

On the two traditions of the bronze mirror casting techniques in East Asia

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Abstract

In East Asia, the technique of casting bronze mirrors with stone molds first emerged in present-day Gansu-Qinghai area at the upper reaches of the Yellow River no later than the beginning of the 2nd millennium BCE. Since then, this technique diffused eastward along the zone on both sides of the later Great Wall into Northeast China, Korean Peninsula and Kyushu region in present-day Japan and formed the tradition of stone mold-casting technique of bronze mirrors. In Japan, this technique lasted to the 3rd century CE. The technique of casting bronze mirrors with pottery molds emerged around the 9th century BCE in the core area of the domain of the Western Zhou Dynasty, i.e. the Shaanxi Plain, the western Henan and southern Shanxi Provinces, and got mature at least in the end of the 3rd century BCE, which was the turn of the Qin and Han Dynasties; after that, this technique quickly spread to Northeast China, Korean Peninsula, and diffused into Japan Archipelago and finally ended East Asia's tradition of stone mold-casting technique of bronze mirrors at the beginning of the 3rd century CE.

Keywords: bronze mirrors—East Asia—molds; foundries—history—China, Korea and Japan.

Introduction

As a daily utensil, bronze mirror has long history in East Asia. The researches on the ancient bronze mirrors are not limited in the types, the decorative patterns and inscriptions on the mirror backs but including the manufacturing techniques especially the casting techniques. The research on the casting techniques is greatly important for the explorations to the origination, developments, evolutions and diffusions of bronze mirrors. Generally, the basic workflow of making bronze mirror is: making molds – casting – trimming and finishing. In this procedure, the key step is the making and using of casting molds. Based on this understanding, this paper discusses the technical traditions and their evolutions of the bronze mirror casting in ancient East Asia through the clarifying and analyzing to the archaeologically discovered mirror molds in this area.

The discoveries of pottery mirror molds and the pottery mold casting tradition

Pottery molds are the mirror molds made of clay and baked or burned, or sometimes not baked and burned, which are also called “clay molds”, “earthen molds” or “sand molds” and so on, and generally named “pottery mirror molds”. To date, no pottery mirror molds have been found in Korean Peninsula and the earliest pottery mirror molds found in Japan Archipelago were made in the later half of the 7th century CE, which is beyond the discussion scope of this paper; so for this topic, we only discuss the three cases found archaeologically so far in China.

1. The pottery mirror molds of the Eastern Zhou Period found in Houma, Shanxi

In 1960, four pieces of pottery mirror molds were found in Site II to the south of Niucun Ancient City Site (or the “Bronze Foundry Sites at Houma”). They were mirror back molds and not have been used for casting, and their dates were around 500 BCE. All of these pottery molds are made of clay tempered with fine sands and in similar shapes, but the details of the structures are somewhat different. The sample H85:1 has a pear-shaped outline with a slightly convex back; on its top, a trapezoidal gate is opened, and a triangular terrace in the middle separates the gate in half. The mold cavity is flat and bearing fine designs like hydra patterns. In the center of the mold cavity is a hole 2cm in length and 1.2cm in width which looks like the cavity of the mirror knob (Figure 1:1). The sample F13:16 has a circular outline with a flat and seemingly trimmed back; on its top, an inverted trapezoidal gate is opened. The mold cavity was flat and decorated with four circles of designs – cowry design, animal figure design, fish figure design and quatrefoil design – concentrically from the rim to the center (Figure 1:2). The sample F13:17 has similar shape and decorative designs to those of F13:16 but seems like a half-done product. The sample F13:64 is a fragment with grayish-white coating.

2. The pottery mirror mold of the Warring-States Period found in Xiadu (the Lower Capital) Site of the Yan State at Yixian County, Hebei Province

In 1958, the fragment of a pottery mirror mold was gathered in Xiadu Site of the Yan State at Yixian County. Its mold cavity about 9cm in diameter (Figure 2) bore four-*shan* 卍-character design. It is dated in the Warring-States Period. Three pottery molds bearing this type of designs in traditional collections were cataloged in *Yanku Cangjing* 岩窟藏镜 (*Mirror Collection in Antre*, by Liang Shangchun 梁上椿), all of which were said to be found

in Yixian County.

