



Typology, Technology, and Social Function of Nomadic Bronze Knives in the Eurasian Steppe

Gandige, Ts. Batsaikhan*

Department of Food, Light Industry and Design, Mongolian University of Science and Technology, Ulaanbaatar 17010, Mongolia.

How to cite this paper: Gandige, Ts. Batsaikhan. (2026) Typology, Technology, and Social Function of Nomadic Bronze Knives in the Eurasian Steppe. *Journal of Humanities, Arts and Social Science*, 10(5), 577-583.

DOI: 10.26855/jhass.2026.05.012

Received: March 24, 2026

Accepted: April 27, 2026

Published: May 29, 2026

***Corresponding author:** Ts. Batsaikhan, Department of Food, Light Industry and Design, Mongolian University of Science and Technology, Ulaanbaatar 17010, Mongolia.

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Abstract

This study takes the bronze knife of the Eurasian grassland as the research object and explores the relationship between technological dissemination, artifact function, and identity symbolism in early nomadic society. Relying on the archaeological materials of South Siberia, the Mongolian Plateau, and northern China, the research sorts out the evolution of knives from stone and bone shapes to metal shapes, and clarifies the role of the Seima-Turbino metallurgical tradition in the standardization process of grassland bronze knife shape. The study divides bronze knives into twelve categories, including straight-backed short knives, arc-backed long knives, ring-headed knives, and beast-headed decorative knives. With the help of this type classification, analyze the functional evolution of the bronze knife from a practical tool to a ceremonial tool and identity sign. In terms of production technology, grassland bronze craftsmen adopt double casting, tin bronze alloy smelting, and composite tool holder assembly technology. These process choices are doubly affected by local resource conditions and cross-regional metallurgical technology exchanges and dissemination. The spatial distribution of bronze knives shows that its spread shows stage characteristics: starting from the core region of West Siberia, it gradually spreads eastward to the Mongolian Plateau and northern China, and forms many regional variants in the process. The ceremonial bronze knives unearthed in high-level tombs show that such artifacts have gone beyond the scope of daily use and become material symbols that highlight the identity of the elite class and maintain ethnic identity. There is a continuation of the form between the bronze knife and the iron knife of the early Iron Age, which further confirms the inheritance of the grassland knife tradition.

Keywords

Bronze knife; Eurasian Steppe; mould casting; bronze metallurgy; technological transmission

1. Bronze Metallurgy in the Eurasian Steppe and the Emergence of Nomadic Knives

The appearance of bronze knives in ancient nomadic groups should be investigated in the context of the development of bronze metallurgical technology in the Eurasian grassland. Archaeological evidence shows that from the third century BC to the early 2000s BC, metallurgical technology spread in the vast grassland. One of the important archaeological phenomena is the Seima-Turbino cross-cultural phenomenon, roughly dating from 2200 BC to 1900 BC. The distribution range of cultural relics extends from Eastern Europe to the Mongolian Plateau and Northeast Asia. The excavated artifacts include a batch of bronze weapons and tools with fixed shape (Novkorodova, 1989; Yang et al., 2015).

Seima-Turbino cultural relics include bronze spears, axes, short swords, and knives. These objects show that metal tools and weapons have become an integral part of the material equipment of early grassland society. Many studies believe that this craft tradition may have originated in the Altai region and spread through population migration and cross-regional cultural exchanges in the northern grasslands of Eurasia (Эрэнэ-Очир & Худяков, 2016; Yang et al., 2015).

In terms of process technology, the metal craftsmen of Seima-Turbino adopt casting processes such as hollow casting and lost wax casting. With the help of these techniques, they can make bronze weapons and tools with relatively regular shapes and perfect functions (*Sinology - Eurasian Theory Series*).

In this metallurgical context, bronze knives were adopted by steppe nomadic groups as practical metal implements and gradually became part of their production and daily-life activities.

2. Origin and Early Forms of Nomadic Bronze (Knives Third-Second Millennium BCE)

2.1 Transition from Stone and Bone Knives to Metal Knives

Bronze knives did not appear as an isolated technological invention. They developed from earlier cutting-tool traditions in which stone and bone knives were already widely used across the Eurasian steppe during the late Neolithic and Chalcolithic periods (Цэвээндорж, 2014; 2020). These earlier tools commonly had a single-edged blade, a straight or slightly curved back, and a tang or inserted-handle structure.

