minle, Ganguya in Jiuquan, Yingwoshu in Anxi, all being located along the Hexi Corridor in Gansu and belonging to the Siba culture (c.1950–1550 BC) (Fig. 5; GPI 1998: 139; Li and Shui 2000: 36).

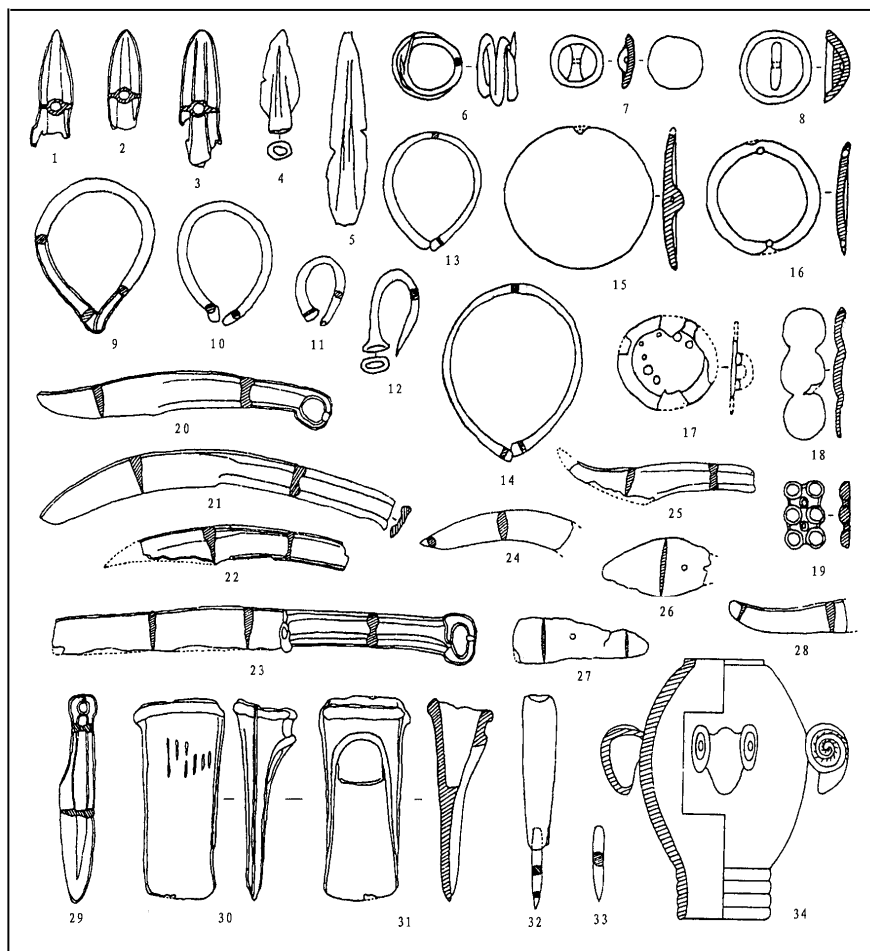


Figure 5. Copper and bronze artefacts of the Siba culture found in Gansu: 1–5. arrowheads; 6. ring; 7–8. buttons; 9–14. earrings and rings; 15–19. ornaments; 20–22. knives; 23–24. socketed axes; 25–28. knives; 29–31. socketed axes; 32–33. awls; 34. macehead (after Bai 2002: 29, figure 3).

These new finds have made a great impact on our understanding of the development of early metallurgy in the Gansu-Qinghai region. The two Machang metal objects found in Jiuquan provide further evidence, together with the previously known Machang knife recovered at Jiangjiaping, Yongdeng county (Fig. 2: 2), to confirm the use of metals in Gansu during the late third millennium BC. The geographical location of this find is also significant because it suggests that the Machang culture may have extended westwards along the Hexi Corridor (Li 2001: 132). In light

of the recent archaeological discoveries in Xinjiang, this evidence has important implications for possible links between western Gansu and eastern Xinjiang during the second half of the third millennium BC, enabling us to suggest that there may have been contact between the Machang culture and the Afanasievo culture from southern Siberia (Mei 2000: 62).

The increasing evidence for the use of copper and copper alloys within the Qijia context further demonstrates the crucial position of the Qijia culture in the early development of metallurgy in Northwest China. Together with previously reported metal finds, we now have had more than seventy metal objects excavated or recovered at various Qijia sites (Sun and Han 1981: 287–8; Debaine-Francfort 1995: 320–1; Mei 2000: 62). These objects show a wide range of types, including knives, awls, rings, axes, mirrors, plaques, and a spearhead. The possible link of the Qijia metals with the west has recently come to be discussed seriously. An (1993: 1117) speculates that the ‘sudden’ appearance of metal objects within the Qijia context probably resulted from cultural influence from the west through the prehistoric Silk Road. Debaine-Francfort (1995: 324–6) notices that some Qijia implement types, such as the socketed axes and the back-curved knife, generally parallel those from the Eurasian steppe culture. Fitzgerald-Huber (1995: 43–52, 1997: 265–7) has conducted a detailed investigation of the issue. In her opinion, a variety of Qijia metal objects, notably the socketed axe and the handled knife with curved back from Xinglin (Fig. 2: 14, 15), the knife handle from Huangniangniangtai (Fig. 2: 9), as well as the small mirror and the socketed axe from Qijiaping (Fig. 2: 11, 12), suggest an exogenous origin, having their closest correlation in the Seima-Turbino complex in Siberia.⁷ The Zongzhai awl and knife blade, each inserted into bone handles (Fig. 2: 19), exhibit a method of hafting which has parallels in the Okunev culture in southern Siberia.⁸ She also considers such aspects of the Qijia culture as the wide range of domesticated animals, the use of stone circles as burial markers, and the practice of suttee as indicative of contact with northern nomadic cultures.

⁷ The Seima-Turbino complex or transcultural phenomenon has been used to describe a large number of early bronze remains widely distributed across northern Eurasia. For a detailed discussion of the phenomenon, see Chernykh 1992: 215–34. Also cf. Gimbutas 1956; Parzinger 2000.

⁸ The Okunev culture is a Bronze Age culture found in the Minusinsk basin on the Middle Yenisei river, being considered later than the Afanasevo culture and earlier than the Andronovo culture of southern Siberia. For a general account of these cultures, see Chernykh 1992: 182–5; 210–15.

Fitzgerald-Huber's argument for contact between Qijia and Seima-Turbino seems to be supported further by the find of the socketed spearhead at Shenna in Xining, Qinghai (Fig. 4: 1). The size of this spearhead is unusually large, being 61 centimetres in length. Its form is characterised by a downward hook and a small loop on either side of the socket respectively. It is of great interest that this unusual type of spearhead was found also in Altai and Siberia, such as one piece from Charysh (Fig. 4: 8) and four pieces from the Rostovka burial site near Omsk in the Middle Irtysh river (Fig. 4: 4–7; Chernykh and Kuzminykh 1989: 67–70). By comparison with the Shenna spearhead, the Charysh and Rostovka pieces are all smaller (less than 40 centimetres in length), with a narrow body and a sharp point. Another notable difference from the Shenna piece is that their hook and loop are placed on the same side of the socket. The Rostovka cemetery is one of the most important sites of the Seima-Turbino culture, which has generally been dated to the middle of the second millennium BC (Chernykh 1992: 215–33). The spearheads from Rostovka and Charysh are comparable in form and size to those from other Seima-Turbino sites, though other spearheads do not have a downward hook. The large number of spearheads from the Seima-Turbino context indicates that they are one of the characteristic types of the Seima-Turbino culture (Chernykh and Kuzminykh 1989: 63–90). The appearance of this type of spearhead at Shenna in Qinghai is unexpected and indeed surprising. Even more curious are its unusually large size and its blunt end, which suggest that it would probably be used as a ritual object rather than a functional one. As Takahama (2000: 114) has pointed out, the manufacturing of the Shenna spearhead most likely imitated a Rostovka prototype.

It is worth noting that spearheads of a form similar to that of the Shenna piece have also been recovered in northern China. Two examples have so far come to our attention. One is in the collection of the Shaanxi Historical Museum, and was reported by S. V. Kiselev (1960: 261), who visited the Museum during the late 1950s.⁹ This spearhead is 35 centimetres long, similar to those from Rostovka but shorter than the Shenna piece (Fig. 4: 2).¹⁰ The other one is in the collection of the Shaanxi Provincial

⁹ Takahama (2000: 113–14) is the first scholar to draw attention to the Shaanxi spearhead in Kiselev's publication. He has also undertaken the first comprehensive comparison between the Shenna spearhead and those from Siberia and Altai.

¹⁰ I am grateful to Professor Zhang Tian'en of the Shaanxi Provincial Institute of Archaeology for helping with my inquiry about the spearhead in question to the Shaanxi Historical Museum (SHM). He has confirmed to me that the spearhead is a stray find and entered into the collection of the Shaanxi Provincial Museum in 1952. It is held now in the collection of the SHM (personal communication, 20 July 2002).

Museum and is also a stray find. It is 34.6 centimetres long and 10 centimetres wide, very close in size to the Shaanxi and Rostovka pieces, though a part of its hook is broken and missing (Fig. 4: 3; Zhang and Li 1999: 18, 119). While the body of the Shanxi spearhead seems to be closer to the Shenna and Shaanxi pieces, the position of its hook and loop, however, is different. Like the Rostovka spearheads, they are placed on the same side of the socket rather than on either side of it. The full implications of these typological features need further research. Although the archaeological contexts of the Shaanxi and Shanxi spearheads are lacking, their appearance in northern China may still be important for an understanding of possible contact with the steppes during the mid-second millennium BC or even earlier.

Their chronological discrepancy is a problem for arguments about contacts between Qijia and Seima-Turbino. The Qijia culture is radiocarbon dated to about 2000 BC (Zhang 1987: 158), while the generally accepted date for the Seima-Turbino culture is around the middle of the second millennium BC, although some Russian scholars are in favour of an earlier or later date (Chernykh 1992: 217). Fitzgerald-Huber (1995: 49–50) is inclined to place the Seima-Turbino a few centuries earlier on the basis of the new calibrated carbon-14 dates for a Sintashta-Petrovka burial, which fall within the range of 2135–1904 BC. However, it has to be admitted that the cultural context of the Seima-Turbino, as well as its relationship with the Sintashta-Petrovka culture, is still far from clear.¹¹ Further research is needed to clarify the chronological position of the Seima-Turbino culture.

On the other hand, there are certain signs indicating that some of the Qijia remains may be dated later than previously thought. The close resemblance in typology and decoration between the Qijia mirror from Gamatai, Qinghai, and those from the Fuhao tomb of the Shang dynasty in Anyang, Henan (Fig. 6) has led to speculation that the lower date for the Qijia culture may extend to 1600 BC or even later (An 1993: 1113). Considering the close links between Qijia and Siba, which has been dated to 1950–1550 BC, it would seem reasonable and comfortable to place at least the later part of Qijia culture within the range of 2000–1700 BC. This new chronological view on Qijia would support arguments for the Qijia's links with the Seima-Turbino culture, as well as other steppe cultures.