3. The pottery mirror molds of the Han Dynasty found in the Ancient City of the Qi State in Linzi District, Zibo County, Shandong Province

To date, 96 pieces of pottery mirror molds have been found in the Ancient City of the Qi State (Figure 3), and the systematic researches have been carried out since 1997.

The pottery mirror molds unearthed in Ancient Linzi City are all made of a kind of local fine sandy clay tempered with husk ash, making the mold body spongy, permeable and light. Clear lamination cannot be observed from the mold section, showing that the whole mold was made of the same material. The mold bodies were made by modeling and engraving methods, and usually both methods were used to make a single mold. After being trimmed and dried, the mold bodies were baked and burned in kilns, the temperature in which were about 800–850° C, and the finished molds were mostly in bluish-gray color, with some in light brown or orange colors. The surfaces of the mold cavities are fine and smooth, which must have been processed by coating with some kind of fine material. The outlines of the molds are usually in a trapezoidal shape with a curved bottom edge, or the shape of a gourd; the backs are usually convex like a bowl with irregularly sloping belly and a flat or irregular bottom, most of which had fingerprints, or traces of pressing, smearing and scraping, etc. These molds are in varying sizes, and can be classified as the face molds and back molds. The casting workflow could be restored roughly as the following: 1) atop the knob crater, the core of the knob hole is set and stuck with clay adhesive; 2) parting agent is brushed on the surfaces of the cavities of the mirror face and mirror back; 3) the molds are assembled; 4) the assembled molds are transversely tied to make them match closely, daub might be used to seal the gaps between the face and back molds in case the bronze liquid will leak through them; 5) the whole assemblage is heated again; 6) the casting is conducted.

The mirror molds found in Ancient Linzi City were all made in the early through the mid Western Han Dynasty, or around the 2nd century BCE.

In China, the pottery mold casting tradition appeared and formed at least around the Spring-and-Autumn and the Warring-States Periods, or the 5th century BCE; to the end of the Qin and the beginning of the Han Dynasties, this tradition had been fully developed and widely spread. The main features of pottery mold casting technique are: the mold body is made of local clay tempered with husk ash or other plant ashes, all of which are easy to find; the applying of modeling and engraving methods makes it easy to produce in large amounts; clay is easy to shape and favorable to cast bronze mirrors with delicate and complex designs; the molds have good permeability

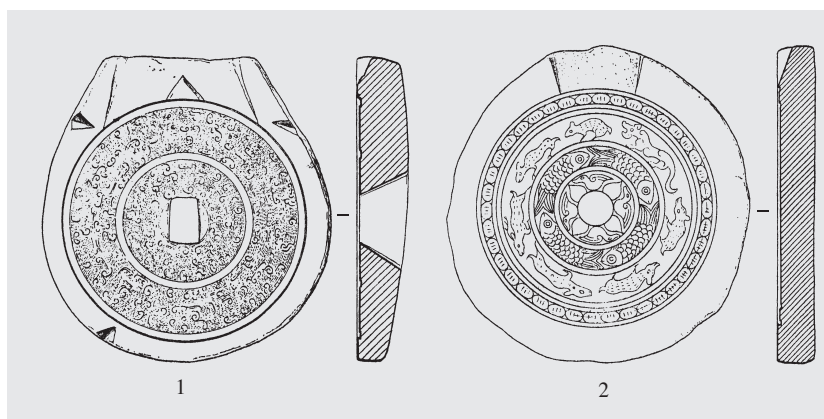


Figure 1 The Eastern Zhou pottery mirror molds unearthed in Houma, Shanxi.
1. H85:1 2. F13:16



Figure 2 The rubbing of the Warring-States pottery mirror mold gathered in Xiadu Site of the Yan State at Yixian County, Hebei.

and mold-filling capacity, both of which are good to the shaping of the mirror bodies and the designs; the making procedure is rather complicated and has high technical demands. The casting is easy to fail and the molds are easy to damage, but the products are usually exquisite with clear decorative designs.

