The Regional Characteristics and Interactions Between the Early Bronze Metallurgies of the Northwest and Central Plains

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In recent years, the beginnings of metallurgy in China have become a hotly-debated topic in the academic community. The debate focuses on whether Chinese metallurgy was a native product or was a product under foreign influence.

The distribution of early copper and bronze objects found in the archaeological context of China concentrate in two major geographic regions. The Northwest has an archaeological inventory of more than 1,500 specimens of early metal artifacts; wherein the Central Plain in the middle reaches of the Yellow River tallies to about 200 artifacts.

I. The Discoveries and Regional Characteristics of Early Copper and Bronze Artifacts

1. The Northwest

In 1977, a bronze knife and a few bronze ingots were unearthed from a Majiayao 马家窑(3300–2650 BC) cultural site at Linjia 林家, Dongxiang 东乡 County, Gansu 甘肃. To date, they are the earliest bronze products ever found within the bounds of modern China. Other early findings include metal objects recovered from three different localities of the Machang 马厂 Culture (2650–2000 BC). In 1975, a metal knife was unearthed from a site at Jiangjiaping 蒋家坪, Yongdeng 永登. In 1987, a metal awl and a metal block were yielded from Zhaobitan 照壁滩 and Gaomuxudi 高苜蓿地 at Fengle 丰乐, Jiuquan 酒泉 respectively (Fig. 1).

If finding of metal objects of Majiayao and Machang are isolated cases, it becomes common in the archaeology of Qijia 齐家 (2200–1800 BC) and Siba 四坝 (1950–1550 BC) cultures. Qijia Culture so far has yielded about 130 specimens of metal artifacts, which include a variety of artifact types (Fig. 2). Wherein the Siba Culture has an inventory of more than 300 specimens of metal artifacts; and the diversity of artifact type increased as well (Fig. 3).

The metal knife recovered from the Majiayao cultural site at Linjia is a cast bronze artifact that contains 6–10% tin. The metal artifacts of Machang Culture include copper and tin-bronze. The technology involved in the production of these artifacts includes hot forging and casting. The above discoveries indicate that in the time frame bracketed between 5,000 to 4,000 years ago, early inhabitants of the Northwest possessed the knowledge of mineral ore smelting and alloying. However, the development of metallurgy in this period was relatively slow-paced.

The early metallurgists of Qijia Culture had the ability to produce complex artifact forms, such as socketed axe, mirror and ringed-pommel dagger. In addition, the

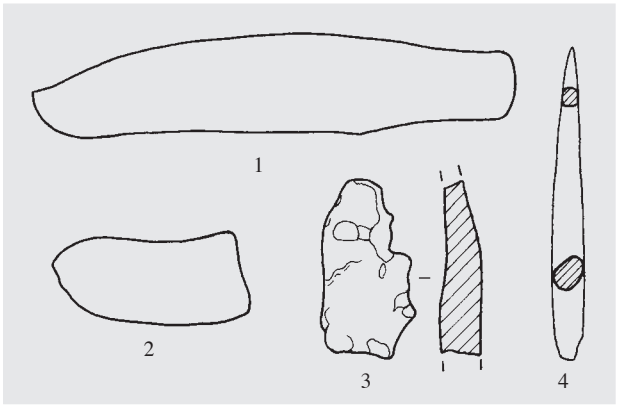

Fig. 1 Bronze artifacts from Majiayao and Machang–Banshan sites
1. knife (Linjia, Dongxiang) 2. knife (Jiangjiaping, Yongdeng) 3. ingot (Gaomuxudi, Jiuquan) 4. awl (Zhaobitan, Jiuquan)