¹¹ For an account of the Sintashta-Petrovka culture and its relationship with the Seima-Turbino phenomenon, see Chernykh (1992: 227–33).

When compared with the cases of the Machang and Qijia finds, the new finds of the Siba culture have an even stronger impact on our understanding of early metallurgy in the Gansu region. Our knowledge of the Siba culture remained rather poor until fairly recently. Previously, it was dated to the mid-second millennium BC and was thought to be contemporary with the latter part of the Qijia culture (An 1992: 323). With information about new sites, such as Ganguya in Jiuquan, Donghuishan in Minle, and Yingwoshu in Anxi now available, it has come to be recognised that the Siba culture can be dated to the early second millennium BC, thus to a large extent overlapping with the Qijia culture (Li 1993: 103). There is some evidence showing that the Machang culture is the major predecessor of the Siba culture, and influence from Qijia can also be noted (GPI 1998: 134–6). As the Siba sites found so far are mostly distributed along the western part of the Hexi Corridor (Fig. 1), it appears that Siba may have played a vital role in linking Qijia with the cultures to the west.

The importance of the Siba culture is clearly demonstrated by the finds of more than 270 copper and bronze objects, among which over 200 were unearthed from the Huoshaogou cemetery in Yumen, forty-eight from Ganguya, sixteen from Donghuishan and seven from Yingwoshu. These objects exhibit a wide range of types, such as knives, axes, awls, bracelets, plaques, earrings, buttons, tubes, mirrors, arrowheads, spearheads, and a macehead (Fig. 5; Li and Shui 2000: 36–7). Many Siba objects, such as ring-pommelled knives with curved backs, socketed axes, awls with bone handles, earrings with flared or trumpet-shaped ends, and

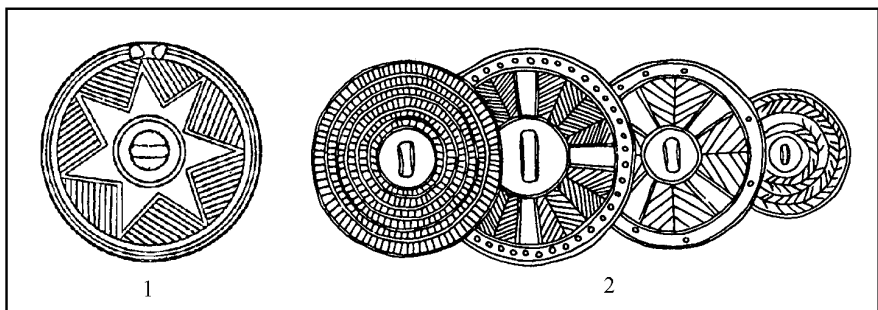


Figure 6. Early bronze mirrors found in China: 1. from the Gamatai site of the Qijia culture in Qinghai; 2. mirrors of the Shang dynasty from Anyang, Henan (after Debaine-Francfort 1995: 323, figure 136).

button-shaped ornaments, exhibit strong typological and stylistic connections with the northern Eurasian steppe (Li 1993: 105). The axes with an open socket (Fig. 5: 30–1) are of special interest since they parallel those recovered in Xinjiang and eastern Kazakhstan and associated with the Andronovo context (Mei 2000: 14, 27). The earrings with trumpet-shaped or flared ends (Fig. 5: 9–13) are also very interesting finds, because earrings of similar form and date have been found not only in Altai, western Siberia, and western Central Asia, mostly from the Andronovo context, but also in northern China, from the Lower Xiajiadian context (Bunker 1998: 611; Takahama 2000: 111–13). The macehead with four projecting ram-heads (Fig. 5: 34) is the most unusual object among the Siba metals, which Bunker (1998: 609–10) considers comparable to Central Asian and ancient Near Eastern designs. Additional evidence for contacts with distant cultures on the Eurasian steppe is provided by such finds as gold and silver nose-rings, and a large number of horse bones (Bunker 1998: 608–9; Fitzgerald-Huber 1997: 268). Collectively, the metal finds from various Siba sites seem to have provided us with long-sought missing links that could connect the Hexi Corridor with both the east and the west during the early Bronze Age.

New finds from scientific examination of the Qijia and Siba metals

Metallurgical examination plays a central role in understanding the development of early metallurgy in Northwest China. Sun and Han (1981) published the first scientific study of early metals from Gansu and Qinghai, which identified the earliest knife of the Majiayao culture (*c.*2800 BC) found at Linjia, Dongxiang, as tin bronze (Fig. 2: 1). Another early knife of the Machang culture (*c.*2300 BC) from Jiangjiaping, Yongdeng (Fig. 2: 2), has also been shown to be made of tin bronze. Examinations of a number of Qijia and Siba objects reveal that they are made of either pure copper or bronzes of different types (including tin bronze and leaded tin bronze). These results have been cited as scientific evidence for the indigenous development of early metallurgy in China, because arsenical copper is missing from these early Chinese metals (Ko 1986: 2). Thus the composition of metal objects of Qijia and Siba seemed to be sharply different from early metallurgy further west in Central Asia and western Eurasia, where the use of arsenical copper is prevalent.¹² Some scholars suggest

¹² Arsenical copper is the first copper alloy that was produced and used in the history of metallurgy. The earliest arsenical copper appeared in Western Asia in the early fourth millennium

that the Qijia culture may have undergone a progressive evolution from the use of copper to bronze, because the analyses show that the metals from the earlier Qijia sites are copper, while those from the later sites are bronze (Zhang 1987: 174; Sun and Han 1997: 83). Now these views face a serious challenge as new analytical data has come to light.

The most noteworthy scientific discovery has been the identification of a significant number of arsenical copper objects among both Siba and Qijia metals, which has led to a fundamental change of our understanding of the early metallurgy in the region. Arsenical copper was first identified among the Siba metals. Examining fifteen objects from Donghuishan, Minle has shown that twelve of them are made of arsenical copper with arsenic at the level of 2–6 per cent, the other three are tin bronze or leaded tin bronze containing arsenic. Among the forty-six objects from Ganguya, Jiuquan, ten have been identified as arsenical copper and another five are tin bronze containing arsenic (Sun and Han 1997: 78–82; Sun 1998: 192). These results clearly indicate that the use of arsenical copper in the Siba context is beyond doubt.

The analytical evidence for the early use of arsenical copper continues to increase. The earlier qualitative examinations of sixty-five metal objects from the Huoshaogou cemetery show that they are made of copper, tin bronze, lead bronze or leaded tin bronze, but not arsenical copper. However, recent analysis of thirty-seven metal samples from the Huoshaogou site has revealed that the arsenic concentrations of thirteen samples are over 2 per cent, indicating that arsenical copper was also employed at Huoshaogou (Qian *et al.* 2000: 48). Moreover, some indications have appeared that the Qijia people may have employed arsenical copper too. A number of metal objects have recently been obtained at the Qijiaping site in Guanghe county and are believed to be associated with a Qijia context. Among them, eight objects (including three knives, one mirror, one bracelet, two buttons and one awl) have so far been subjected to analysis. Results show that the bracelet and the two buttons are made of arsenical copper, while two of the knives contain some arsenic (Ma *et al.* 2001: 111–12).¹³ These new analytical data are

BC, and it was then widely used (Muhly 1988: 10). By the third millennium BC the use of arsenical copper became predominant in the Caucasus and Central Asia (Jettmar 1971: 7; Masson and Kiiatkina 1981; Terekhova 1981: 319; Ravich and Ryndina 1995).

¹³ The results of identifying arsenical copper among the assumed Qijia metal objects have also been reported by Qian *et al.* (2002: 236).

by no means conclusive because they are based on stray finds rather than excavated pieces, but they are suggestive. In view of the close links between Qijia and Siba, it can be expected that more decisive analytical evidence will eventually appear to confirm the use of arsenical copper in the Qijia context.

Even more surprising is that the early use of arsenical copper is not limited to the Hexi Corridor in Gansu, but has also been found in Xinjiang as well as the Central Plains of China. What relationships can there be between these separate finds of early arsenical copper? What does the appearance and early use of arsenical copper mean to our understanding of early metallurgy in China? To answer these questions, it is necessary to examine the new archaeological discoveries in Xinjiang within a wider Eurasian context.

New archaeological and scientific discoveries from eastern Xinjiang

The pivotal geographical position of Xinjiang (Fig. 1) in linking early China with the west was appreciated long ago by many scholars. Loehr (1956: 83), for example, once stated that ‘one of the reasons why possible relations between China and Turkestan-Iran-Luristan cannot be traced satisfactorily is that information on the intermediate regions of Mongolia, Dzungaria,¹⁴ Kazakhstan, and Russian Turkestan is scanty.’ In the early 1980s, Jettmar (1981: 155) expressed his belief in a straightforward way: ‘Excavation of prehistoric sites in the Tarim Basin would be most promising. The material should be studied by specialists in Bronze Age civilization in other parts of Central Asia. Routes to the Far East must have crossed this region.’ However, the prehistory of Xinjiang remained very obscure until quite recently. It is only from the mid-1980s that the archaeological excavations started to reveal considerable evidence for the existence of diverse Bronze Age and Iron Age cultures throughout Xinjiang (Debaine-Francfort 1988, 1989; Shui 1993; Chen and Hiebert 1995; Lü *et al.* 2001). The Bronze Age discoveries from eastern Xinjiang are highly relevant to our discussion of early metallurgy in Northwest China, as well as its possible connections with the west.

So far the major Bronze Age sites found in eastern Xinjiang include the cemeteries at Tianshanbeilu, Wupu, and Nanwan. Based on comparisons with the neighbouring Bronze Age cultures in Gansu as well as a

¹⁴ The Dzungarian basin is located in the northern part of Xinjiang, see Fig. 1.

number of carbon-14 measurements, they can be dated roughly to the second millennium BC. Among these sites, Tianshanbeilu is the largest and earliest, dating to the mid-second millennium BC, with some finds extending back to the beginning of the second millennium BC. Located in Hami city (Fig. 1), the Tianshanbeilu cemetery consists of more than 700 graves with two kinds of burial chamber, shaft pits and mud-brick shaft pits. The dead were buried lying on their sides in a flexed position. A large number of funerary goods have been found, including pottery vessels (plain and painted), as well as artefacts of bronze, gold, silver, bone, and stone. The pottery vessels are mostly jars, cups, pots, and bowls. The bronze objects consist mainly of small implements and ornaments, such as knives, awls, axes, tubes, earrings, bracelets, mirrors, beads, buckles, and plaques. A few bronze weapons, such as daggers and arrowheads have also been discovered (Figs. 7; 8). The gold earrings and silver hairpins found are the earliest gold and silver objects known so far in Xinjiang (Yue *et al.* 1999: 110–12; Lü *et al.* 2001: 179–84).