The discoveries of stone mirror molds and the stone mold casting tradition

The stone mirror molds are those made of various stones, mainly quartz-feldspar porphyry, talc, fine sandstone, etc. The archaeologically discovered stone mirror molds are mostly distributed in northeast China, Korean Peninsula and Kyushu region of Japan Archipelago.

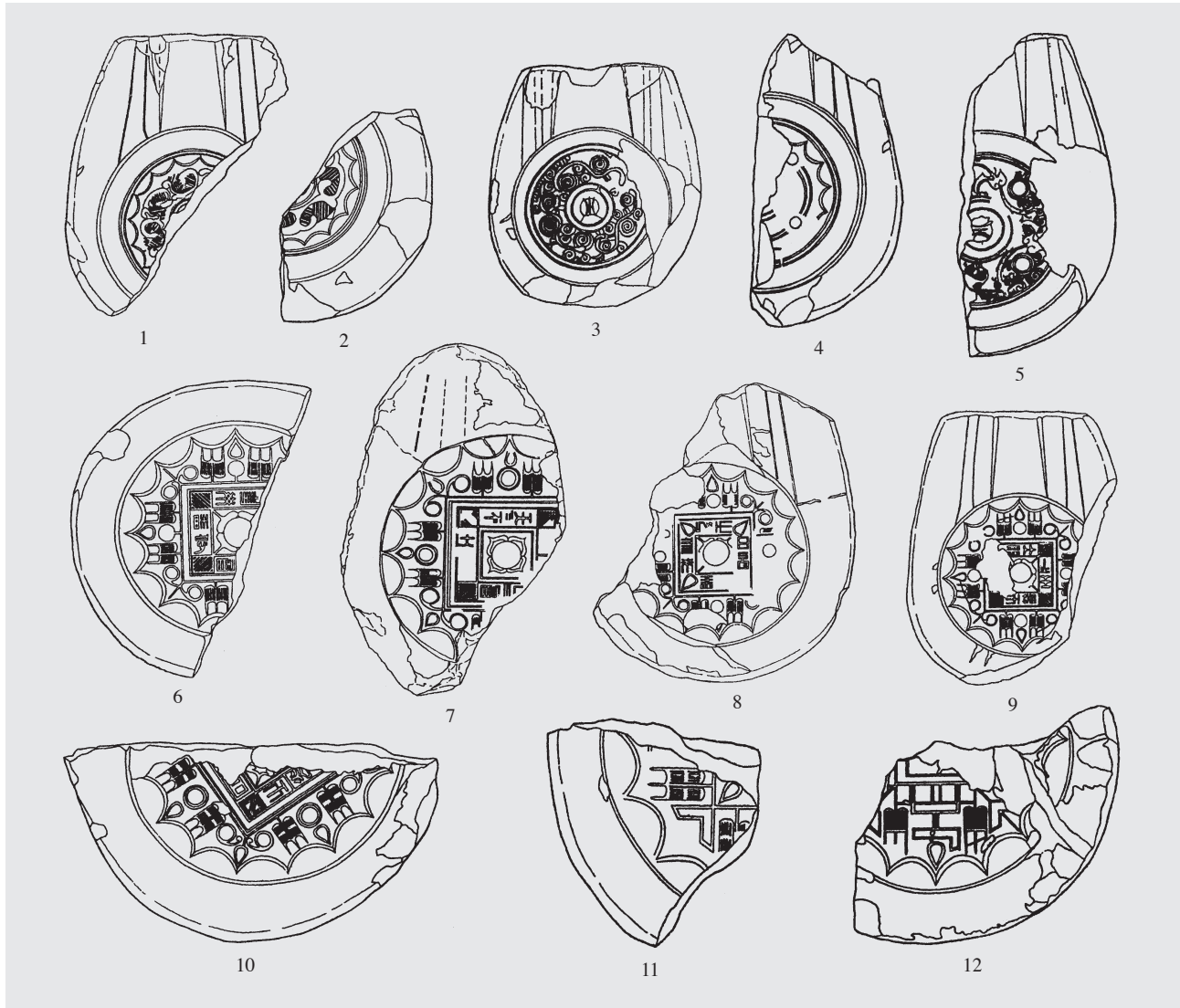


Figure 3 The Han pottery mirror molds unearthed from Ancient Linzi City in Shandong.