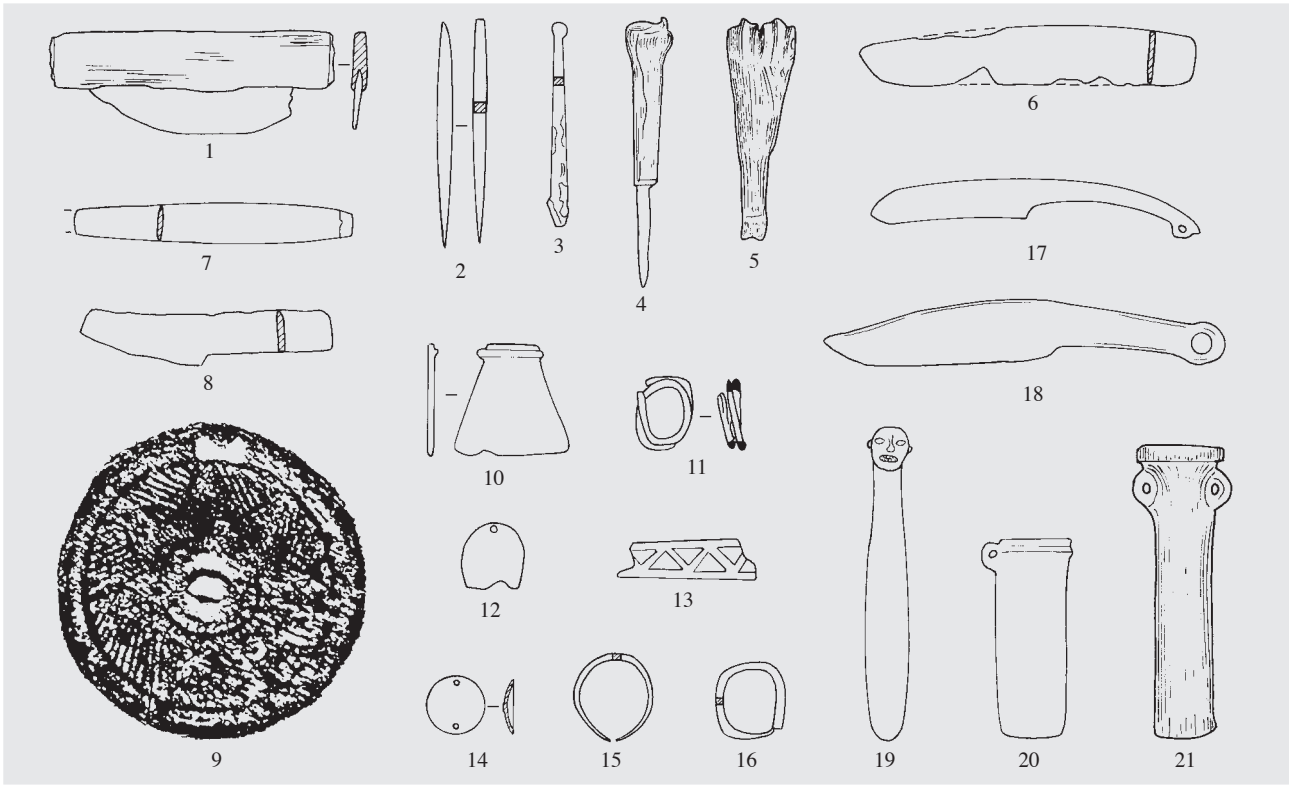

Fig. 2 Bronze artifacts from Qijia site

1. knife with a bone handle (Weijiataizi 魏家台子, Linxia 临夏) 2, 10, 12. awl, axe and fragment respectively (Qinweijia 秦魏家, Yongjing 永靖) 3, 13. drill and handle of a knife respectively (Huangniangniangtai 黄娘娘台, Wuwei 武威) 4–7. awl, knife with a bone hand and two knives (Zongzhai 总寨, Huzhu 互助) 8. knife (Dahezhuang 大何庄, Yongjing) 9, 11, 16. mirror, ring and earring respectively (Gamatai 尕马台, Guinan 贵南) 14, 15. button and bracelet respectively (Xinzhuangping 新庄坪, Jishishan 积石山) 17, 20. knife and axe respectively (Xinglin 杏林, Minxian 岷县) 18. knife (Shangguandi 商罐地, Kangle 康乐) 19. dagger with a human face-shaped handle (Qijiaping 齐家平, Guanghe 广河)

appearance of personal apparels further widened the application of metal in human societies. During this period, the proportions of casting and alloying practices in the metal industry gradually increased. Yet, as a whole, Qijia Culture was still in the early development of metallurgy.

In comparison to that of Qijia Culture, the metallurgy of Siba Culture shows signs of maturity. It is expressed in a number of areas: broadening of the use of bronze as a material; diversification of artifact type; the proportion of bronze artifacts exceeded that of copper artifacts; the composition of alloy became complicated; although a variety of production technologies, such as casting, hot forging and hammering, were simultaneously available, cast technology became prevalent and sophisticated; and lastly, the appearance and widespread distribution of bronze arrowheads. In addition, a unique characteristic of the Siba metallurgy is the appearance of arsenic-bronze. The recoveries of arsenic-bronzes in Siba cultural sites are particularly significant in the understanding of the formation and development of regional characteristics of early metallurgy in China. According to a study of the bronzes yielded from the site at Donghuishan 东灰山, Minle 民乐, Gansu, there existed a technological development from arsenic-bronze to tin-bronze. This finding suggests that the Siba metallurgy likely went through a developmental trend from copper to arsenic-bronze, and finally to tin-bronze. The proportion of arsenic in Siba's arsenic-bronzes is similar to that of the early arsenic-bronzes in western Asia, southeastern Europe and North Africa, suggesting possible interactions between the early metallurgy of western China and that of foreign territories.