The connections between the Tianshanbeilu finds and those from the Siba and Qijia sites are best demonstrated by the funerary objects of painted pottery and metal. Some painted pottery vessels from Tianshanbeilu are comparable in form and decoration to those Siba and Qijia pieces (Fig. 9), leading some scholars to suggest that the Tianshanbeilu cemetery could belong to the Siba culture.¹⁵ The repertoire of the Tianshanbeilu metal artefacts is also similar to that of the Siba and Qijia cultures, which consists mainly of small implements and ornaments. The typological similarities between objects from these three cultures can be observed in the cases of back-carved knives, knives with two protrusions on the back (Tianshanbeilu, Qijia), knives with a ring-shaped pommel (Tianshanbeilu, Siba), mirrors with decoration on the back (Tianshanbeilu, Qijia), axes with the socket open at both ends (Tianshanbeilu, Siba), ring-shaped earrings, buttons, and awls with bone handles (Siba, Qijia) (Figs. 2; 3: 5–8). Like the Huoshaogou cemetery of the Siba culture, the Tianshanbeilu graves also yielded gold and silver ornaments. Furthermore, recent metallurgical examination of more than one hundred Tianshanbeilu metal objects has revealed that while the majority of objects are made of tin bronze, arsenical copper makes up a

¹⁵ Liu Guorui, one of the excavators of the Tianshanbeilu cemetery, believes that the Tianshanbeilu finds indicate the existence of Siba culture itself in eastern Xinjiang rather than merely cultural influence from Siba (personal communication, in Hami city in July 1997). Debaine-Francfort also holds that Tianshanbeilu is a likely site of the Siba or western Qijia culture (personal communication, in Cambridge in Dec. 1999).

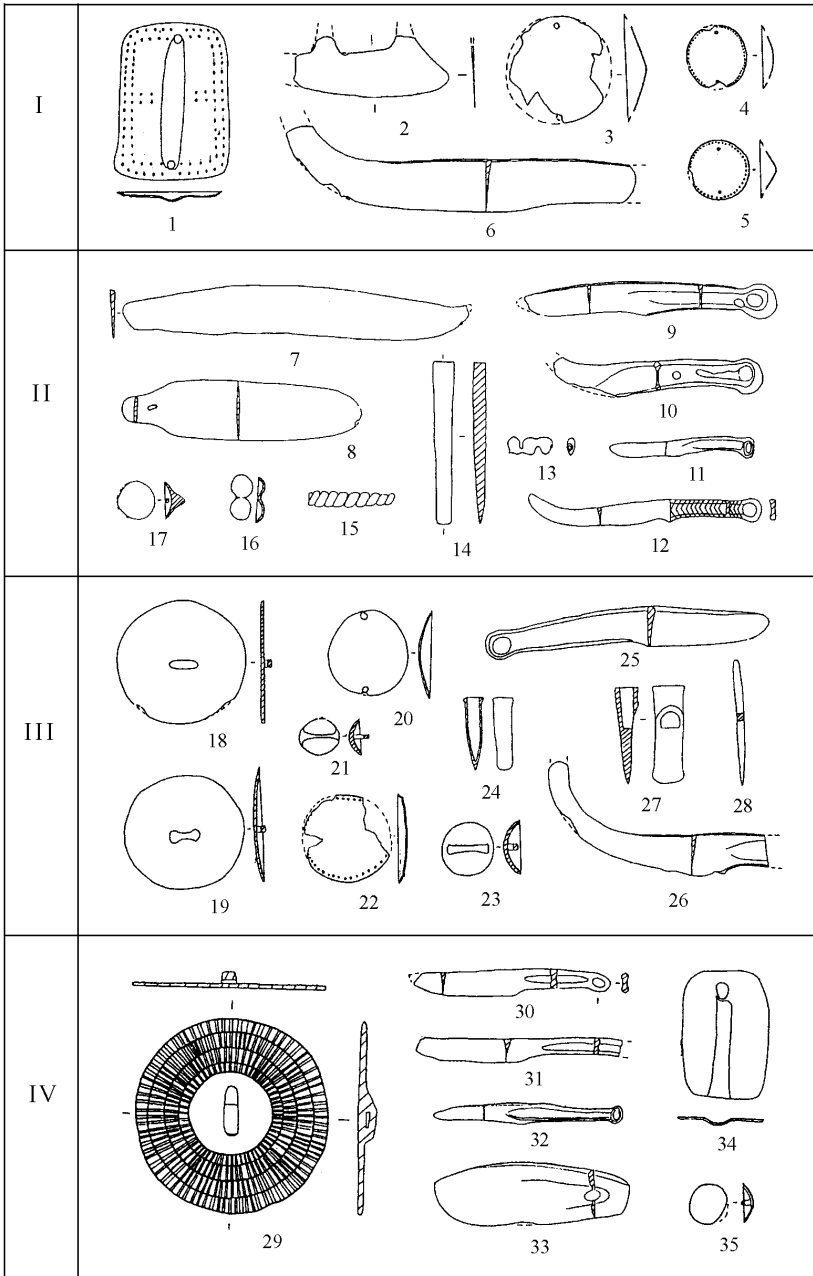


Figure 7. Copper and bronze artefacts found at the Tianshanbeilu cemetery, Hami, Xinjiang (Periods I to IV in chronological order): 1, 3–5, 13, 15–23, 34, 35. plaques, buttons and other ornaments; 2, 6–12, 25, 26, 30–3. knives, sickles and knife-dagger; 14, 24, 27, 28. awls and axes; 29. mirror (after Lü *et al.* 2001: 182–3, figures 15–18).

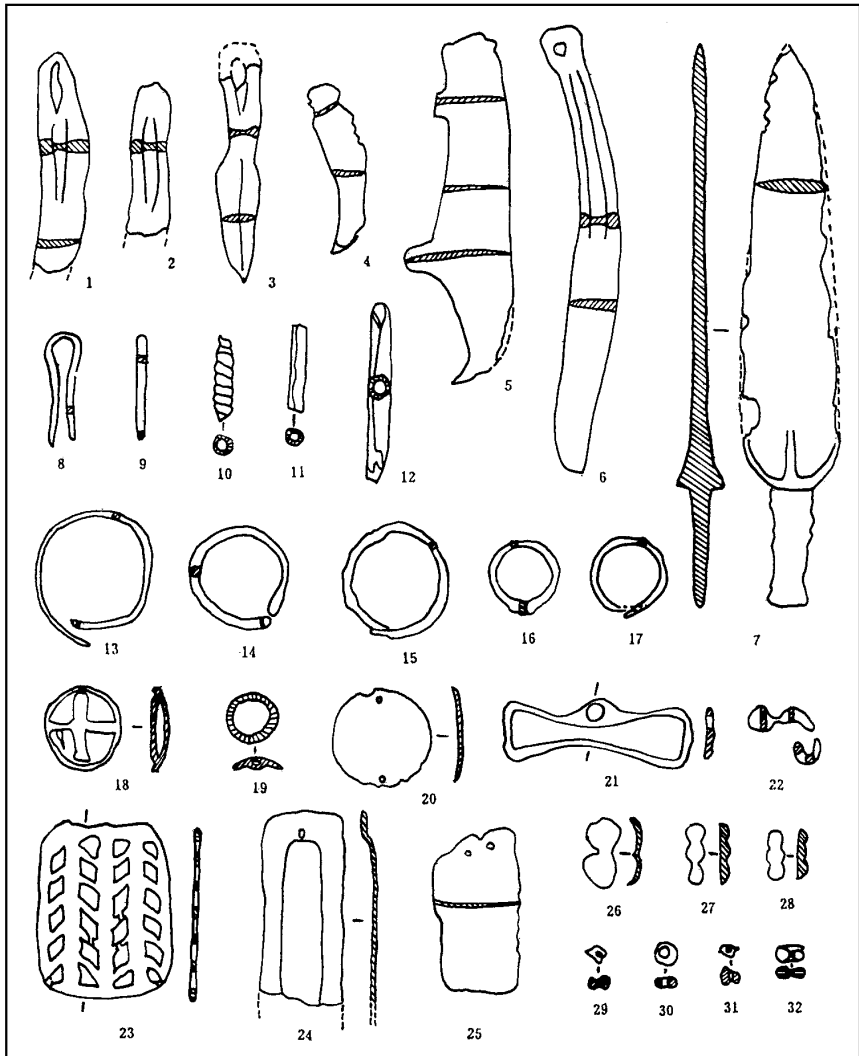


Figure 8. Copper and bronze artefacts found at the Tianshanbeilu cemetery, Hami, Xinjiang: 1, 2, 4–6. knives; 3, 7. daggers; 8–32. rings, plaques, buttons, tubes and other small ornaments and implements (after Qian *et al.* 2001: 80, figure 1).

significant proportion (about 10 per cent). Other materials such as tin bronze containing arsenic, pure copper, and leaded tin bronze were also employed. The bronze-working technologies used by the Tianshanbeilu people include casting, forging, annealing, and cold-working (Mei 2000: 39; Qian *et al.* 2001: 83). All of these scientific results correspond with

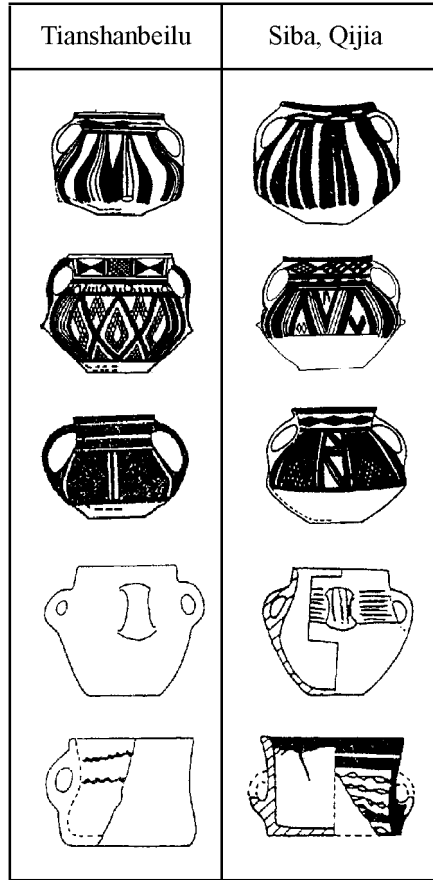


Figure 9. Painted pottery vessels of the Tianshanbeilu, Siba and Qijia cultures (after Lü *et al.* 2001: 180–1, figures 11, 13; Debaine-Francfort 1995: 126, figure 74).

those of the Siba culture, which also employed a wide range of materials such as Cu-Sn, Cu-As, Cu-Sn-As, Cu, and Cu-Sn-Pb (Sun and Han 1997: 78–82). Therefore, from both typological and technological comparisons, it seems quite clear that Tianshanbeilu was in close contact with Siba, and probably through Siba with Qijia, during the first half of the second millennium BC.

From the point of view of cultural contact between the Hexi Corridor and the Eurasian steppe, Tianshanbeilu would seem to act as one of the links between the two regions. The region of eastern Xinjiang can be linked to the Eurasian steppe through northern and north-western Xinjiang (Fig. 1). Then, a question arises: what are the relationships

between Tianshanbeilu and the bronze-using cultures in north-western and northern Xinjiang? Currently there is no ready answer for this question because archaeological finds in these regions are still very limited. However, some evidence, mostly based on stray finds, has gradually appeared, showing the significant existence of Andronovo-type cultures in north-western Xinjiang during the second millennium BC.¹⁶ Metallurgical examinations of a number of Andronovo-type bronze objects found in the regions of Tacheng and Yili have revealed the common use of tin bronze with tin at the level of 2–10 per cent (Mei *et al.* 1998: 14–15). Some bronze forms seen in Tianshanbeilu, Siba, and Qijia have also been recovered in north-western Xinjiang, such as the axes with the socket open at both ends and the back-curved sickles (Li and Dang 1995). Obviously, there remain many questions to be answered with regard to the cultural contact between eastern and north-western Xinjiang. In particular, the lack of excavated material in north-western Xinjiang for the first half of the second millennium BC makes it rather difficult to trace the early development of Andronovo culture in the region.