1–3. molds with interlaced hydra pattern (SLQJF:77, 29 and 22) 4. mold with four-nipple and concentric rings design (SLQJF:20) 5. mold with four-nipple and dragon design (SLQJF:19) 6–10. molds with grass-leaf pattern (SLQJF:18, traditional collection, SLQJF:13, 78 and 11) 11 and 12. molds with TLV and grass-leaf pattern (SLQJF:74 and 02)

1. The stone mirror molds found in Northeast China

Up to now, four stone mirror molds have been found in three localities, all of which are distributed in southern Jilin Province.

The stone mirror mold gathered at Nanshangang Site in Dongliao County is a fragment taking about one third of the original shape. The original mold would have been in a square shape with curved corners and made of soft stone (Figure 4:1). The top of the fragment has a part of the gate remained, the mold cavity was smooth and in black color; it was used to make multi-knobbed mirror with coarse geometric pattern.

The stone mirror mold gathered at Dajiashan 大架山 Site in Dongfeng County is made of talc and in square shape 15cm high and 14cm wide (Figure 4:4). The gate

is on the top of the obverse, the sprue between it and the mold cavity is short; the mold cavity is in the middle of the obverse, in the center slightly to the top is the cavity for double knob, across which is the notch for the core of the knob hole, and the casting design is coarse geometric pattern.

Two stone mirror molds gathered at Xiaoduling 小都岭 Site in Tonghua City are both made of gray talc. One of them (Xiaoduling SF:01) is intact and in rectangular shape, on the top of the obverse side of which is the wedge-shaped gate, in the middle of the obverse is the mirror body cavity; in the center slightly to the bottom of the mirror body cavity is the double knob cavity, and the notch for the core of the knob hole is crossing it. The casting design is coarse geometric pattern (Figures 4:2

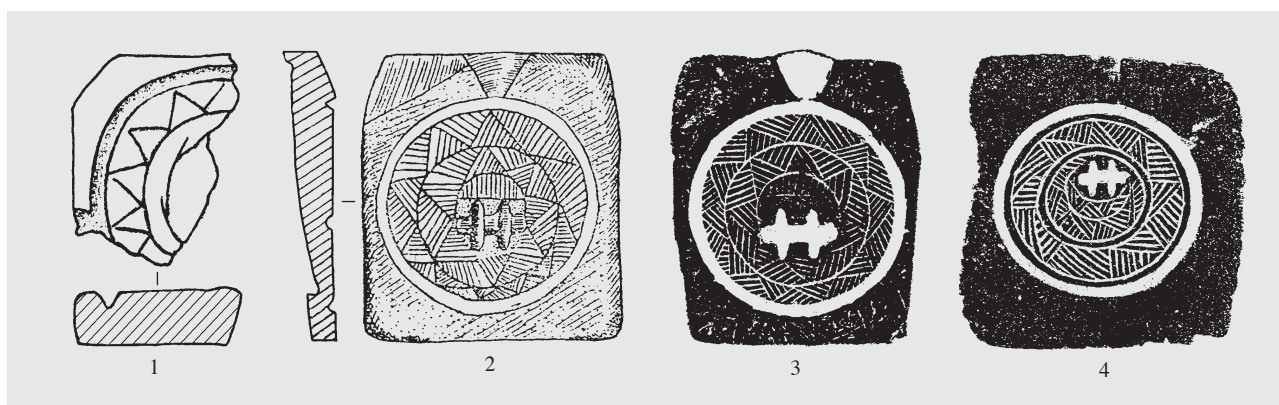


Figure 4 The stone mirror molds unearthed in Jilin Province.