The earliest metal artifacts of Xinjiang 新疆 were collected in the eastern slopes of the Pamir Plateau. Beads, small sticks, small daggers, and blocks made of metal were found in several localities in the Shufu 疏附 County. Tests indicate that they were forged from native copper with considerable amount of impurities. The excavator argued that these artifacts share characteris-

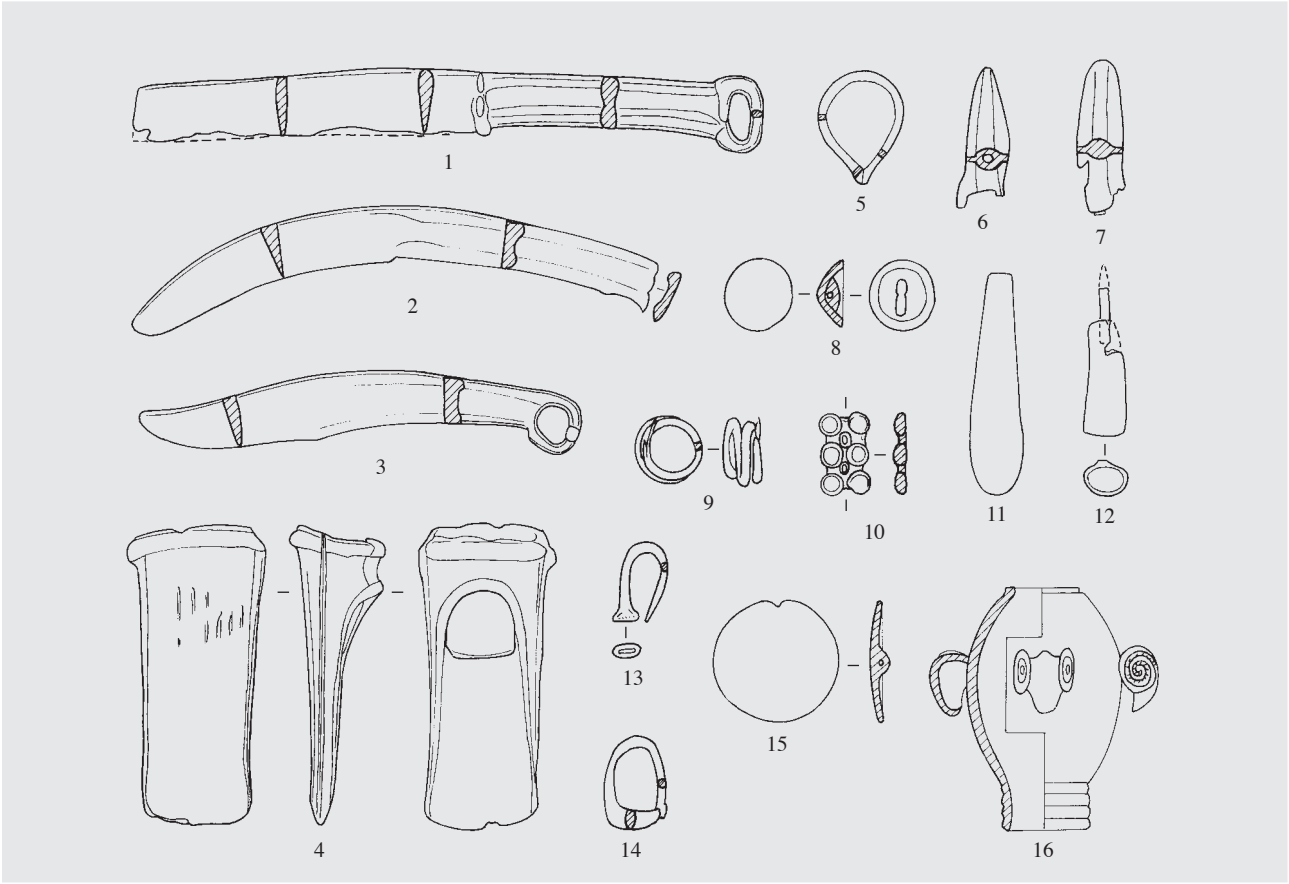

Fig. 3 Bronze artifacts from Siba site

1–3. knives 4. axe with a socket 5, 13, 14. earrings 6, 7. arrowheads 8. button 9. ring 10. ornament in the shape of connected pearls 11. dagger 12. awl with a bone handle 15. plaque 16. pommel of staff (1–10, 12–15. Ganguya 干骨崖; 11, 16. Huoshaogou 火烧沟)

tics with those found in Kelteminar of Central Asia, and estimated them to date between 3000 and 2000 BC.

By late 1980s, about 1,000 counts of metal artifacts were excavated from the burials at Hami located on the North Tianshan 天山 Route of Xinjiang. To date, this is the richest early bronze-yielding locality in western China. Metallographic analyses on selected artifacts indicate that tin-bronze comprises 69%, and copper and arsenic-bronzes comprise 12% and 10% of the sample respectively, and the remaining artifacts were made of a tri-alloy. In terms of manufacturing technology, the ratio of casting to hot forging is 35:44. In addition, the arsenic-bronzes yielded from the burials of the North Tianshan Route are monotonic in artifact category that they comprise mainly of personal apparels, and utilitarian tools and weapons are rare.