The cultural relationship between eastern and northern Xinjiang is even more obscure at this stage. Li (1999: 58–61) recently suggested that the Tianshanbeilu pottery could be divided into two groups, which he designates as Group A and B. In his opinion, the pottery vessels of Group B are comparable in form to those vessels found at the Ke'ermuqi cemetery in Altai,¹⁷ suggesting that the remains represented by the Group B ceramics at Tianshanbeilu probably came from the Altai region by way of northern Xinjiang. This suggestion actually implies that there were connections between eastern Xinjiang and the Altai region no later than the mid-second millennium BC. It is also worth noting that some bronze objects from Tianshanbeilu, such as the back-curved knives (Figs. 7: 25; 8: 6), the sword/dagger (Fig. 8: 7), the tanged flat knife (Fig. 7: 8) and the socketed axe (Fig. 7: 27), are generally comparable in type to those seen in the bronze cultures on the Eurasian steppe, especially in

¹⁶ The Andronovo culture, a Bronze Age complex flourishing during the second millennium BC, comprised many regional variants and covered an extensive area stretching from the Urals eastward to the Minusinsk basin of southern Siberia, and from the northern border of the forest-steppe south to the Pamirs of Tadjikistan (Mallory 1989: 227). For an account of the Andronovo culture, see Chernykh 1992: 210–15. The existence of Andronovo-type cultures in north-western Xinjiang has only recently been recognised and discussed in Peng 1998; Mei and Shell 1999.

¹⁷ The Ke'ermuqi cemetery is the only Bronze Age site excavated so far in the Altai region of northern Xinjiang. Some finds from this cemetery exhibit links with Bronze Age cultures in southern Siberia. For an excavation report, see XIA 1981.

the Seima-Turbino culture (Chernykh 1992: 219–21; Parzinger 2000: 70–2). Therefore, some kind of relationship must have existed between Tianshanbeilu and early bronze cultures in the north during the mid-second millennium BC or earlier, though no specific evidence has yet been found.

On the basis of the above evidence, it is suggested that eastern Xinjiang may be one of the intermediary links that connected the Hexi Corridor with the Eurasian steppe. The archaeological finds from Tianshanbeilu in eastern Xinjiang have just begun to reveal the region's pivotal role in bridging the early bronze cultures to the east and west. The recognition of eastern Xinjiang's crucial importance has paved the way for a new understanding of early copper-based metallurgy in Northwest China and further east.

A new understanding of early copper-based metallurgy in China

Although we are still far from a conclusive answer to the problem of diffusion or independent invention, a new understanding of the early development of copper-based metallurgy in China is on the horizon. The new archaeological and scientific data presented in preceding sections have demonstrated that the early metal-using cultures found so far in Northwest China (the Hexi Corridor and East Xingiang), such as Qijia, Siba and Tianshanbeilu, were all in contact with the bronze cultures on the Eurasian steppe. In other words, the influence from the people further west played a part in the early development of copper-based metallurgy in Northwest China. This is a new idea, which offers a fresh perspective on early copper-based metallurgy in other regions of China.

By comparison with the early metal finds in Northwest China, two observations can be made about the early copper and bronze objects found so far in many places in Northern Central China. First, the development of copper-based metallurgy before 2000 BC remains extremely obscure in northern China (the present-day provinces of Henan, Shaanxi, Shanxi, Hebei and Shandong). If we leave the controversial brass pieces of the fourth and third millennium BC aside, then the majority of the early metal objects from northern China would fall into the first half of the second millennium BC, being slightly later than the Machang and earlier Qijia metals, but contemporary with the Siba and later Qijia finds. Second, the early metals from northern China can be roughly divided into two groups: those of the Lower Xiajiadian (c.1900–1600 BC) and Zhukaigou cultures (Periods III and IV, c.1800–1500 BC) found in the

northern frontier of China, and those found in the Central Plains of China, which are mostly associated with the cultures of Longshan (c.2400–1900 BC), Erlitou (c.1900–1500 BC) and Yueshi (c.1900–1500 BC).¹⁸ While the northern group shows an affiliation with the Siba culture, as evidenced by the finds of earrings with trumpet-shaped or flared ends, ring-shaped ornaments and socketed arrowheads (Fig. 10),¹⁹ the Central Plains group exhibits some distinctive regional features, which are best illustrated by the metal vessels, bells, dagger-axes; plaques inlaid with turquoise and tanged arrowheads from various Erlitou sites (Figs. 11; 12: 2–4; Linduff 1998; Bai 2002). The manufacturing and use of bronze vessels and the employment of piece-mould casting are the most characteristic development, signalling a major social and technological change in the Central Plains of China (Underhill 2002: 253–6).

An (1993: 1117) suggests that Qijia may have influenced Longshan in the early use of copper and bronze. However, archaeological finds so far have not presented sufficient evidence to prove or disprove this suggestion. With regard to the early use of metals, the disputed relationship between the Northwest and the Central Plains of China before 2000 BC remains a problem in need of further research. As far as the present evidence is concerned, however, certain contacts appear to have existed between the two regions after 2000 BC. In the opinion of Lin (1986: 288–9), the ring-pommel knife with perforated grip and the battle-axe from the Erlitou site (Fig. 11: 7, 8) indicate contact with the Northern Zone region, namely the northern frontier of China. Ring-pommel knives, which can be dated as early as the Erlitou culture have not yet been found in the Northern Zone; however they have been discovered among the Siba metal assemblage (Fig. 5: 20), suggesting a possible link with the north-western region. A recent analysis of thirteen Erlitou metal objects has revealed an awl made of arsenical copper (Jin 2000: 57), recalling the objects of arsenical copper identified among the Siba and Qijia metals. A bronze plaque inlaid with turquoise found in Tianshui, eastern Gansu (Fig. 12: 1), offers further evidence for cultural contacts

¹⁸ The Lower Xiajiadian culture is distributed in the present-day provincial regions of Liaoning, Inner Mongolia, Beijing, and northern Hebei; the Zhukaigou culture is in southern Central Inner Mongolia; the Longshan culture in Shandong, Henan, and Shanxi; the Erlitou culture in Henan and southern Shanxi; the Yueshi culture in Shandong. For further information about the Lower Xiajiadian, see Guo 1995; about the Zhukaigou, see Linduff 1995; about the Longshan, Erlitou and Yueshi, see Chang 1986: 242–52; 256–79; 307–16; 369–71.

¹⁹ Linduff (1995: 139–41; 1997: 21) notes that the Qijia influence on Zhukaigou can be identified from the presence of some pottery vessels of Qijia types in the Zhukaigou ceramic assemblage.

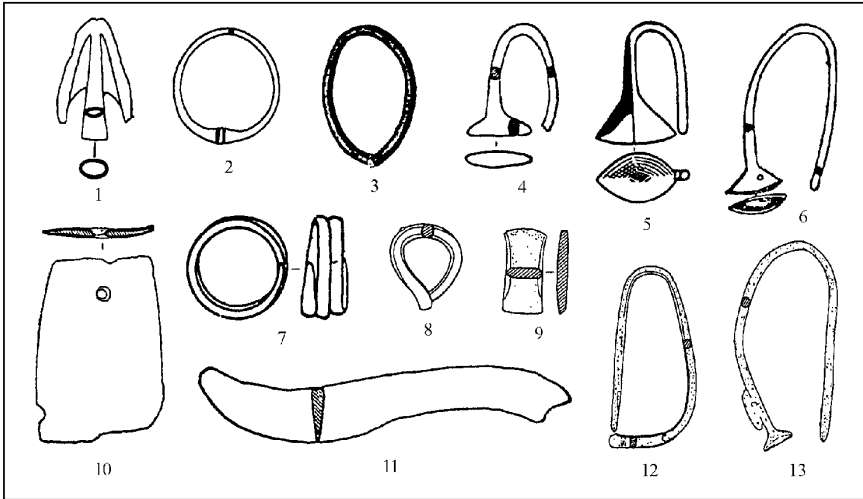


Figure 10. Copper and bronze artefacts of the Lower Xiajiadian and Zhukaigou cultures found along the northern frontier of China: 1–7, 10, 11. from the sites of the Lower Xiajiadian culture; 8, 9, 12, 13. from the Zhukaigou site (Periods III and IV) (after Bai 2002: 30–1, figures 4–5).

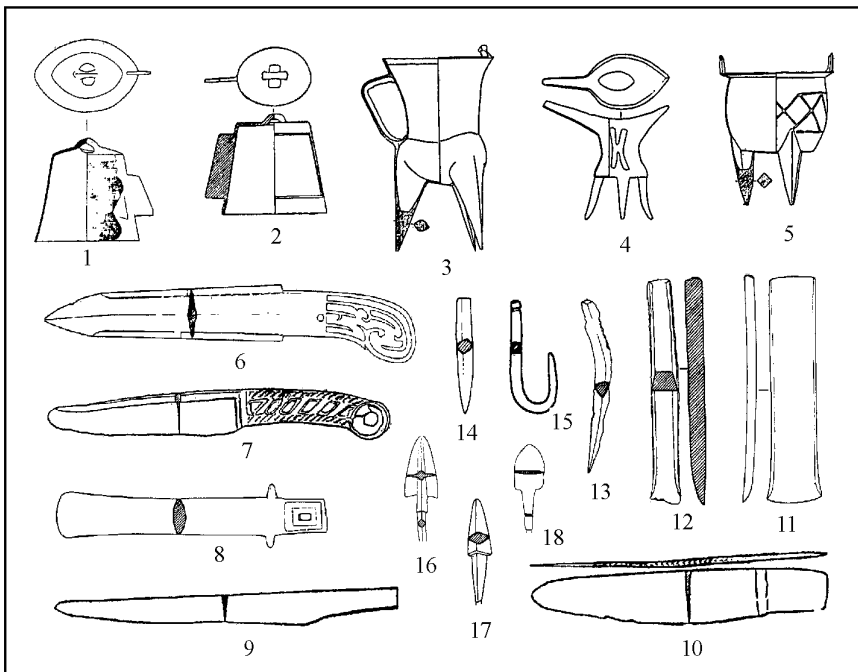


Figure 11. Copper and bronze artefacts of the Erlitou culture found in Yanshi, Henan, central China: 1–2. bells; 3–5. vessels; 6. dagger-axe; 7, 9, 10. knives; 8. axe; 11–15. small implements; 16–18. arrowheads (after Bai 2002: 33–6, figures 7–9, 11).