1. unearthed from Nanshangang Site, Dongliao County 2 and 3. gathered at Xiaoduling Site in Tonghua City (SF:01) 4. gathered at Dajiashan Site in Dongfeng County

and 3). The other (Xiaoduling SF:02) is a fragment, the casting design is also coarse geometric pattern.

The four molds mentioned above are all gathered rather than unearthed archaeologically; the publisher of the ones found at Xiaoduling Site dates them as around the Spring-and-Autumn and the Warring-States Periods. Referring to this, it can be inferred that the *terminus ante quem* of the appearance of stone mirror molds in Northeast China would be around the 5th century BCE.

2. The stone mirror molds found in Korean Peninsula

So far, two stone mirror molds have been reported to be found in Korean Peninsula, both of which are made of talc.

The one found at Namyang-ri 남양리, Maengsan-gun 맹산군, Pyongannam-do, North Korea, is a fragment, the remaining part of which is in irregular circular shape about 20cm in diameter; mold cavities for mirror back and sprues are found on both sides, both of which are used for casting multi-knobbed mirror with coarse geometric pattern (Figure 5), and it is dated as the 4th century to the early 3rd century BCE.

The Mirror Mold Yeong'am No. 10, which is attributed to Dokcheon-ri 倭川里 or Donggurim-ri 东鸠林里, Yeong'am-gun 灵岩郡, Jeollanam-do, South Korea, is also a fragment taking one third or so of the original shape. However, the circular mold cavity for mirror body and that for the double knob a still kept, the restored diameter of the former of which is about 8cm, and it is dated as around the 2nd century BCE.

3. The stone mirror molds found in Japan Archipelago

Up to now, 14 stone mirror molds have been found in 10 localities in Japan Archipelago, most of which are distributed in the north Kyushu. Most of these molds, usually damaged or fragmentary, are made of quartz-feldspar porphyry and a few of them are made of talc. They were made from the end of the Middle Yayoi to the end of the Late Yayoi Period, or 1st to 3rd centuries CE.

One of the two stone mirror mold fragments found at Iikura D Site in Fukuoka City (No. 1) has parts of the

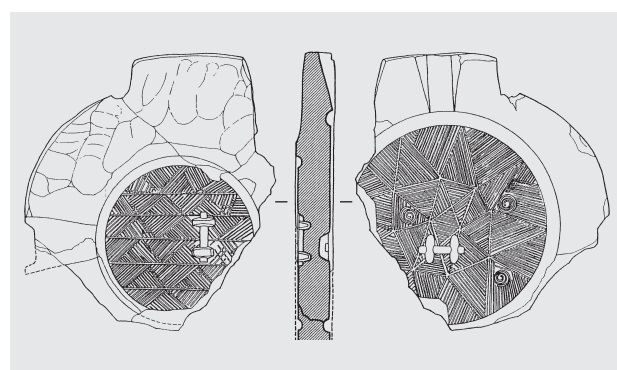


Figure 5 The stone mirror mold unearthed in Namyang-ri, Pyongannam-do, North Korea.

mold cavity and sprue kept (Figure 6:2); the original mold would have been used for casting bronze mirrors 6.8cm in diameter and with interconnected arcs design. A stone mirror mold unearthed at Ijiri 井尻 B Site in Fukuoka City has less than a half of the original item preserved (Figure 6:1), it would have been used for casting bronze mirrors 10cm in diameter and with interconnected arcs design and animal figure belt design.