A small number of bronze artifacts, dated to about 2000 BC, were yielded from the sites at Gumugou 古墓沟 and Xiaohe 小河 in Bayinguoleng 巴音郭楞, the Mongolian Autonomous Prefecture 蒙古自治州 of Xinjiang. Parenthetically, the former site also yielded wood artifacts bearing marks of chopping, chiseling, etching and shaving. They were likely cut-marks of metal tools.

The Nanwan 南湾 cemetery site at Kuisu 奎苏 Town, Balikun 巴里坤 (1600–1100 BC) also yielded an assemblage of early bronzes. The style of its early phase artifacts is similar to that of the burials distributed in the North Tianshan Route. Some sorts of cultural connection should have existed between the two.

The dates of Yanbulake 焉不拉克 Culture (1300–700 BC) are comparatively late. Its metallurgy was a continuation of the western China tradition. Artifact types include a variety of utilitarian tools, weapons and apparels.

Historians of metallurgy conducted metallographic analyses on a sample of 234 metal specimens recovered from 16 localities in eastern Xinjiang. They concluded that the metallurgic industry in eastern Xinjiang could be roughly partitioned into three developmental phases. The early phase is represented by the burials distributed in the North Tianshan Route. The majority of the metal

assemblage was tin-bronzes; however, copper and arsenic-bronzes maintained considerable proportions. The middle phase is represented by the burials at Yanbulake. During this phase, tin-bronze still maintained the majority; the proportion of arsenic-bronze increased, and some of them were high arsenic-bronzes. The late phase is represented by the burials at Heigouliang 黑沟梁. The composition of lead increased in the bronze alloy in the expense of arsenic. In addition, this phase witnessed the appearance of high tin-bronze that composed up to 16% of tin and the appearance of brass, that is, an alloy of copper and zinc. The bronze alloy consistently contained significant amount of impurities regardless of temporal difference. Casting and forging technologies coexisted throughout the three phases. The early bronzes (2000–500 BC) of eastern Xinjiang, in general, contained arsenic; however, the composition of arsenic was usually under 8%, but a few artifacts contained more than 20% arsenic. In all, arsenic had long been used in the alloy-forming of the early bronzes in eastern Xinjiang. Consequently, arsenic-bronzes were widely found in the prehistoric archaeology of the region. The artifact types, chemical compositions and manufacture techniques of the bronze assemblage of the burials of the North Tianshan Route are similar to those of Siba Culture, indicating that eastern Xinjiang had played a significant role in the East-West interactions.

An assemblage of early bronzes had been recovered from northwestern Xinjiang and the periphery of Dzungaria 准噶尔 Basin. It comprises a variety of utilitarian tools and weapons, and a small number of apparels. These artifacts bear the stamps of Andronovo Culture in form, artifact type and decorative pattern. The metallographic analysis on selected artifacts indicates that they comprise mainly of tin-bronzes that contain 2–10% of tin. Moreover, the chemical compositions of these artifacts are similar to that of the Andronovo Culture. Latter date (first half of the 1st millennium BC) artifacts of the assemblage include a small number of arsenic-bronzes. In all, during the period between the mid-2nd and mid-1st millennium BC, copper and bronze artifacts coexisted in this region, albeit tin-bronze comprised the majority. The composition of alloy did not show significant change over time. Some colleagues pointed out that the Nulasai 奴拉赛 site at Nileke 尼勒克 County in the Yili 伊犁 River basin of Xinjiang was the pioneer in the use of "sulphuric ore–ice copper–copper" technology. It is also the only early smelting site in Euro-Asia that arsenic ore was added to deliberately produce an alloy of arsenic-bronze. This site is particularly important in the history of metallurgy.

The Chawuhu 察吾呼 Culture (1100–500 BC) distributes on the foothills between the middle section of the Tianshan Mountain Ranges and Tarim River. Its bronze assemblage comprises a variety of weapons, utilitarian tools and small apparels. They show no apparent temporal change in form and type through the four cultural phases. In addition, bronzes bear the Chawuhu characteristics were found in Hejing 和静, Baicheng 拜城 and Luntai 轮台 (Bügür). Yet, sites distributed along the Tarim River, such as Heshuo 和硕, Kuga 库车 and Aksu 阿克苏, yielded remains of a bronze culture different from that of Chawuhu. Bronzes recovered include double-eared socketed axe, arrowheads, awls, knives, needles and bracelets. Their absolute dates have been estimated to be earlier than that of Chawuhu.

2. The Central Plains

The Central Plain (I define the Central Plain as the region in western Henan 河南 and southern Shanxi 山西) yielded a few very early–as early as the Yangshao 仰韶 Culture–copper and bronze artifacts and features of smelting. However, these findings in the Central Plain are small in number and their provenances are controversial in the archaeological community. Because of that, this paper is not going to discuss findings earlier than the late Longshan 龙山 phase.