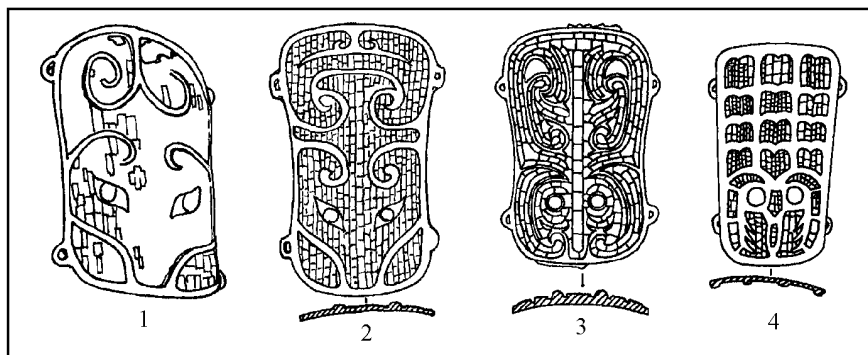


Figure 12. Copper and bronze plaques inlaid with turquoise: 1. from Tianshui, eastern Gansu; 2–4. from the sites of the Erlitou culture (after T. Zhang 2002: 43–4, figures 1–2).

between the north-western region and the Central Plains of China. Several plaques inlaid with turquoise have been unearthed at various Erlitou sites and can be considered as typical Erlitou objects (Fig. 12: 2–4). Therefore, together with other pottery evidence, the find of the Tianshui plaque would support the argument that certain cultural interactions existed between Qijia and Erlitou (T. Zhang 2002: 43–5).

In her long article entitled ‘Qijia and Erlitou: the question of contacts with distant cultures’, Fitzgerald-Huber (1995: 52–63) argues that a number of objects discovered at the Erlitou sites point to contact with North Asia as well as western Central Asia. While many of her arguments are stimulating, her suggestion of a relationship between the Erlitou vessel forms and those of Bactria would seem unlikely. It is true that there is a growing body of evidence showing cultural contacts of the Erlitou culture with neighbouring and distant cultures, but the distinction between Erlitou and Qijia-Siba has already been very clear in terms of manufacturing methods and the functions of metal objects. The Erlitou culture represents a fundamentally new period when an independent development of bronze metallurgy, as shown by the employment of ritual vessels and piece-mould casting technique, started to gain full momentum in the Central Plains of China.

The two-way traffic of cultural influence along the prehistoric ‘Silk Road’

As shown in the preceding sections, cultural interaction among Tianshanbeilu, Siba, and Qijia already took place along the Hexi Corridor

from the early second millennium BC, indicating that the well-known Silk Road served as a channel for east–west connections much earlier than previously thought. The distribution pattern of the earliest painted pottery along the Hexi Corridor seems to suggest a westward expansion of the Machang culture during the late third millennium BC, which may have resulted in the beginning and early use of painted pottery in Xinjiang (Li 2001: 132). The affiliation of the Tianshanbeilu painted pottery with the Siba and Qijia cultures further demonstrates that the eastern influence from Gansu-Qinghai had a predominant influence on the early development of painted pottery in eastern Xinjiang (Fig. 9). Even in the latter half of the second millennium BC, the Gansu-Qinghai influence continued to play a role in the evolution of painted pottery in eastern Xinjiang, as shown by comparing Yanbulake ceramics with those of the Xindian culture (Chen and Hiebert 1995: 288).²⁰ Does this westward dispersion of painted pottery also involve bronze technology? To those scholars who are in favour of an indigenous origin of metallurgy in Gansu, this would seem very likely, but it could be argued that there actually existed a two-way traffic of cultural influence along the Hexi Corridor; while painted pottery spread westward from Gansu into Xinjiang, bronze technology was transmitted in the reverse direction.

The argument for an indigenous origin of metallurgy in Gansu is primarily based on the following evidence: first, the earliest bronze knife found at the Linjia site in Gansu (Fig. 2: 1) can be dated to the early third millennium BC, and there is further evidence for the use of copper and bronze during the Machang period of the late third millennium BC (Fig. 2: 2); second, the examination of the Qijia metals has revealed an evolution from copper to bronze production processes; third, the common use of tin bronze in Gansu began from the early second millennium BC, which is contemporary with the beginning of tin bronze in Central Asia, and earlier than the typical Andronovo culture in southern Siberia and Kazakhstan; fourth, Gansu, especially the Hexi Corridor, is rich in non-ferrous metal resources which would provide a necessary material basis for the insemination and growth of a local copper-smelting industry; fifth, there have been no metal finds earlier than 2000 BC so far in Xinjiang; and finally, the spread of painted pottery westward over a long period has

²⁰ The Yanbulake culture is distributed in the Hami region of eastern Xinjiang, and the Xindian culture in eastern Qinghai and Gansu. For further information about Yanbulake, see Mei 2000: 12; about Xindian, see Chang 1986: 377–84; Shui 2001: 116–38.

been well established (Sun and Han 1997: 83; Qian *et al.* 2001: 88; Li 2002: 89).

All of this evidence requires serious consideration and the importance of the implications cannot be downplayed. However, such arguments do not undermine the counter-suggestion that some influence from western metallurgy was experienced no later than 2000 BC. It is true that the lack of metals from the third millennium BC in Xinjiang makes it difficult at present to ascribe a western impetus for the beginning of metallurgy in Gansu. But for the period of the early second millennium BC, the evidence currently available, as presented earlier, points to the significant role of western influence. Fully to consider this point, it is necessary and also important to place Northwest China within a wider Eurasian context. It is in that context that we can trace a full range of prototypes for many early metal objects found in Northwest China, such as socketed axes, back-curved knives and sickles, daggers, spearheads, and earrings. It is also in that context that we can find much earlier arsenical copper and a much wider use of tin bronze.

Recent scholarship tends to link the Afanasievo culture, the earliest metal-using culture of the third millennium BC found in southern Siberia, with the Yamnaya (Pit-grave) culture of eastern Europe, the first steppe culture (*c.* 3500–2500 BC) to employ arsenical copper and to exploit steppe copper ores extensively (Anthony 1998: 102–5). This connection is made because aspects of the Afanasievo culture bear a strong resemblance in burial rites and pottery forms to those of the Yamnaya (Chernykh 1992: 183). In the opinion of Mallory (1989: 225–6), the Afanasievo culture originated somewhere to the west and can be seen as an extension of the Yamnaya culture from the Pontic-Caspian region eastwards to the Yenisei by about 3000 BC. Bearing this background in mind, the argument for possible Afanasievo-Xinjiang contact based on the finds at the Gumugou cemetery in the north-eastern rim of the Tarim basin would seem reasonable and needs to be kept open for the future archaeological finds.²¹ In other words, the possibility for the dispersal of early copper-based metallurgy from the Eurasian steppe into Xinjiang and further east to Gansu cannot be excluded at present and will have to be considered when further archaeological evidence becomes available.

²¹ Han Kangxin (1986: 371–3) is the first scholar to suggest the contact between Xinjiang and the Afanasievo culture of southern Siberia on the basis of his examination of the eighteen skulls excavated from the Gumugou burials. Kuzmina (1998: 69–72) presents further observations to support the argument for a Gumugou–Afanasievo connection. For a review of the Xinjiang–Afanasievo contact, see Mei 2000: 58–9.

In fact, besides the issue of early copper-based metallurgy, there is other evidence pointing to the early cultural contacts between Northwest China and areas further west. For example, the earliest remains of carbonised wheat found at the Donghuishan site in Minle, western Gansu, have been dated by C-14 tests to 3000–2500 BC. Given the evidence that wheat was first domesticated in western Asia, Li (1999: 62) suggests that the first appearance of wheat in Gansu was most likely the result of early cultural contacts between Gansu and the regions to the west. This implies that some sort of western influence had already come into being in Gansu through Xinjiang as early as 3000 BC.

There is a widely held view that many of the hundreds of jade objects found at the Fuhao tomb of the late Shang dynasty (*c.* 1200 BC) in Anyang may be linked to the well-known jade source at Hetian (Khotan) in southern Xinjiang. This supposition was based on the similarities of chemical compositions revealed by scientific analysis (Wang 1993: 167–8; Di Cosmo 1996: 90). The archaeological record, however, has not offered sufficient information to show how jade was transported from Xinjiang to the Central Plains of China during the thirteenth century BC. In recent years, there have been some important finds of jade from a Qijia site in eastern Gansu, which are thought to come from Hetian also (Li 1999: 62). These finds seem to suggest that jade may have been traded along the prehistoric Silk Road from the early second millennium BC. If further finds and scientific analysis support this suggestion, then the claim for the jade connection between Xinjiang and Central Plains of China during the late Shang period would become more tenable.

Another major technology that may have been transmitted eastwards along the prehistoric Silk Road is iron-making. As early iron objects dated to 1000–600 BC have increasingly been discovered in Northwest China in recent years, more and more scholars are inclined to claim the introduction of iron technology into the Central Plains of China from Xinjiang and western Central Asia during the early first millennium BC (Tang 1993; Zhao 1996; Wagner 1999). Much emphasis has been given to the early iron objects found in Xinjiang, which include knives, awls, sickles, and rings from the cemetery sites of Yanbulake, Chawuhugou, Qunbake, and Dongfengchang.²² These finds seem to indicate clearly that iron technology was known in Xinjiang at quite an early date, most likely earlier than the eighth century BC (Chen 1989). It has been noted that

²² For further information about the cemetery sites of Yanbulake, Chawuhugou, Qunbake, and Dongfengchang, see Chen and Hiebert 1995; Mei 2000: 12, 16–18.

Chawuhugou and Qunbake, the two major early Iron Age sites found in southern Xinjiang, show some signs of contact with the Chust culture (c.1300–800 BC), a site which has provided the earliest evidence for the use of iron in the Fergana valley in Uzbekistan. Therefore, there is a possibility that the Chust culture may have played a role in the beginning and early use of iron in southern Xinjiang (Mei 2000: 67–9). The eastward transmission of iron technology appears to have taken a route from southern Xinjiang to eastern Xinjiang and then on into the Hexi Corridor. This view seems to be supported by finds of iron knives of the Yanbulake culture in eastern Xinjiang, as well as iron knives and spades of the Shajing culture (c.900–600 BC), which are distributed in the middle part of the Hexi Corridor (Li 1994: 501–5; Zhao 1996: 293–4). At the same time, there is ample evidence showing the westward dispersal of painted pottery and the rapid growth of various local traditions along the foothills of the Tian Shan mountains (Mei 2000: 15–22).

In summary, cultural interaction between China and Central Asia during the Bronze Age seems to have been characterised by the two-way traffic along the prehistoric Silk Road. On the one hand, the westward expansion of painted pottery traditions from Gansu-Qinghai into Xinjiang may have started as early as the late third millennium BC and lasted until the late second millennium BC when the tradition of painted pottery had already declined in Gansu-Qinghai. However, in Xinjiang, the art of painted pottery continued to spread westwards, while a number of local decorative styles and shapes were formed and developed in complexity during the first millennium BC. On the other hand, the eastward transmission of early cultural influence may have involved wheat, copper-based metallurgy, jade, and iron technology. Although many questions still remain regarding any specific processes of transmission, in general terms, it has become clear now that some western materials and technologies were indeed transmitted eastward and made valuable contributions to the growth of Chinese civilisation.