The fragment of a stone mirror mold unearthed at Sugu-Nofuji Site in Kasuga City, Fukuoka Prefecture has only a very small part of the mold cavity preserved, which is in dark color and bearing nipple and spiral designs (Figure 6:7). At Locality A of Sugu-Eida Site in the same city, three pieces of stone mirror mold fragments were unearthed, Nos. 1 and 2 of which belong to the same mirror mold, which would have been used for casting bronze mirrors 7.9cm in diameter and with interconnected arcs design (Figure 6:6). No. 5 has only one fifth of the mold cavity remained, but the cavity for mirror knob and the notch for the core of the knob hole are also kept (Figure 6:3). The fragment of a mirror mold made of talc unearthed at Locality B of Sugu-Sakamoto Site has traces of diagonal comb pattern preserved on the rim of the mold

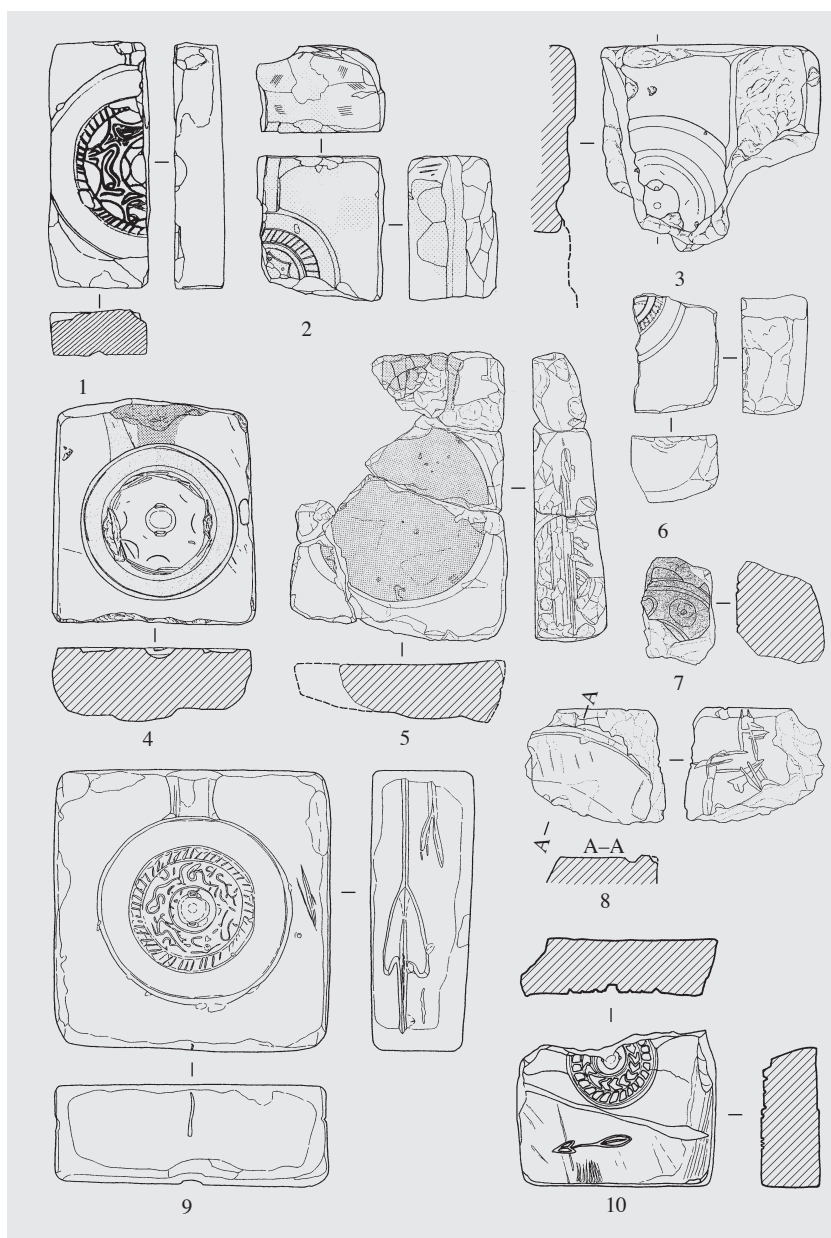


Figure 6 The stone mirror molds unearthed in Kyushu Region, Japan.