Only a few examples of copper and bronzes are available for the late Longshan Culture (2190–1965 BC). Phase IV of Wangchenggang 王城岗 at Dengfeng 登封, Henan yielded one fragment of bronze sheet. Sites at Dongzhai 董砦 and Lutaigang 鹿台岗 at Zhengzhou 郑州 yielded one fragment of bronze sheet and some smelting remains. A piece of slag was found in Pingliangtai 平粮台, Huaiyang 淮阳. Two fragments of crucible were found in Meishan 煤山, Linru 临汝, Henan. A burial in the Taosi 陶寺 site at Xiangfen 襄汾, Shanxi was offered a copper bell. Recently, the same site also yielded a serrated bracelet made of bronze. A series of chemical analyses have determined the compositions of a sample of these metal artifacts. The bell of Taosi is made of copper, which comprises 97.8% copper; the serrated bracelet is made of arsenic-bronze. The metal sheet of Wangchenggang is made of a tri-alloy of tin, lead and copper. We can conclude that the metal industry of the Central Plain during the late Longshan phase had reached a certain technological level, although it was still in the initial stage of the industry.

The archaeological finding of bronzes in the context of Erlitou 二里头 Culture (1780–1529 BC) of the Central Plain increases significantly. Thus far, about 200 specimens have been documented. They were found mainly in the Erlitou site, with isolated findings in Wangchenggang at Dengfeng, Donggangou 东干沟 at Luoyang 洛阳, Yangzhuang 杨庄 at Zhumadian 驻马店, Xinzhai 新砦 at Mixian 密县, and Dongxiafeng 东下冯 at Xixian 夏县, Shanxi.

The Erlitou bronze assemblage has a rich variety of small utilitarian tools, weapons, musical instruments, apparels, and ritual paraphernalia (Fig. 4). Moreover, casting site, fragments of crucibles, and pottery and stone molds were also found. The large number and diverse varieties of bronze objects, and the domination of bronze alloy in the metal industry suggest a certain degree of technological advancement. In particular, the appearance of bronze vessel is a threshold of the development of metallurgy. The Erlitou phase IV bronze assemblage includes high lead bronze that contains more than 20% of lead. It indicates that the people had gained considerable understanding of the characteristics of lead.

To date, the scholarly circle disagrees on how to assess the status of Erlitou Culture in the development of bronze metallurgy. Some argue that the bronze industry at this time contained certain primitive elements. They point out that the compositions of bronze alloy are inconsistent, the forms of the bronze objects are often imitations of that of the respective pottery and lithic artifacts, the technically challenged bronze ritual vessels were only seen in the late phase in only one central place site. They maintain that the Erlitou Culture had yet to reach the developed phase of Bronze Age. On the contrary, some argue that the Erlitou bronze industry had already reached a certain high production standard. The tin-bronzes of the early and middle phases and the lead-tin-bronzes of the late phase of Erlitou Culture represent significant achievements in bronze metallurgy. The alloy composition of bronze technology took its basic form during the Erlitou cultural phase. It laid the foundation for the highly developed bronze civilization of the Shang. The appearance of ritual paraphernalia was most-telling milestone development of the bronze metallurgy of Erlitou Culture. The bronze paraphernalia assemblage has more than 20 ritual artifacts that include vessels in the forms of *jue* 爵, *jia* 斝, *he* 盉 band *ding* 鼎. Traces on the vessel walls suggest that the vessels were made with piece mold method, and some simple patterns were used to decorate the vessels. Yet, we must also consider that all the bronze vessels were recovered from Erlitou phases III and IV. Their thin walls and simple decorations suggest their primitive characteristics.

Many colleagues have noticed that the bronze metallurgy of Erlitou show distinctive temporal differences.