After the bronze smelting technology was introduced, this kind of shape and characteristics were used in metal utensils. Many early bronze knives still retain the shape characteristics of stone knives and bone knives: the body of the knife is usually short, with a single-sided blade, and it is connected to the handle through an inserted handle. Therefore, the early development of bronze knives reflects the transition of tool production from stone and bone materials to metal materials, rather than the complete interruption of the production tradition.

2.2 Early Bronze Knives in the Seima-Turbino System

The bronze knife unearthed from the Seima-Turbino cultural relics is one of the earliest metal knives known in the Eurasian grassland. The main characteristics of this kind of knife are a narrow blade, a single blade, a moderate length of the knife body, and a simple handle style. In the burial remains, bronze knives are often unearthed together with spearheads, axes, and other weapons. The background of this excavation shows that they are both practical cutting tools and, in some cases, used as weapons.

The Seima-Turbino culture influenced the spread and evolution of bronze weapons and tools in many parts of Eurasia. Later cultures are not simply copied from the knife shape, but will also be improved according to local technological conditions and usage scenarios.

3. Development of Knives in the Middle Bronze Age (Mid-second millennium BCE)

3.1 Cultural Systems of Southern Siberia and the Mongolian Steppe

By the middle of the second millennium BC, a number of Bronze Age cultural groups had been formed on the Eurasian grassland, including the Yerunino culture, the Krotovo culture, and the Andronovo culture. These ethnic groups take animal husbandry production and early nomadic economy as the main production mode. Archaeological relics such as bronze knives, bronze spearheads, and bronze casting molds have been unearthed in the Yerunino cultural site, indicating that the bronze smelting in the region has developed to a stage of scale and standardization.

During this period, bronze knives were more closely related to actual production activities, mainly used for slaughtering livestock, cutting leather, and carpentry. With the development of the nomadic economy, knives have gradually become common daily utensils in grassland society.

3.2 Bronze Knives on the Mongolian Plateau

In the remains of the Bronze Age on the Mongolian Plateau, several tin bronze knives dating from about 2000 BC to 1800 BC have been unearthed, some of which are related to the culture of Menghe Hairi Khan. According to the study, these bronze knives are related to the Seima-Turbino technical system of West Siberia. The dissemination of this technology may be realized through cultural exchanges between the Mongolian Plateau and northern China

(Novgorodova, 1989; ЦЭВЭЭНДОРЖ, 2014).

During this period, the shape of the bronze knife has changed: the body of the knife has become longer, the tip is sharper, and the blade is more polished. These changes show that knives are developing in the direction of both tools and weapons.

4. Maturation of Bronze Age Knives (First millennium BCE)

4.1 Karasuk Culture and the Steppe Weapon System

The period of the Karasuk culture is about 1500 BC to 800 BC, which is an important stage in the development of the bronze weapon system of the Eurasian grassland. The bronze knife in this period has the characteristics of a longer blade, a larger arc on the back of the knife, and a more complex structure of the handle. There is also a clearer functional distinction between the knife and the short sword (Sun, 2000; Yang et al., 2015).

The late Karasuk bronze knife form is considered to be one of the sources of the later Scythian weapon form. Therefore, they form the background foundation of the grassland weapon system in the early millennium BC at the technical and formal levels.

4.2 Knives in the Bronze Cultures of Northern China

In northern China, bronze knives occur widely in several archaeological cultures, including the Lower Xiajiadian culture, Upper Xiajiadian culture, and Ordos bronze culture. These cultural systems had close contact with Eurasian steppe groups. In northeast China, the Liaoning bronze dagger culture shows a more developed bronze weapon tradition. Its most representative artifact is the lute-shaped bronze sword, mainly distributed in Liaoning and the northern Korean Peninsula (Sun, 2000; Tian & Guo, 1986).

At this stage, bronze knives were no longer the most representative weapon type. They continued, however, to function as important daily tools.