1. No. 1, Ijiri B Site in Fukuoka City
2. No. 1, Iikura D Site in Fukuoka City
3. No. 5, Locality A of Sugu-Eida Site in Kasuga City
4. No. 4, Sugu-Okamoto Site in Kasuga City
5. No. 3, Sugu-Okamoto Site in Kasuga City (mirror face mold)
6. No. 2, Locality A of Sugu-Eida Site in Kasuga City
7. No. unknown, Sugu-Nofuji Site in Kasuga City
8. No. unknown, Locality B of Sugu-Sakamoto Site
9. No. unknown, Hiruhata Site in Yasu Machi, Fukuoka Prefecture
10. No. unknown, Jitoku Site in Masuoda, Tanushimaru Machi, Fukuoka Prefecture

cavity, the restored diameter of which would have been 6cm or so (Figure 6:8). Two restorable stone mirror molds are unearthed from Sugu-Okamoto Site in Sakamoto area; the No. 4 of them is preserved better (Figure 6:4), which was used for casting bronze mirrors 7.65cm in diameter and with interconnected arcs design. The No. 3 of them,

which was a mirror face mold, consisted of four fragments, the mold cavity and sprue still have portions preserved; the center of the mold cavity is slightly concave, and the sprue is not on the same line with the center. The original diameter of the mold cavity was about 8.8cm (Figure 6:5).

The sample unearthed at Jitoku Site in Masuoda, Tanushimaru Machi, Fukuoka Prefecture has mold cavities on both sides: on the obverse is the back mold cavity and on the reverse, the face mold cavity; the back mold was used to cast bronze mirrors with V-shaped pattern belt and 4.6cm in diameter (Figure 6:10).

The stone mirror mold unearthed at Hiruhata ヒルハタ Site in Yasu Machi, Fukuoka Prefecture is well preserved; its mold cavity was used for casting bronze mirrors 9.3cm in diameter and with interconnected arcs design (Figure 6:9).

Among the stone mirror molds mentioned above, the ones in Northeast China are dated in the 5th to 3rd centuries BCE, the ones in Korean Peninsula are dated in the 4th to 2nd centuries BCE and the ones in Japan Archipelago, 1st to 3rd centuries CE. Based on these data, we can infer that the stone mold casting tradition of bronze mirrors emerged at least in the 5th century BCE and lasted as late as in the 3rd century CE. The main features of stone mold casting technique are: the materials for making the molds have the requirements on hardness, density and fire-resistance, so they are not available everywhere; the molds can only be made with engraving method, so they cannot be made in batches; their casting ability is limited, which means that they can only be used to cast the mirrors with geometric and linear patterns and some other simple designs but hardly to cast the ones with delicate and complicated designs; their permeability and mold-filling capacity are weak. However, the producing procedure of stone molds is relatively simple and the molds are not easy to damage in the casting process, and one mold can be used for many times. The products (stone mold mirrors) usually look crude and their designs are coarse and dim.

The development of pottery mold-casting tradition and the decline of stone mold-casting tradition of the bronze mirrors

The archaeological discoveries and simulation experiments all show that pottery mold mirrors and stone mold mirrors had distinct external technical characteristics. Based on this conclusion, we can find that the bronze mirrors of the Qijia Culture unearthed at Gamatai Site, Guinan County, Qinghai and in Linxia County, Gansu bear characteristics of stone mold mirrors. The bronze mirrors of the late Shang Dynasty unearthed in Yinxu Site, which are dated as in the 13th to 12th centuries BCE, bear sharply different technical characteristics from those of other coexisting local bronzes made with pottery mold casting technique and might have been cast with stone molds. The bronze mirrors of the Western Zhou Dynasty and the bronze mirrors with double knob and animal designs excavated from the Cemetery of the Guo State at Shangcunling, Sanmenxia City, Henan are also products of stone mold casting technique. The multi-knobbed mirrors with geometric patterns unearthed in Northeast China, which are dated from the early Spring-and-Autumn to the late Warring-States Periods are also unquestionably products of stone mold casting technique.