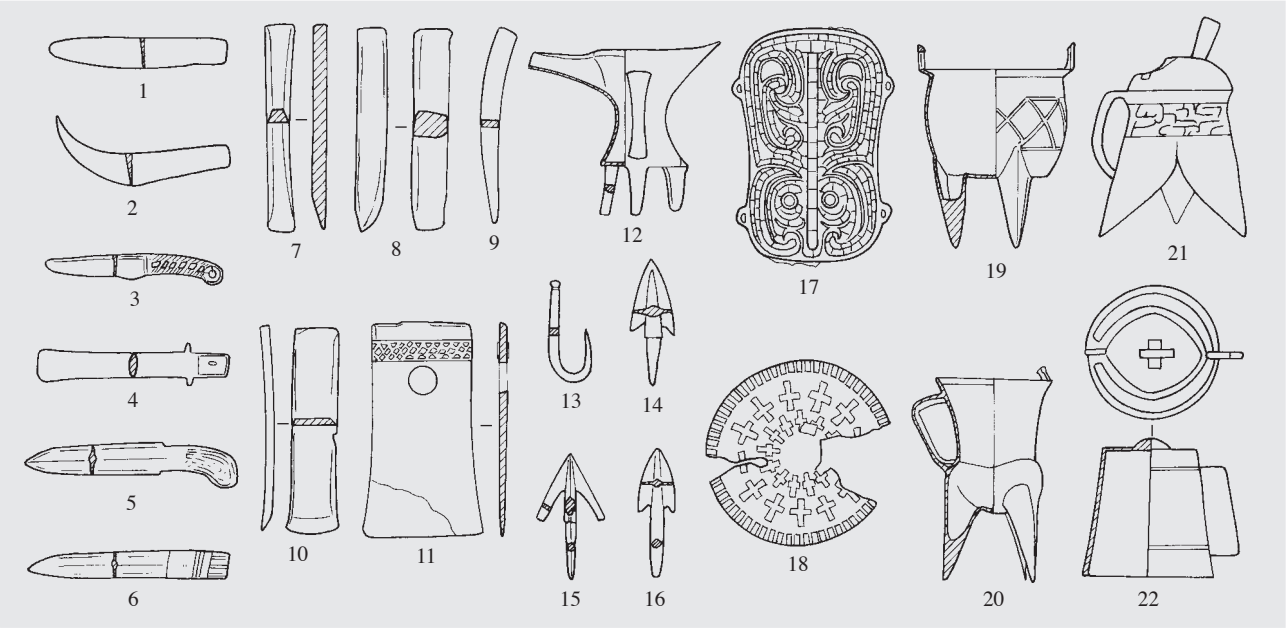

Fig. 4 Bronze artifacts from Erlitou site

1, 2. knives 3. knife with a ring-shaped handle 4. *qi*-scepter 5, 6. *ge*-halberds 7. chisel 8, 10. adzes 9. awl 11. *yue*-axe 12. *jue*-tripod 13. fishing hook 14–16. arrowheads 17. plaque with beast pattern 18. round plaque with cross pattern 19. *ding*-tripod 20. *jia*-tripod 21. *he*-tripod 22. bell

For instance, the bronze assemblage of Erlitou phases I and II comprises of small utilization tools and weapons; wherein weapons of more complex morphologies, apparels and ritual paraphernalia made their appearance in phase III. These features reflect that the bronze industry of phase III experienced a rapid progress. In addition, the Erlitou times also exhibited distinctive regional difference. Other than the type site at Erlitou, bronze industries of the other Erlitou cultural sites were comparatively under-developed. Perhaps this difference indicates that the bronze industry as an important part of the handicraft department had been monopolized by the state (the Xia Dynasty). This was an inevitable consequence after the emergence of state polity.

II. Regional Traditions and Development of Early Bronze Metallurgy

The Central Plain and the Northwest had different cultural traditions, modes of economy and technological systems. The spaces they occupied differentially interacted with and influenced by the neighboring archaeological cultures. Consequently, their metallurgies followed different paths of development. These differences expressed in the following ways:

1. Variety of products

Overall, early bronze products comprised mainly of small weapons, utilitarian tools and apparels. The unique cultural traditions and modes of economy of the human groups occupying different geographic zones were expressed in the bronze artifacts. The early bronzes recovered from the region of Yili River and the periphery of Dzungaria Basin are similar to those found in Central Asia and southern Siberia (Fig. 5). Moreover, the groups made and used these bronze artifacts engaged in a subsistence comprised mainly of animal herding. The bronze assemblage of Yanbulake Culture distributed in Hami and the North Tianshan Route bear the distinctive stamp of northwestern Xinjiang. On the one hand, it indicates that these groups had close connection during the early Bronze Age. On the other hand, it implies that they shared some features in subsistence practice. Similarly, the Chawuhu Culture of the mid- section of Tianshan Mountain Ranges had strong cultural traits of pastoralism. The distribution of Siba Culture is contagious to eastern Xinjiang. The Siba bronzes are similar to the bronzes recovered from the burials distributed along the North Tianshan Route, which include consistence in the composition of bronze alloy. The Siba Culture exhibits a

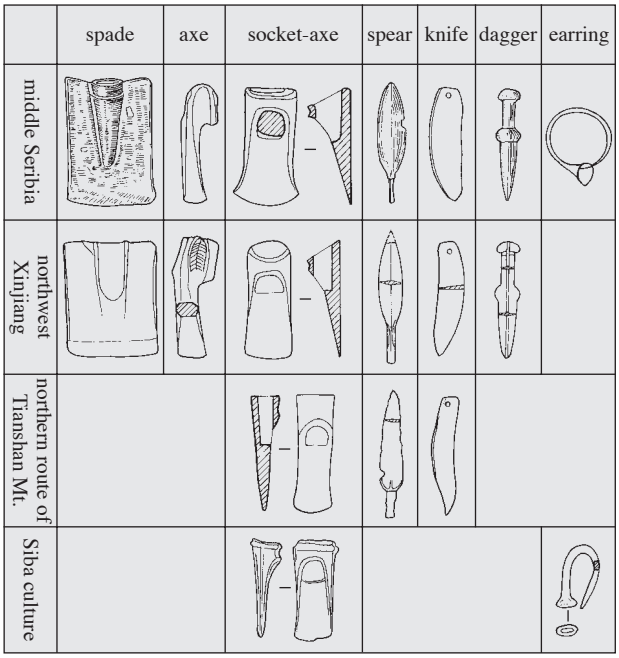

Fig. 5 Comparison of the bronze artifacts between Hexi Corridor, Xinjiang and foreign lands

mixed subsistence of farming and pastoralism. We can therefore infer that the subsistence of the human group using the graveyards of the North Tianshan Route is likely similar to that of the Siba Culture.