The production of bronze knives involved a complete metallurgical process. It can be described through four main stages: raw material acquisition, smelting, casting, and handle assembly.

5. Manufacturing Technology of Bronze Knives

5.1 Raw Material Procurement and Interregional Supply Networks

Copper and tin are needed to make bronze knives. These raw materials are usually taken from specific mineral-producing areas and flow to grassland ethnic groups through interregional trade. Archaeological evidence, such as non-local ores and semi-finished ingots unearthed in many grassland sites, shows that the regional supply network ensures the circulation of metallurgical raw materials (Yang et al., 2015).

5.2 Bronze Smelting and Alloying

Bronze smelting mainly includes two core processes: melting copper ore and combining copper and tin into alloys. Usually, 10%-20% tin is added to copper, which can improve the hardness, reduce the melting point, and improve the fluidity of the molten liquid. These characteristics make the alloy more suitable for casting tools and other small metal objects that need to be finely shaped.

5.3 Mould Casting

Grassland bronze knives are mainly cast by the standard casting method, and the common process is divided into single-sided mud model casting and double-sided model casting. The double-fold model can better control the shape of the object and make the blade thickness more uniform. After the casting is completed, the blade is usually forged and polished to process the blade that meets the requirements of use.

5.4 Handle Production and Assembly

Bronze knives often used a composite structure. The blade was cast in bronze, while the handle was made from wood, bone, or animal horn. Two main joining methods were used: tang insertion, in which the tang was fitted into the handle, and riveting, in which rivets fixed the blade and handle together. This composite construction was common

in Eurasian steppe bronze knives and reflects a repeated technical solution for combining metal blades with organic handles.

6. Typological System of Steppe Bronze Knives

Bronze knives from Eurasian steppe contexts can be classified using observable morphological variables, including blade-back profile, cutting-edge profile, point shape, hafting structure, and decorative treatment. Based on finds from southern Siberia, the Mongolian Plateau, and northern China, twelve basic types can be identified, as summarized in Table 1 (Эрэнэ-Очир & Худяков, 2016; Inner Mongolia Institute of Cultural Relics and Archaeology, 2000; Sun, 2000; Tian & Guo, 1986).

Table 1. Typological classification of bronze knives associated with Eurasian steppe nomadic contexts

Type	Main morphological features	Chronology	Main distribution	Main function
Straight-backed short knife	Straight back, slightly curved edge, short body, usually 15-20 cm	Early Bronze Age, around 2000 BCE	Southern Siberia and the Altai region	Daily production tool
Slightly curved-backed knife	Slightly curved back and more curved cutting edge	Early to Middle Bronze Age	Mongolian Plateau and southern Siberia	Cutting tool
Broad-bladed knife	Broad blade and relatively blunt point	Middle Bronze Age	Mongolian Plateau	Butchering tool
Narrow long knife	Long and narrow blade, sharp point, blade length over 25 cm	Middle to Late Bronze Age	Karasuk culture and Upper Xiajiadian culture	Tool and weapon
Curved-backed long knife	Distinctly curved back and up-turned point	Middle to Late Bronze Age	Northern Chinese steppe zone	Leather processing
Grooved-blade knife	Shallow groove on the blade surface	Late Bronze Age	Various parts of the Eurasian steppe	Weight reduction and structural reinforcement
Riveted-hilt knife	Handle fixed to the blade by rivets	Middle to Late Bronze Age	Broadly distributed	Practical tool
Tanged knife	Handle inserted into or attached to the blade tang; the most common structure	All periods	Various parts of the Eurasian steppe	General-purpose tool
Ring-pommel knife	Ring-shaped terminal at the end of the handle	Late Bronze Age	Eurasian steppe	Tool and weapon
Animal-pommel knife	Handle terminal decorated with animal forms, such as deer, sheep, or wolves	Late Bronze Age	Ordos region and Scythian cultural zone	Funerary or ritual object
Knife-sword transitional form	Broad blade, sharp point, double-edged or nearly double-edged structure	Late Bronze Age	Southern Siberia and northern China	Weapon
Ceremonial decorated knife	Limited edge wear and dense decorative elements	Late Bronze Age	High-status burials	Status object

This typology shows a general shift in form and use. In the Early Bronze Age, straight-backed short knives and slightly curved-backed knives were mainly practical tools. During the Middle Bronze Age, blades became longer, and some forms acquired both utilitarian and weapon-related functions. In the Late Bronze Age, decorated forms became more common. Animal-pommel knives and ceremonially decorated knives indicate that some bronze knives were used not only as tools or weapons but also as objects related to burial practice, ritual display, and social status (Lu, 2021; Tian & Guo, 1986).

