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Scientific analysis of a Buddha attributed to the Yongle period of the Ming dynasty

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SUMMARY A technical study of a Buddha figure in the British Museum collection (1908,0420.4) with the inscription 'Bestowed in the Yongle period of the Great Ming' was carried out to clarify the dating in the light of its inclusion in an exhibition at the British Museum in 2014 concentrating on the Ming dynasty in the transformational years from 1400 to 1450. The object consists of three parts: the Buddha figure, a rectangular stepped base, and an arched mandorla. The Buddha is made of gilt brass by the lost wax method, while the stepped base and the mandorla are made of copper with engraved designs. The scientific evidence for manufacture and the metal composition of the Buddha figure are consistent with a date in the Yongle period (AD 1403–1424). While the Buddha was probably made in the Yongle period, technical and stylistic evidence suggest that the stepped base and mandorla are more likely to be eighteenth-century additions.

Introduction

A statue acquired by the British Museum (BM) in 1908 shows the figure of the historical Buddha, Sakyamuni, in meditative pose seated on an integral double lotus-petal pedestal set onto a separate rectangular stepped base and framed by an arched mandorla (1908,0420.4), Figure 1. An incised inscription on the lotus-petal pedestal (indicated by an arrow in Figure 1) states 'Bestowed in the Yongle period of the Great Ming' (*Da Ming Yongle nian shi:* 大明永乐年施), which would date the piece to the reign of Zhu Di (AD 1403–1424), the third emperor of the Ming dynasty (AD 1368–1644), Figure 2. It is one of the largest Yongle-period 'Sino-Tibetan' figures and can be closely

Figure 1. The British Museum Yongle Buddha (1908,0420.4), with the location of the inscription and small holes at the bottom of the stepped base marked with arrows

Table 1. The results of surface analysis by XRF and ICP-AES analysis of a drilled sample

Part	Area analysed	Cu	Sn	Pb	Zn	Fe	Ni	As	Sb	Bi	Co	Mn	Cd	Ag	Au
Mandorla by XRF	Back	98.7	0.4	0.7		√								√	
Stepped base by XRF	Top sheet of metal (painted red)	98.5	0.5	0.8		√								√	
	Plain metal sheet in top layer	98.1	0.5	1.2		√								√	
	Plain metal sheet in bottom layer	98.1	0.6	1.0		√								√	
	Engraved panel in bottom layer	98.6	0.5	0.8		√								√	
	Bar rivet on mandorla	77.5	0.2	0.5	21.7	√								√	
	Metal pins	97.5	0.3	0.7	1.2										
Buddha by ICP-AES	Drilled sample at the bottom	85.0	0.23	1.40	12.7	0.28	0.032	0.11	0.08	0.05	<0.002	0.0006	<0.0009	0.100	0.006

Notes. The analysis of the Buddha was undertaken by ICP-AES on a drilled sample [4], while the mandorla and base were analysed by surface XRF. The √ symbol indicates that an element was detected but not quantified. Elements for which there is no entry were not detected in that analysis.

Figure 2. Incised inscription, interpreted as 'Bestowed in the Yongle period of the Great Ming'

related to images of the Buddha in fourteenth- and early fifteenth-century illustrated 'sūtras', such as a Sino-Tibetan illustrated woodblock edition of the 'Suvarnaprabhāsasūtra' (dated to 1419) and the 'Qi sha Tripitaka' [1]. The arched mandorla consists of pierced lotus scrolls and a flaming border, and the rectangular stepped base is densely ornamented with lotus petals, classic scrolls and scrolling lotus. This figure with its base and mandorla is almost identical to a slightly larger piece in the former Speelman Collection [2, 3].

Figure 3. The Buddha with integral pedestal

Figure 4. X-radiograph of the Buddha from the front

Figure 5. X-radiograph of the Buddha from the side

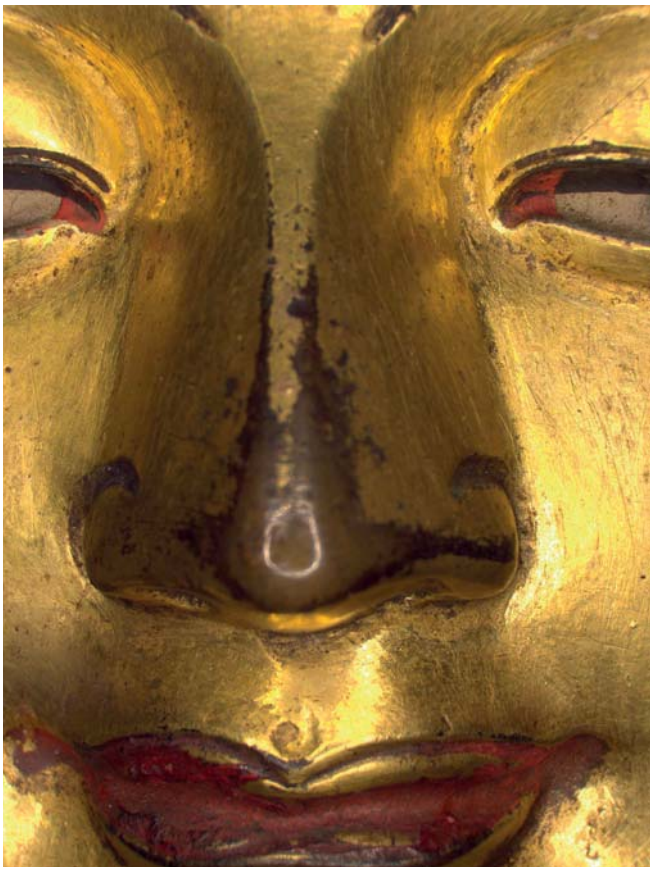

Figure 6. The face of the Buddha showing the painted eyes and lips. Image height: 2.5 mm