In the He-Huang region, the Majiayao Culture and Machang Culture yielded only a few examples of copper and bronze artifacts, and all of them are small utilitarian tools. Although the bronze assemblage of Qijia Culture increased in size, the richness of the assemblage, like Majiayao and Machang, was still low and limited to small utilitarian tools. Qijia Culture was mainly subsisted by farming; however, the groups living in the western distribution of Qijia Culture and higher altitude should have practiced pastoralism. Intriguingly, all the presently known bronze-yielding sites are located in the western portion of the Qijia distribution.

The bronzes of the Central Plain and the bronzes of the Northwest are distinctive in both form and type. This difference was first seen in the late Longshan phase, and became more distinctive during the early Erlitou phase. For instance, small bronzes commonly seen in the Central Plain include arrowheads, knives, fish hooks, axes, adzes, chisels, halberds, battleaxes, bracelets, plaques, etc. Bronze artifacts commonly seen in the Northwest, such as earrings, finger rings, mirrors, bulbs, beads, cylinders, buckles, etc., were rare in the Central Plain. This difference suggests that the two regions followed distinctive cultural traditions. During the late Erlitou

phase, the advancement of metallurgic technology gave rise to bronze ritual paraphernalia. From then on, the divergence between the bronzes of the two regions broadened. The fundamental factor attributing to this difference was that the groups residing in the Central Plain were mainly supported by agriculture, which was in stark contrast to the mixed subsistence and pastoralism traditionally practiced by the northwestern groups. This difference further affected the life ways of the people living in different geographic zones and expressed in the forms and types of the bronzes.

2. Alloy technology

The metallurgies of both the Central Plain and the Northwest went through a development from copper to alloyed bronze; but they were different in composing the alloy. The metallurgy of the Longshan–Erlitou cultural complex in the Central Plain and the Qijia Culture in the He-Huang region experienced a direct development from copper to tin-bronze. The Siba Culture distributed to the west of the Gansu Corridor and the Yanbulake Culture distributed along the North Tianshan Route in eastern Xinjiang experienced a development from copper to arsenic-bronze, then to tin-bronze. The early metallurgy distributed along the Yili River and in the periphery of the Dzungaria Basin seems to follow the latter path.

3. Cast technology

The inventions of metal casting synchronized with the use of casting mold. In many regions of the world, the initial phase of metal casting commonly chose stone materials that are low in hardness, easy to chisel and highly resistant to heat to make the molds. This technological tradition continued for a long time. The metal-casting industry in China should have begun with the use of stone mold. This technology co-existed with the forging technology for a long period. The co-existence of two technologies is most obvious in northwestern China. Because the majority of their bronze products comprised a variety of small implements, weapons and apparels, stone molds and forging could have satisfactorily met the demand. During the late Longshan phase in the Central Plain, it is not entirely clear what kinds of molds were used in bronze casting. However, there are indications that stone molds were used. This tradition was most likely continued until the early Erlitou phase, when clay (pottery) molds appeared at about phase II of the Erlitou Culture. This innovation stimulated and readily raised the technological standard of metallurgy in the Central Plain. The new technology, to a large extend, was introduced to meet the demand of ritual bronzes of the upper social echelon.

4. Regional interaction

In the first half of the 2nd millennium BC, there existed two cultural spheres of metallurgy in modern day China. Their formations were inseparable with cultural interactions between regions. Because of geographical proximity, the Xinjiang region has a long history of cultural communications with Central Asia, and Altai and southern Siberia of Russia. Their relationship can be monitored in the similarities of the cultural remains unearthed in both regions. Simultaneously, there also existed intensive cultural interactions among the various areas within the bounds of modern Xinjiang region. For instances, the deer head knives popular in the Ordos were found in area around Hami; the bronze plaques of the Xiongnu 匈奴 (Hun) Culture were found in Mulei 木垒 and other localities. The recovery of exotic bronze artifacts in Xinjiang suggests that during the 2nd and 1st millennium BC eastern Xinjiang played a significant role in the cultural communications between the West and the East. The early bronzes of northwestern Xinjiang bore unmistakable characteristics of the Andronovo Culture. These elements, to a certain extent, impacted the bronze industry of eastern Xinjiang, and reached as far east as the Gansu Corridor and He-Huang region.