The shift to the Steppe Road

It has been argued in the above discussion that the earliest cultural interaction between China and Central Asia appears to have taken place along the prehistoric Silk Road. This picture could be challenged and questioned: why the Silk Road and why not the routes from southern Siberia

or Transbaikalia to the northern frontier of China (Fig. 1)?²³ Having recognised that there has been plenty of evidence for the cultural contact between North China and southern Siberia during the late second millennium BC, one would naturally wonder why this contact could not have taken place during the early second millennium BC or earlier.

Because archaeological finds from the intermediary regions such as Mongolia are still rather limited, the possibility of earlier contacts between North China and southern Siberia cannot indeed be excluded at this point.²⁴ As far as current archaeological evidence is concerned, however, it seems fairly clear that it was the prehistoric Silk Road that played a major role in the cultural interaction between China and the west during the first half of the second millennium BC. The importance of the Northern Zone of China²⁵ becomes apparent only after the

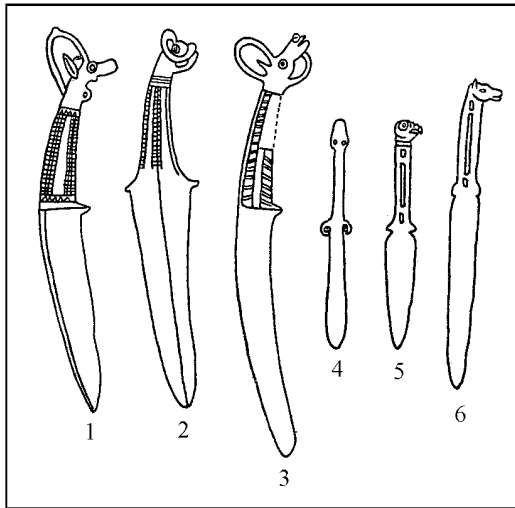


Figure 13. Copper and bronze knives and daggers in animal style found in North China: 1–2. knives; 2, 4–6. Daggers (after Wu 1985: 136, figures 1; 139, figure 3).

²³ For example, Mallory and Mair (2000: 328) see the Ordos as another channel of communication, stating that ‘we can follow the path of bronze metallurgy in general from the steppelands and Central Asia east through Xinjiang (or southeast via the Ordos) into Gansu and then into the Central Plains where bronze metallurgy suddenly appears in the Erlitou culture.’

²⁴ Wu (1993: 257–9) notes that tripod Li vessels, the typical pottery forms of the Zhukaigou culture, have been seen in Mongolia and Transbaikalia, but not in the regions to the west of the Lake Baikal, such as the Minusinsk basin.

²⁵ The term ‘Northern Zone’ has been generally accepted for defining the distinct cultural region that roughly covers the northern frontier of China, cf. Lin 1986.

mid-second millennium BC, and is best illustrated by the rise of distinctive bronzes in animal style (Fig. 13). We therefore have to ask what were the reasons for this significant cultural change along the northern frontier of China, and what was the significance of the new route in the relationship between China and Central Asia?

When we compare the situation in Gansu with that on the northern frontier of China, we note that a decline of bronze cultures in Gansu from the mid-second millennium BC appears to have been connected with an upsurge of bronze cultures on the northern frontier of China. Shui (2001: 175–84) has systematically examined the process of decline in Gansu after the end of the Qijia culture and noted a significant shift from an agricultural economy to a stockbreeding economy, particularly apparent in the Kayue culture (*c.*1500–500 BC). He argues that a change of climate towards dry and cold around 1500 BC was a major factor that may have contributed to a decline in agricultural activities and a shift to animal husbandry. Associated with this shift, one could note that the large settlement sites seen earlier in the Qijia context disappeared and the scale of the bronze industry seemed to become smaller, as shown by the much more limited use of copper and bronze objects in the Xindian and Siwa cultures (*c.*1500–700 BC). Based on the analysis of the plant and animal remains from the Zhukaigou site in central Inner Mongolia, Tian (1997: 269) also points out that there was a climate change towards dry and cold from about 1500 BC onwards, which led to a gradual growth of the stock-breeding economy at Zhukaigou. It was during the same period, namely the late phase of the Zhukaigou culture, that the earliest Ordos-type or northern-type bronzes, such as the dagger and the knife emerged (Fig. 14). Then, the following centuries witnessed a vigorous rise of bronzes in animal style across the northern frontier of China and the areas further to the north, as evidenced by numerous bronze finds from North China, Mongolia, and southern Siberia (Fig. 13; Wu 1985; Takahama 1997; Bunker *et al.* 1997).

Therefore, the climate change around the mid-second millennium BC probably not only resulted in the disintegration of large agricultural communities in north-western China, but also forced a transition towards a stock-breeding economy, which led to or stimulated a deeper exploitation of the eastern Eurasian steppe and thus paved the way for the opening of a Steppe Road that runs from the northern frontier of China through Mongolia to southern Siberia and further west (Fig. 1). From the mid-second millennium BC onwards, there is increasing evidence for contacts

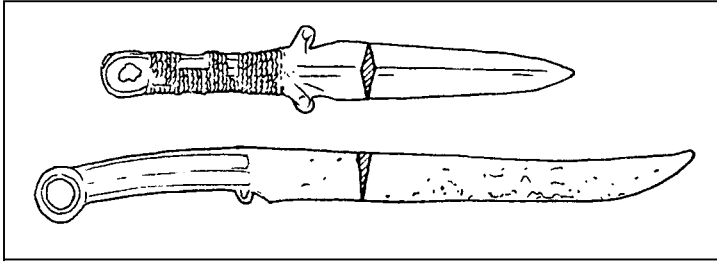


Figure 14. The earliest bronze dagger and knife of the northern type found at the Zhukaigou site in Inner Mongolia (after Tian 1997: 275, figure 4).

along the Steppe Road rather than along the prehistoric Silk Road, a fact suggesting a significant shift between them with regard to their roles in connecting China with Central Asia. This shift offered a general cultural background, against which bronzes in animal style came into being, not only along the northern frontier of China, but also in Siberia and Transbaikalia during the latter part of the second millennium BC. Similarly, the introduction of chariots into China during the late centuries of the second millennium BC would also be better considered within the context of the Steppe Road.

The historical record claims that people of the Xia dynasty (*c.* nineteenth to sixteenth centuries BC) already knew how to make wheeled vehicles, but archaeological finds so far have not yet provided any convincing proof for this.²⁶ The earliest archaeological evidence for the use of chariots in China is that from Anyang, the capital of the late Shang dynasty (*c.* 1200 BC). When the chariot appeared in Anyang, it was already in a fully developed form. On the western Eurasian steppe, however, there is ample evidence for the much earlier use of chariots. In particular, finds from the Sintashta site show that the chariot was already employed by about 2000 BC between the Volga and east of the Urals (Anthony and Vinogradov 1995). The view that the chariot was introduced into China from the west is now widely held among scholars, but there are differences of opinion regarding when and how this significant cultural borrowing took place (Shaughnessy 1988; Bagley 1999: 202–8; X. Wu 2001). Some scholars suggest that it was transmitted gradually from western Central Asia to Xinjiang, and from there to Gansu-Qinghai,

²⁶ Lin, M. (2000: 55–66) argues for the beginning of the wheeled vehicles in the Xia dynasty on the basis of some bronze implements which, he believes, would have been used for making wooden vehicles.

then to the Central Plains of China (H. Wang 2002: 46).²⁷ However, archaeological finds from both Xinjiang and Gansu so far have not offered any significant validation for this suggestion. The only find from Xinjiang that bears a relation to the wheeled vehicle is a part of a wooden wagon wheel from the Wupu cemetery in Hami dating to the late second millennium BC (Mair 1995: 283). In terms of both chronology and the vehicle type, it seems unlikely that the solid wheel from Wupu could have stimulated the appearance of the chariots with spoked wheels in Anyang, Central China.

Although direct archaeological evidence is still lacking for the appearance of chariots on the eastern Eurasian steppe around the mid-second millennium BC, the finds of the Bronze Age rock engravings of the vehicle images (especially those with spoked wheels) in Altai, Tuva, Mongolia, and northern frontier of China (Fig. 1) provide indirect evidence that the Steppe Road would have been the major channel for the eastward transmission of chariots (Wu 1994: 328–9). Indeed, the use of chariots could have been an important impetus for the opening of the Steppe Road on the eastern Eurasian steppe during the latter half of the second millennium BC.

Conclusions

These preliminary observations on the early cultural relationship between China and Central Asia can be summarised as follows.

1 There is a growing body of evidence from Gansu, Qinghai, and Xinjiang suggesting that the early development of copper-based metallurgy in Northwest China may have received an impetus from the Eurasian steppe during the first half of the second millennium BC. Whether such western influence played a role in the beginnings of metallurgy in Northwest China during the third millennium BC remains to be resolved. Similarly, whether the origins of bronze metallurgy in the Central Plains of China should be traced to the early bronze cultures in north-western China

²⁷ Mallory and Mair (2000: 326) seem to favour the route through Xinjiang too, as shown in their following remarks, ‘... it seems probable, then, that Bronze Age Iranians or Tocharians came into contact with peoples of western China in the 2nd millennium BC and introduced the chariot to the Shang. The venue of the meeting of these two worlds was, naturally, the modern province of Xinjiang and the area just to its northeast.’ W. Wang (1998: 386) surmises that both the prehistoric Silk Road and the Steppe Road could be used as the routes for the eastward transmission of chariots.

is still unclear. As far as the current evidence is concerned, a distinctive indigenous development of bronze technology emerged in the Central Plains of China from the early second millennium BC, while some signs of connections with north-western China also appeared. Further research is needed to clarify the relationship between the Northwest and the Central Plains of China during the late third and early second millennia BC.

2 The early relationship between China and Central Asia seems to be characterised by a two-way traffic of cultural influence, with bronze technology being transmitted eastward and painted pottery spreading westward from Gansu into Xinjiang. This traffic was most likely established along the prehistoric Silk Road from the late third millennium BC.

3 The climate change towards dry and cold during the mid-second millennium BC may have resulted in a shift from the prehistoric Silk Road to the Steppe Road for communication between China and Central Asia. The rise of bronzes in animal style along the northern frontier of China and the introduction of chariots into the metropolitan region of China during the later centuries of the second millennium BC can be best understood within the Steppe Road context.

Acknowledgements

I am very grateful to the British Academy for inviting me to present the second Elsley Zeitlyn Lecture on Chinese Archaeology and Culture. I am also grateful to Professors Colin Renfrew, Jessica Rawson, Takahama Shu, Hirao Yoshimitsu, Colin Shell, Ho Peng-Yoke, Ko Tsun, Han Rubin and Sun Shuyun for their guidance, encouragement and support of this research. I would like to thank my colleagues and friends in China for their help and assistance in various ways: Wang Bo, Lü Enguo, Xu Xinguo, Li Shuicheng, Shui Tao, Chen Xingcan, Abodu Idiris, Zhang Yuzhong, Zhang Ping, Li Xiao, Liu Guorui, Qiu Ling, Chang Xi'en, Dai Chunyang, Wang Hui, Zhou Guangji, Li Qian, Chen Honghai, Li Yanxiang, Qian Wei, Ma Qinglin and Guo Wu. Grateful thanks are also due to Miss Wendy Romer, Mrs Yunhua Shi, Dr Marsha Levine and Dr Yasuhiro Hayakawa for their great help with revising the draft and preparing the figures. This research has received considerable financial support from the Japan Society for the Promotion of Science, to whom I would like to express my profound gratitude. Professor Jessica Rawson has offered many constructive and useful comments on the draft of this paper, for which I am deeply indebted. Any errors that still remain are entirely my own responsibility.