The pre-Qin molds for casting bronzes discovered so far in the Gansu and Qinghai of Northwest China, the Northern Frontier Zone along the two sides of Great Wall and Northeast China are almost all stone molds; therefore, these regions could be attributed into the distribution areas of stone mold casting tradition of bronze industry. Meanwhile, the archaeological discoveries of stone molds in Korean Peninsula and Japan Archipelago show that they were also the distribution areas of stone mold casting tradition of bronze industry. According to these, we may suggest that the stone mold casting technique of bronze mirrors emerged firstly in Gansu-Qinghai region in the upper reaches of the Yellow River around the beginning of the 2nd millennium BCE and was diffusing eastward along the Northern Frontier Zone or the course of the later Great Wall into the Northeast China, Korean Peninsula and Kyushu Island of Japan Archipelago,

formed the stone mold casting tradition of bronze mirrors and lasted as late as to the 3rd century CE.

The emergence of pottery mold casting tradition of bronze mirrors, based on the available materials at present, could be tracked back to the 9th century BCE. Among the bronze mirrors of the Shang and Zhou Dynasties discovered so far in the Central Plains, the earliest one bearing patterns of genuine Zhou styles would be the “bronze mirror with double-ring pattern” of the late Western Zhou Dynasty unearthed at Liuji Village in Fufeng County, Shaanxi, which might have been cast with pottery molds in local workshop. It is probably that the pottery mold casting technique of bronze mirrors in ancient China took place around the 9th century BCE in the central zone of the territory of the Western Zhou Dynasty, which are present-day Guanzhong Plains, the western Henan and southern Shanxi Provinces; it quickly developed since then and became fully mature at the transitional period of the Qin and Han Dynasties, or the end of the 3rd century BCE. The emergence of the pottery mold casting technique of bronze mirrors symbolizes the formation of the characteristic tradition of bronze mirror making technique of ancient China.

When the pottery mold casting technique of bronze mirrors was fully developed, it was introduced to the Northeast Asia in the historic context of the flourishing communications and interchanges among the nations



Figure 7 The distribution of the localities yielding mirror molds in East Asia.

In Japan Archipelago: 1. Ikura D Site in Fukuoka City 2. Ijiri B Site in Fukuoka City 3. Sugu-Nofuji Site in Kasuga City 4. Sugu-Eida Site in Kasuga City 5. Sugu-Sakamoto Site in Kasuga City 6. Sugu-Okamoto Site in Kasuga City 7. Jitoku Site in Masuoda, Tanushimaru Machi, Fukuoka Prefecture 8. Hiruhata Site in Yasu Machi, Fukuoka Prefecture 9. Nonose IV Site in Asakura, Ehime Prefecture 10. Tarumi Site in Suita City, Osaka Prefecture

and regions in this area. In Northeast China, the pottery mold casting technique from the Central Plains replaced the local stone mold casting technique during the Qin and Western Han Dynasties in bronze mirror making; at the same time, the stone mold casting technique was still widely applied in Korean Peninsula and Japan Archipelago. We have not had exact evidence for the introduction of pottery mold casting technique of bronze mirrors into Korean Peninsula, but in the 3rd century CE, pottery mold casting technique of bronze mirrors has been introduced into Japan Archipelago.

Seen from the entire bronze mirror making history in ancient East Asia, it seems that the stone mold casting tradition emerged earlier than the pottery mold casting tradition, and the declining of the former directly corresponded with the spreading of the latter (Figure 7). Bronze mirror casting was an important technique in ancient times; while technique, which is also a kind of culture, has its own system and tradition, and each technical system has its own evolution and diffusion routes along with the migration of the people bearing it and the interchanges of the cultures, so the emergence, evolution and diffusion of the bronze mirror casting techniques in East Asia are not only helpful for us to understand the development of this craft itself but also for us to explore the social tendencies and cultural vicissitudes in East Asia at that time.

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Postscript

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