Qijia Culture was the last ripple of the north-westward diffusion of the Central Plains cultures. As Qijia Culture finally settled down in the He-Huang region, it became inevitable that Qijia Culture played an intermediate role in the East-West cultural interactions of the time. Its geographic location facilitated it to act on both the east (Central Plain) and the west (Gansu Corridor). Material remains of Erlitou style, such as pottery *he*-vessel with sealed mouth and bronze beast-faced plaques, had been unearthed from multiple sites of the Qijia Culture. We should not under-estimate the intensity of cultural influence of Erlitou to the western territories. In the process of cultural interaction, it is expected that Erlitou must have obtained cultural vitality from the cultures of the western region, such as metallurgy.

III. Diffusion and Interaction of Early Bronze Metallurgy Between the East and the West

Scholars of metallurgy cannot agree on the relationship between the metallurgy of China and the metallurgy of other parts of the world. Yan Wenming 严文明 argued that there existed distinctive difference in the form and

type of the bronze artifacts of western Gansu and Erlitou Culture. An Zhimin 安志敏 further pointed out that:

> "The current archaeological findings indicate that the bronze industry of China appeared at a comparative late time. It was about 4,000 years ago, during the Longshan Culture, bronzes first appeared in China. After a series of developments, based on the technological foundation of Erlitou Culture, the unique Shang-Zhou civilization eventually took its form in the Central Plain. How early metallurgy began is still an unsolved question. However, the beginning of bronze industry in China was most likely diffused from the west via the prehistoric 'Silk Route'. For instance, in spite of peripherally located in the Northwest, the early bronze industry of Qijia Culture was richer than that of the Central Plain. It is likely that Qijia Culture had early contact with bronze-using groups, and it also influenced the Longshan Culture."

American scholar Louisa G. Fitzgerald-Huber argued that the bronze civilization of Erlitou perhaps was related to the eastward diffusion of Bactrian metallurgy. In this process, people of the Seima–Turbino, Okunevo and Andronovo cultures–nomadic pastoral groups active in Central Asia and Siberia–might have played important intermediate roles. These several branches of bronze cultures of the Euro-Asian steppes gradually entered Xinjiang. Followed the Gansu Corridor, they made contact and impacted Qijia Culture in the He-Huang region. Finally through Qijia Culture, they exerted influence to the Erlitou Culture in the Central Plains. Recently Lin Yun 林沄 pointed out that the assemblage of early bronzes of trumpet-shaped earrings and composite cylindrical adzes with socket was an expression of cultural diffusion of Central Asia to northern China through Xinjiang.

We maintain that the beginning of metallurgy in China should be examined in the greater context of Euro-Asia; only such a strategy can generate unbiased perspectives on the early bronze metallurgy of China.

Archaeological evidences have demonstrated that the Near East and its neighboring area were the geographic region where metallurgy first emerged. In 1973, Theodore A. Wertime compiled an inventory of the early metal implements found in the Near East. The earliest man-made metal products of the Near East dated to 7000 BC, and all of them were made of native copper. Between 6000 and 4000 BC, a small number of metallic remains were the products of casting. The earliest smelted metal appeared in about 4000 BC. The artifacts contain small amount of arsenic (0.3–3.7%), and they show evidences of technological procedures of super-cooling and annealing after casting.

Arsenic-bronze is the first bi-element alloy ever made by the human kinds. It is a landmark in the history of metallurgy. In about 4000 BC, arsenic-bronze emerged and spread widely in the Anatolia Plateau. It then diffused to southeastern Europe, the Caucasus and Central Asia. In the first half of the 2nd millennium BC, a center of arsenic-bronzes emerged in the Ural area and continued its eastward diffusion. This discovery is particular important in the study of the beginning of arsenic-bronze in western China. To conclude, both cooper and arsenic-bronze were first emerged in and diffused from the Near East and its neighboring regions. Moreover, arsenic-bronzes are also seen in the Indus Valley; the Karsuk Culture in southern Siberia of Russia was still using arsenic-bronzes during the late Bronze Age. In fact, arsenic-bronze was widely distributed in the Euro-Asian steppes and continued to be in use for a long span of time.

Northwest China is, in a broad sense, a part of Central Asia. The modes of subsistence and cultural properties of the two regions share certain characteristics. In about 5,000 years ago, the cultural interaction between the two regions gradually intensified, which included the communications of metallurgy. Northwest China was not a passive receiver of the metallurgy of Central Asia. It modified the technology and finally formed its unique features. Over the vast country of northwestern Xinjiang, eastern Xinjiang, Gansu Corridor, and He-Huang region, the form and type of early bronzes were always in a stage of subtle changes. This foreign influence of metallurgy drifted across a vast space, being filtered and modified, was considerably weakened when it finally reached the Central Plains.

The emergence of metallurgy in the Central Plains and the formation of a unique technological style eventually completed during the late phase of Erlitou Culture.

Note: The original paper, published in *Kaogu Xuebao* 考古学报 2005.3: 239–278, with 17 illustrations and three tables, is written by Li Shuicheng 李水城. This summary is prepared by the original author and English-translated by Lee Yun-Kuen 李润权.