References

Abbreviations Used in References

- KG *Kaogu* (Archaeology)
 KGXB *Kaogu xuebao* (Acta Archaeologia Sinica)
 WW *Wenwu* (Cultural Relics)
 XJWW *Xinjiang wenwu* (Cultural Relics in Xinjiang)
 ZKN *Zhongguo kaoguxue nianjian* (Chinese Archaeology Yearbook)

- An, Z. (1981), 'Zhongguo zaoqi tongqi de jige wenti (Some problems concerning China's early copper and bronze artefacts)', *KGXB*, 3: 269–85.
- (1992), 'The Bronze Age in eastern parts of Central Asia', in A. H. Dani and V. M. Masson (eds.), *History of Civilizations of Central Asia: The dawn of civilization: earliest times to 700 BC* (Paris), 319–36.
- (1993), 'Shilun Zhongguo de zaoqi tongqi (On early copper and bronze artefacts in China)', *KG*, 12: 1110–19. For an English translation, see Linduff, *et al.* (2000): 29–46.
- Anthony, D. W. (1998), 'The opening of the Eurasian steppe at 2000 BCE', in Mair (ed.), 94–113.
- and Vinogradov, N. B. (1995), 'Birth of the Chariot', *Archaeology*, 48.2: 36–41.
- Bagley, R. (1999), 'Shang archaeology', in Loewe and Shaughnessy (eds.), 124–231.
- Bai, Y. (2002), 'Zhongguo de zaoqi tongqi yu qingtongqi de qi yuan (The origins of early Chinese copper and bronze)', *Dongnan Wenhua* (Southeast Culture), 7: 25–37.
- Barnard, N. (1961). *Bronze Casting and Bronze alloys in Ancient China*. Monumenta Serica Monography, XIV (Tokyo).
- (1983), 'Further evidence to support the hypothesis of indigenous origins of metallurgy in ancient China', in Keightley (ed.), 237–77.
- and Sato, T. (1975), *Metallurgical Remains of Ancient China* (Tokyo).
- Bunker, E. C. (1993), 'Gold in the ancient Chinese world: A cultural puzzle', *Artibus Asiae*, 53(1/2): 27–50.
- (1998), 'Cultural diversity in the Tarim basin vicinity and its impact on ancient Chinese culture', in Mair (ed.), 604–18.
- Kawami, T. S., Linduff, K. M., and Wu, E. (1997), *Ancient Bronzes of the Eastern Eurasian Steppes from the Arthur M. Sackler Collections* (New York).
- Chang, K. C. (1963), *The Archaeology of Ancient China* (New Haven).
- (1986), *The Archaeology of Ancient China* (4th edn.) (New Haven and London).
- Chen, G. (1989), 'Xinjiang chutu de zaoqi tieqi (On early iron artefacts unearthed in Xinjiang)', in *Qingzhu Su Bingqi Kaogu Wushiwu Nian Lunwenji* (Collected Works in Celebration of the Fifty-five-year Archaeological Career of Su Bingqi) (Beijing), 425–32.
- Chen, K. T., and Hiebert, F. T. (1995), 'The late prehistory of Xinjiang in relation to its neighbors', *Journal of World Prehistory*, 9(2): 243–300.
- Cheng, T. K. (1974), 'Metallurgy in Shang China', *T'oung Pao*, 60(4/5): 209–29.
- Chernykh, E. N. (1992), *Ancient Metallurgy in the USSR: The Early Metal Age*, trans. S. Wright (Cambridge).

- and Kuzminykh, S. V. (1989), *Drevnyaya Metallurgiya Severnoi Evrazii* (Ancient Metallurgy in the Northern Eurasia) (Moscow).
- Debaine-Francfort, C. (1988), 'Archéologie du Xinjiang des origines aux Han: Première Partie', *Paleorient*, 14(1): 5–29.
- (1989), 'Archéologie du Xinjiang des origines aux Han: IIème partie', *Paleorient*, 15(1): 183–213.
- (1995), *Du Néolithique à l'Âge du Bronze en Chine du Nord-Ouest: La culture de Qijia et ses connexions* (Paris).
- Di Cosmo, N. (1996), 'Ancient Xinjiang between Central Asia and China', *Anthropology and Archeology of Eurasia*, 34(4): 87–101.
- (1999), 'The northern frontier in pre-imperial China', in Loewe and Shaughnessy (eds.), 885–966.
- EC (1997): The Editorial Committee (eds.), *Zhongguo Wenwu Jinghua* (The Treasures of Chinese Cultural Relics) (Beijing).
- Fitzgerald-Huber, L. G. (1995), 'Qijia and Erlitou: the question of contacts with distant cultures', *Early China*, 20: 17–67.
- (1997), 'A review of Debaine-Francfort 1995', *Early China*, 22: 246–70.
- Gimbutas, M. (1956), 'Borodino, Seima and their contemporaries', *Proceedings of the Prehistoric Society*, 22: 143–72.
- GPI (Gansu Provincial Institute of Cultural Relics and Archaeology and Jilin University) (1998), *Minle Donghuishan Kaogu: Siba wenhua mudi de jieshi yu yanjiu* (Excavation Report of the Donghuishan Site in Mingle—Excavation and Study on the Cemetery of Siba Culture) (Beijing).
- Guo, D. (1995), 'Lower Xiajiadian culture', in Sarah M. Nelson (ed.), *The Archaeology of Northeast China* (London and New York), 147–81.
- Han, K. (1986), 'Xinjiang Kongquhe Gumugou mudi rengu yanjiu (Anthropological characteristics of the human skulls from the ancient cemetery at Gumugou, Xinjiang)', *KGXB*, 3: 361–84.
- Ho, P. T. (1975), *The Cradle of the East: An Inquiry into the Indigenous Origins of Techniques and Ideas of Neolithic and Early Historic China, 5000–1000 B.C.* (Hong Kong).
- Jacobson, E. (1988), 'Beyond the frontier: a reconsideration of cultural interchange between China and the Early Nomads', *Early China*, 13: 201–40.
- Jettmar, K. (1971), 'Metallurgy in the early steppe', *Artibus Asiae*, 33(1/2): 5–16.
- (1981), 'Cultural and ethnic groups west of China in the second and first millennia B.C.', *Asian Perspectives*, 24 (2): 145–62.
- Jia, J. (1996), 'Gansu Jishishan xian Xinzhuangping Qijia wenhua yizhi diaocha (An investigation of the Qijia culture site at Xinzhuangping, Jishishan county, Gansu)', *KG*, 11: 46–52.
- Jin, Z. (2000), 'Erlitou qitongqi de zjran kexue yanjiu yu Xia wenming tansuo (A scientific study of the Erlitou bronzes and an exploration of the Xia civilisation)', *WW*, 1: 57–64.
- Keightley, D. N. (1983) (ed.), *The Origins of Chinese Civilization* (Los Angeles).
- Kim, G. H., Yi, K. W., and Kang, H. T. (2002) (eds.), *BUMA-V: Message from the History of Metals to the Future Metal Age* (Seoul).
- Kiselev, S. V. (1960), 'The Neolithic and Bronze Ages in China', *Soviet Archaeology*, 4: 244–66 (in Russian).

- Ko, T. (1986), 'A brief history of metallurgy', in Beijing University of Iron and Steel Technology (ed.), *Zhongguo Yejin Shi Lunwenji* (Papers on the History of Metallurgy in China) (Beijing), 1–11.
- Kohl, P. L. (1981) (ed.), *The Bronze Age Civilization of Central Asia: Recent Soviet Discoveries* (New York).
- Kuzmina, E. E. (1998), 'Cultural connections of the Tarim Basin people and the pastoralists of the Asian steppe in the Bronze Age', in Mair (ed.), 63–93.
- Li, S. (1993), 'Siba wenhua yanjiu (A study of the Siba culture)', in B. Su (ed.), *Kaoguxue Wenhua Lunji (3)* (A Collection of Papers on Archaeological Cultures, vol. 3) (Beijing), 80–121.
- (1994), 'Shajing wenhua yanjiu (A study of the Shajing culture)', *Guoxue Yanjiu* (Studies in Sinology), 2: 493–523.
- (1999), 'Cong kaogu faxian kan gongyuanqian liangqianji dongxifang wenhua de pongzhuang yu jiaoliu (The cultural exchange between the East and the West during the 2nd millennium BC: An archaeological perspective)', *XJWW*, 1: 53–65.
- (2001), 'Hexi diqu xinjian Majiayao wenhua yicun ji xiangguan wenti (The remains of the Majiayao culture newly seen in the Hexi region and relevant problems)', in Su (ed.), 121–35.
- (2002), 'Patterns of growth: early copper and bronze finds in West China', in Kim *et al.* (eds.), 283–90.
- and Shui, T. (1988), 'Qiuquan xian Fengle xiang Zhaobitan yizhi he Gaomuxudi yizhi (The Zhaobitan and Gaomuxudi sites in Fengle, Qiuquan county)', *ZKN* 1987, 272.
- (2000), 'Siba wenhua tongqi yanjiu (A study of the copper and bronze objects of the Siba culture)', *WW*, 3: 36–44.
- Li, X., and Dang, T. (1995), 'Zhunge'er pendi Zhouyuan diqu chutu tongqi chutan (A preliminary study of copper and bronze artefacts unearthed from the surrounding regions of the Zhunge'er Basin)', *XJWW*, 1: 40–51.
- Lin, M. (2000), 'Qingtong shidai de zaoche gongju yu zhongguo zhanche de qianyuan (The Bronze Age implements for the manufacture of vehicles and the origins of chariots in China)', in *Gudao Xifeng* (The Prevalence of Western Custom in Ancient and Medieval China) (Beijing), 33–76.
- Lin, Y. (1986), 'A reexamination of the relationship between bronzes of the Shang culture and of the Northern Zone', in K. C. Chang (ed.), *Studies of Shang Archaeology* (New Haven and London), 237–73.
- Linduff, K. M. (1995), 'Zhukaigou, steppe culture and the rise of Chinese civilization', *Antiquity*, 69: 133–45.
- (1997), 'An Archaeological Overview', in Bunker (ed.), 18–98.
- (1998), 'The emergence and demise of bronze-producing cultures outside the Central Plains of China', in Mair (ed.), 619–43.
- (2002), 'How far east does the Eurasian metallurgical tradition extend?', in Kim *et al.* (eds.), 35–45.
- Han, R., and Sun, S. (2000) (eds.), *The Beginnings of Metallurgy in China* (New York).
- Loehr, M. (1949), 'Weapons and tools from Anyang and Siberian analogies', *American Journal of Archaeology*, 53: 26–144.
- (1956), *Chinese Bronze Age Weapons* (Ann Arbor).