7. Regional Distribution and Transmission Routes of Bronze Knives in the Eurasian Steppe

7.1 Regional Distribution Pattern

Based on the available archaeological evidence, the distribution of bronze knives in the Eurasian steppe can be divided into three main zones.

The first zone is the western metallurgical core, including the Altai region and southern Siberia. Bronze knives in this area appeared relatively early. Their forms are generally simple, and their functions appear to be mainly practical.

The second zone is the central transmission area, including the Mongolian Plateau and the Lake Baikal region. This area served as a major corridor for the eastward movement of bronze metallurgical technology. Knife forms in this zone show mixed features, with both western and eastern technical elements.

The third zone is the eastern development area, including the northern steppe of China and western Liaoning. Bronze knives in this area show greater morphological variation and more decorative treatment. Local typological systems were gradually formed in regions such as Ordos and western Liaoning (Inner Mongolia Institute of Cultural Relics and Archaeology, 2000; Lu, 2021; Tian & Guo, 1986).

7.2 Model of Technological Transmission

The archaeological evidence suggests that the transmission of bronze-knife technology followed three main stages.

In the first stage, metallurgical technology spread from the West Siberian Metallurgical Belt to the Altai region. This process promoted the formation of the early bronze metallurgical technology system in the Eurasian grassland.

In the second stage, this technology spread from the Altai region to the Mongolian plateau. After that, the bronze knife was introduced to the eastern grassland and improved in its blending with local cultural traditions.

In the third stage, the technology spread further from the Mongolian plateau to the grasslands in northern China. This process contributed to the formation of a bronze cultural system with distinct regional characteristics, including the bronze culture in Ordos and Liaoxi.

This transmission path is basically consistent with the general trend of bronze metallurgy spreading eastward in the Eurasian grassland as a whole. Relevant evidence shows that the grassland is the communication channel connecting the technological traditions of the East and the West (Novgorodova, 1989; Yang et al., 2015).

8. Social Functions and Cultural Meanings of Bronze Knives

8.1 Function as Production Tools

In nomadic societies, bronze knives are mainly used as production tools. The cutting marks on animal skeletons unearthed in archaeological sites, as well as the slaughtering utensils found together, indicate that bronze knives were used to slaughter livestock. Bronze knives are also used in leather processing, including making clothes, tents, and harnesses. In addition, they are also used to make and maintain riding and shooting equipment, such as bows, arrows, and saddles. These uses show that bronze knives are an integral part of the basic tool system of nomadic production (Эрэнэ-Очир & Худяков, 2016; Цэвээндорж, 2014).

8.2 Function as Weapons

Some bronze knives, especially narrow-bladed long knives and forms transitional between knives and swords, had combat functions. In nomadic military contexts, they were used together with short swords. The functional distinction between knives and short swords in the late Bronze Age indicates a degree of specialization in the weapon system of nomadic groups (Эрэнэ-Очир & Худяков, 2016; Sun, 2000).

8.3 Symbolic Function in Social Identity

Bronze knives and short swords are unearthed in some high-grade tombs as burial goods, and often appear with harnesses and accessories. Bronze knives decorated with animal patterns are particularly typical in this regard. Its shape is related to the art of Scythian animal pattern, which shows that the bronze knife integrates the material system and symbol system of grassland nomadic culture, and is one of the carriers for the nobles to show their identity (Lu, 2021; Tian & Guo, 1986; Цэвээндорж, 2020).

9. Transition from Bronze Knives to Nomadic Knives of the Iron Age

After the middle of the millennium BC, iron smelting technology was more widely used in the Eurasian grasslands, and the region gradually entered the Iron Age. Compared with bronze, iron has higher hardness, iron ore resources are easier to obtain, and the production cost is lower. Affected by these factors, iron knives have replaced bronze knives and become common production tools.