- Loewe, M. and Shaughnessy, E. (1999) (eds.), *The Cambridge History of Ancient China: from the Origins of Civilization to 221 B.C.* (Cambridge).
- Lü, E., Chang, X., and Wang, B. (2001), 'Xinjiang qingtong shidai kaogu wenhua qianlun (On the Bronze Age cultures in Xinjiang)', in Su (ed.), 172–93.
- Ma, Q., Hu, Z., and Li, Z. (2001), 'Zhongguo gudai duxi qingtongqi (The tinned bronzes in ancient China)', *Gugong Wenwu Yuekan* (Palace Museum Bulletin) 90(1): 110–18.
- Mair, V. H. (1990), 'Old Sinitic *myag, Old Persian magus, and English "Magician"', *Early China*, 15: 27–47.
- (1995), 'Prehistoric Caucasoid corpses of the Tarim Basin', *Journal of Indo-European Studies* 23 (3/4): 281–307.
- (1998) (ed.), *The Bronze Age and Early Iron Age Peoples of Eastern Central Asia*, 2 vols. (Washington).
- Mallory, J. P. (1989), *In search of the Indo-Europeans: Language, Archaeology and Myth* (London).
- Mallory, J. P., and Mair, V. H. (2000), *The Tarim Mummies: Ancient China and the Mystery of the Earliest Peoples from the West* (London).
- Masson, V. M. and Kiiatkina, T. P. (1981), 'Man at the dawn of civilization', in Kohl (ed.), 107–34.
- Mei, J. (2000), *Copper and Bronze Metallurgy in Late Prehistoric Xinjiang: Its Cultural Context and Relationship with Neighboring Regions*. BAR International Series 865 (Oxford).
- and Shell, C. (1999), 'The existence of Andronovo cultural influence in Xinjiang during the second millennium BC', *Antiquity*, 73(281): 570–8.
- Li, X., and Wang, B. (1998), 'A metallurgical study of early copper and bronze artefacts from Xinjiang, China', *Bulletin of the Metals Museum*, 30 (1998-II): 1–22.
- Muhly, J. D. (1988), 'The beginnings of metallurgy in the Old World', in R. Maddin (ed.), *The Beginning of the Use of Metals and Alloys* (Cambridge, MA), 2–20.
- OCR (1998): Office for Cultural Relics of Qinghai, 'Qinghai Tongde xian Zongri yizhi fajue jianbao (A brief report of the excavation at the Zongri site in Tongde county, Qinghai)', *KG*, 5: 1–14.
- Parzinger, G. (2000), 'The Seima-Turbino phenomenon and the origin of the Siberian animal style', *Archaeology, Ethnology and Anthropology of Eurasia*, 1: 66–75.
- Peng, K. (1998), 'The Andronovo bronze artefacts discovered in Gongliu county in Yili, Xinjiang', in Mair (ed.), 573–80.
- Puett, M. (1998), 'China in early Eurasian history: a brief review of recent scholarship on the issue', in Mair (ed.), 699–715.
- Qian, W., Sun, S., and Han, R. (2000), 'Gudai shentong yanjiu zongshu (A review of the studies of ancient arsenical copper)', *Wenwu Baohu Yu Kaogu Kexue* (Sciences of Conservation and Archaeology), 12(2): 43–50.
- (2001), 'Xinjiang Hami Tianshanbeilu mudi chutu tongqi de chubu yanjiu (A preliminary study of the bronzes unearthed from the Tianshanbeilu cemetery in Hami, Xinjiang)', *WW*, 6: 78–89.
- Qian, W., Sun, S., and Ko, T. (2002), 'Copper-arsenic alloys in ancient China', in Kim *et al.* (eds.), 235–42.

- QTC (1986): Qinghai Team of Cultural Relics and Archaeology, 'Qinghai Huzhu tuzhu zizhixian Zongzhai Machang, Qijia, Xindian wenhua muzhang (The burials of the Machang, Qijia and Xindian cultures at Zongzhai in Tuzhu county, Qinghai)', *KG*, 4: 306–17.
- Ravich, I. G., and Ryndina, V. (1995), 'Early copper-arsenic alloys and the problems of their use in the Bronze Age of the North Caucasus', *Bulletin of the Metals Museum*, 23: 1–18.
- Shaughnessy, E. (1988), 'Historical perspectives on the introduction of the chariot into China', *Harvard Journal of Asiatic Studies* 4(1): 189–237.
- Shui, T. (1993), 'Xinjiang qingtong shidai zhu wenhua de bijiao yanjiu (A comparative study of the Bronze Age cultures in Xinjiang)', *Guoxue Yanjiu* (Studies in Sinology), 1: 447–90.
- (2001), *Zhongguo Xibei Diqu Qingtong Shidai Kaogu Lunji* (Papers on the Bronze Age Archaeology of Northwest China) (Beijing).
- Smith, C. S. (1977), Review of Barnard and Sato 1975 and Ho Ping-ti 1975, *Technology and Culture* 18(1): 80–6.
- Su, B. (2001) (ed.), *Su Bingqi Yu Dangdai Zhongguo Kaoguxue* (Su Bingqi and Archaeology in Contemporary China) (Beijing).
- Su, R., Hua, J., Li, K., and Lu, B. (1995), *Zhongguo Shanggu Jinshu Jishu* (The Metal Technology of Early China) (Jinan).
- Sun, S. (1998), 'Donghuishan yizhi Siba wenhua tongqi de jian ding ji yanjiu (The examination and study of the copper objects from the Siba culture site at Donghuishan)', in *GPI*: 191–5.
- and Han, R. (1981), 'Zhongguo zaoqi tongqi de chubu yanjiu (A preliminary study of early Chinese copper and bronze artefacts)', *KGXB*, 3: 287–301. For an English translation, see *Early China*, 1983, vol. 9, 261–73 or Linduff, *et al.* (2000) (eds.), 129–51.
- (1997), 'Gansu zaoqi tongqi de faxian yu yelian zhizao jishu de yanjiu (Discovery of early copper and bronze artefacts in Gansu and studies of their smelting and manufacturing techniques)', *WW*, 7: 75–84. For an English translation, see Linduff, *et al.* (2000) (eds.), 175–93.
- Takahama, S. (1997), 'Chinese northern bronzes', in *Mounted Nomads of Asian Steppe* (Tokyo), 140–9 (in Japanese).
- (2000), 'On several types of copper objects of the first half of the second millennium BC from the central Eurasia', in *Metals and Civilisation* (Nara), 111–23 (in Japanese).
- Tang, J. (1993), 'Zhongguo yetieshu de qi yuan wenti (On the origin of iron metallurgy in China)', *KG*, 6: 556–65.
- Terekhova, N. N. (1981), 'The history of metalworking production among the ancient agriculturalists of Southern Turkmenia', in Kohl (ed.), 313–24.
- Tian, G. (1997), 'Zhongguo beifangxi qingtongqi wenhua he lixing de chubu yanjiu (A preliminary study of bronze cultures and types of the Chinese Northern Complex)', in B. Su (ed.), *Kaoguxue Wenhua Lunji (4)* (A Collection of Papers on Archaeological Cultures, vol. 4) (Beijing), 266–307.
- Underhill, A. P. (2002), *Craft Production and Social Change in Northern China* (New York).
- Wagner, D. B. (1993), *Iron and Steel in Ancient China* (Leiden, New York, and Köln).

- (1999), 'The earliest use of iron in China', in S. M. M. Young *et al.* (eds.), *Metals in Antiquity*, BAR International Series, 792, 1–9.
- Wang, B. (1993), *Sichouzhilu Kaogu Yanjiu (Archaeological Research on the Silk Road)* (Urumchi).
- Wang, H. (2002), 'Zhongguo mache de qianyuan (The origins of chariots in China)', *Ouya Xuekan* (Eurasian Studies) 3: 1–75.
- Wang, W. (1998), 'Shangdai mache yuanyuan lice (Some conjectures on the origins of the Shang chariots)', in The Institute of Archaeology (ed.), *Zhongguo Shang Wenhua Guoji Xueshu Taolunhui Lunwenji* (Proceedings of the International Conference on the Shang Culture in China) (Beijing), 380–8.
- Watson, W. (1971), *Cultural Frontiers in Ancient East Asia* (Edinburgh).
- (1985), 'An interpenetration of opposites? Pre-Han bronze metallurgy in west China', *Proceedings of the British Academy*, 70: 327–58.
- (1997), *Studies in Chinese Archaeology and Art* (London).
- Wu, E. (1985), 'Yin zi Zhou chu de beifan qitong qi (The bronzes of northern China from the late Shang to the early Western Zhou dynasty)', *KGXB*, 2: 135–56.
- (1993), 'Zhukaigou Wenhua de faxian jiqi yiyi (The discovery and significance of the Zhukaigou culture)', in *Zhongguo Kaoguxue Luncong* (Treatises on Chinese Archaeology) (Beijing), 256–66.
- (1994), 'Lun gudai zhanche jiqi xiangguan wenti (On the chariots and relevant issues)', in *Neimenggu Wenwu Kaogu Wenji* (Papers on Cultural Relics and Archaeology in Inner Mongolia) (Beijing), 327–35.
- Wu, X. (2001), 'Guanyu Zhongguo mache qiyan wenji yanjiu de shuping (A review on the study of the origins of chariots in China)', *Gudai Wenming Yanjiu* (Ancient Civilizations Review), 11: 32–9.
- XIA (Xinjiang Institute of Archaeology) (1981), 'Xinjiang Ke'ermuqi gumuqun fajue jianbao (Brief report on the excavation of Ke'ermuqi cemetery in Xinjiang)', *WW*, 1: 23–32.
- Yang, Y. (1985), 'Gansu Minxian Xinglin Qijia wenhua yizhi diaocha (An investigation of the Qijia culture site at Xingling, Minxian, Gansu)', *KG*, 11: 977–9.
- Yue, F., Idiris, A., and Du, G. *et al.* (1999), *Xinjiang Wenwu Guji Daguan* (A Grand View of Xinjiang's Cultural Relics and Historic Sites) (Urumchi).
- Zhang, J., and Li, Y. (1999) (eds.), *Changhai Yizhu* (Ancient Treasures) (Guangzhou).
- Zhang, T. (2002), 'Tianshui chutu de shoumian tongpaishi ji youguan wenti (The bronze plaque with animal face unearthed in Tianshui and relevant problems)', *Zhongyuan Wenwu* (Cultural Relics from Central China), 1: 43–6.
- Zhang, Z. (1987), 'Qijia wenhua yanjiu (A study of the Qijia culture)', *KGXB*, 2: 153–76.
- Zhao, H. (1996), 'Gongyuanqian wushiji zhongye yiqian zhongguo rengong tieqi de faxian jiqi xiangguan wenti (The iron objects earlier than the fifth century BC found in China and other relevant issues)', in *Kaogu Wenwu Yanjiu* (Studies of Archaeology and Cultural Relics) (Xi'an), 289–300.