The early iron knife did not completely break away from the tradition of bronze knives. Its shape retains many structural features of the bronze knife, including a single-edged blade body, an arc blade back, and a handle structure with a core embedded. This continuity shows that the bronze knife is only replaced by an iron knife in terms of material, and its design concept has not changed immediately. The production experience and usage of bronze knives continued to affect the shape of nomadic knives in the early Iron Age (Sun, 2000).

10. Conclusion

The bronze knives unearthed in the Eurasian grassland provide an archaeological basis for the study of the technical practice, livelihood mode, and social identity of early nomadic society. This study integrates archaeological materials from South Siberia, the Mongolian Plateau, and northern China, and explores the origin, technological evolution, type sequence, spatial distribution, and social functions of grassland bronze knives from the 3rd millennium BC to the 1st millennium BC. The main research conclusions are as follows.

First of all, bronze knives were developed from the early stone knives and bone knives by drawing on metal processing technology. The Seima-Turbino metallurgical culture provides it with early styling styles and production processes. The characteristics of a single-edged blade body, handle-type handle structure, and other characteristics have been continued for a long time, and have become stable shape elements in knife production in grassland areas (Novgorodova, 1989; ЦЭВЭЭНДОРЖ, 2014).

Secondly, the development of the typology of grassland bronze knives shows obvious age changes. The early tools were mainly practical tools, including straight-backed short knives and micro-arc-backed knives. In the mid-term stage, the length of the knife body increases, the functional differentiation is more prominent, and the bronze knife is both used both as a tool and a weapon. In the late stage, the characteristics of decoration and ceremonial utensils became more and more prominent. The bronze knife with the head of the beast unearthed in high-level tombs shows that such artifacts have been incorporated into the social classification and identification system. Based on this, this study establishes a set of twelve types of sequences to provide a basis for subsequent comparative research.

Third, the evidence of manufacturing technology reveals how grassland metal craftsmen choose and combine various production technologies. The double-shell casting, tin bronze alloy smelting, and composite shank assembly processes are not only constrained by the conditions for the acquisition of local copper and tin mineral resources, but also benefit from the spread of cross-regional metallurgical technology. The relevant evidence of blade forging and polishing shows that craftsmen will use cold processing technology after casting to optimize the blade shape and improve its cutting performance.

Fourth, the spatial distribution of bronze knives is in line with the broader cultural exchange pattern of the Eurasian grassland. The spread of bronze knives from West Siberia to the Altai region, the Mongolian Plateau, and northern China has gone through several stages. This process is not a simple copy of mature crafts. Ethnic groups from all over the world have localized and transformed the introduced forms and production processes, and finally formed regional types with their own characteristics (Inner Mongolia Institute of Cultural Relics and Archaeology, 2000; Yang et al., 2015).

Fifth, the bronze knife has multiple social functions. As tools, they are material utensils produced by nomads; as weapons, they participate in grassland military activities and are used with short swords; as identity symbols, they are buried in tombs and often decorated with patterns to highlight the identity of the upper class. These functions are not replaced in linear order, but often overlap with each other, which shows that bronze knives play a flexible and changeable role in the grassland society.

Sixth, the transformation from bronze knife to iron knife reflects the continuity of technical tradition. The early iron knife retained many shape characteristics of the bronze knife. This shows that the replacement of materials did not immediately change the knowledge and usage habits of the production process. This process can be summarized as form continuation and material renewal, reflecting that a nomadic society is both conservative and adaptable in technical selection (Peng, 2012; Sun, 2000).

In general, the bronze knife of the Eurasian grassland is an important physical evidence for the study of the technical system and social identity of early nomadic ethnic groups. There are still certain limitations in this study: the typological judgment standards need to be further standardized, the distribution of scientific analysis data is uneven, and the proposed dissemination mode also needs to be further verified. Subsequent research should introduce means such as metallological analysis, trace use trace research, and isotope traceability analysis, so as to promote the research and discussion from the description level of objects to the level of explaining the testable social and historical process.

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