In a previous study, the Buddha itself was analysed by inductively coupled plasma-atomic emission spectrometry (ICP-AES) of a drilled sample from the bottom of its double lotus-petal pedestal and it was found that the alloy is a brass with 12.7% zinc (Zn), Table 1 [4]. The association of the figure with the rectangular base and mandorla was not studied at that time.

Despite the inscription, which states that it was made in the Yongle period, the contemporaneous date of manufacture of the figure, base and mandorla has been doubted. An in-depth investigation was carried out in the hope of clarifying the dates of these three components.

Analytical methods

In this study the three components – the Buddha on its lotus pedestal, the stepped base and the mandorla – were examined using microscopy, X-radiography and X-ray fluorescence (XRF) analysis. X-radiography, which allowed the investigation of the internal construction of the Buddha figure, was undertaken using a Siefert DS1 X-ray tube. Exposure conditions were 180 kV for 50 mA minutes.

The rectangular stepped base and the mandorla were analysed by XRF using an Artax μXRF spectrometer with a molybdenum target X-ray tube rated up to 40 W and operated at 50 kV and 800 μA with a counting time of 200 seconds. Surface analysis was performed on areas where the gilding was missing and since no preparation was carried out to remove possible surface corrosion, the results may not be as accurate as those from ICP-AES analysis. However, XRF examination provided sufficient information on the alloys present in the stepped base and the mandorla to allow comparison of the metal composition between the components.

Figure 7. The hand of the Buddha showing the painted finger nails. Image width: 2.5 mm

Analytical results

The Buddha

The Buddha weighs 8.514 kg and is 37 cm tall, which makes it one of the largest gilt brass figures of this type and period [5]. There is a series of holes on the lower part of the double lotus-petal pedestal (Figure 3), which are concealed by the stepped base when the components are assembled, Figure 1.

Figure 8. The open bottom of the stepped base with the recess for the pedestal visible in the centre

Figure 9. The recess in the single sheet of copper on the top of the stepped base

Figure 10. Underside of the Buddha, showing the residual adhesive, indicated with an arrow

The X-radiographs of the Buddha showed that it was cast in one piece with the lotus pedestal, Figures 4 and 5. The presence of a supporting armature in the right arm confirms that it was cast by the lost wax method [6]. A core is probably present in the arm because it appears denser in the X-radiograph than the hollow body. A chaplet, a typical feature of the lost wax casting method, was also observed above the chest.

The eyes are painted and now appear grey with red at the inner corners, and the lips are also painted red, Figure 6. The fingernails of the Buddha were originally painted and what remains of the pigment now appears grey, Figure 7. In each case the colour was applied on top of the gilding. It was found by XRF analysis that the red paint contains mercury and sulphur, indicating the use of vermilion or cinnabar, and that the grey contains mainly lead, suggesting the use of lead white. The grey colour of the lead white may have been caused by dirt or by discolouration resulting from a reaction with pollutants such as reduced sulphur gases in the environment.

The stepped base

The stepped base is made of six layers, each consisting of an engraved panel framed with plain sheets of metal fastened by metal pins, Figure 8. The purpose of the small holes in the lowest engraved layer (shown in Figure 1) is not known. The top of the stepped base is a single sheet of metal with a hammered recess into which the pedestal of the Buddha fits exactly, Figure 9. Surface XRF analysis of the engraved sheets and the single plain sheet showed that they are all copper with trace amounts of tin and lead.

Both the top and bottom surface of the stepped base are painted red, Figures 8 and 9. The red material was identified as mercury sulphide and, based on its microscopic appearance and the colourless impurities it contains, is probably ground cinnabar [7].

The mandorla

The mandorla is mounted on the stepped base by inserting two metal bars into two openings, Figure 9. The back of the mandorla is black in colour. The black material, which adheres well to the surface, was identified as carbon by Raman spectroscopy and may perhaps result from exposure to candle or oil lamp soot over a long period in a temple. Surface XRF analysis showed that the mandorla is also made of copper with trace amounts of tin and lead.

The gilding

Surface XRF analysis showed the presence of mercury, providing evidence that the outer surface of all the components was mercury gilt. The gilding is broken by the corrosion of the underlying metal, resulting in some pitted corrosion on the surface.

Discussion

The Buddha

During the Yongle period, an exchange of missions between China and Tibet was instigated by the Chinese emperor. Tibetan religious leaders were invited to court to instruct

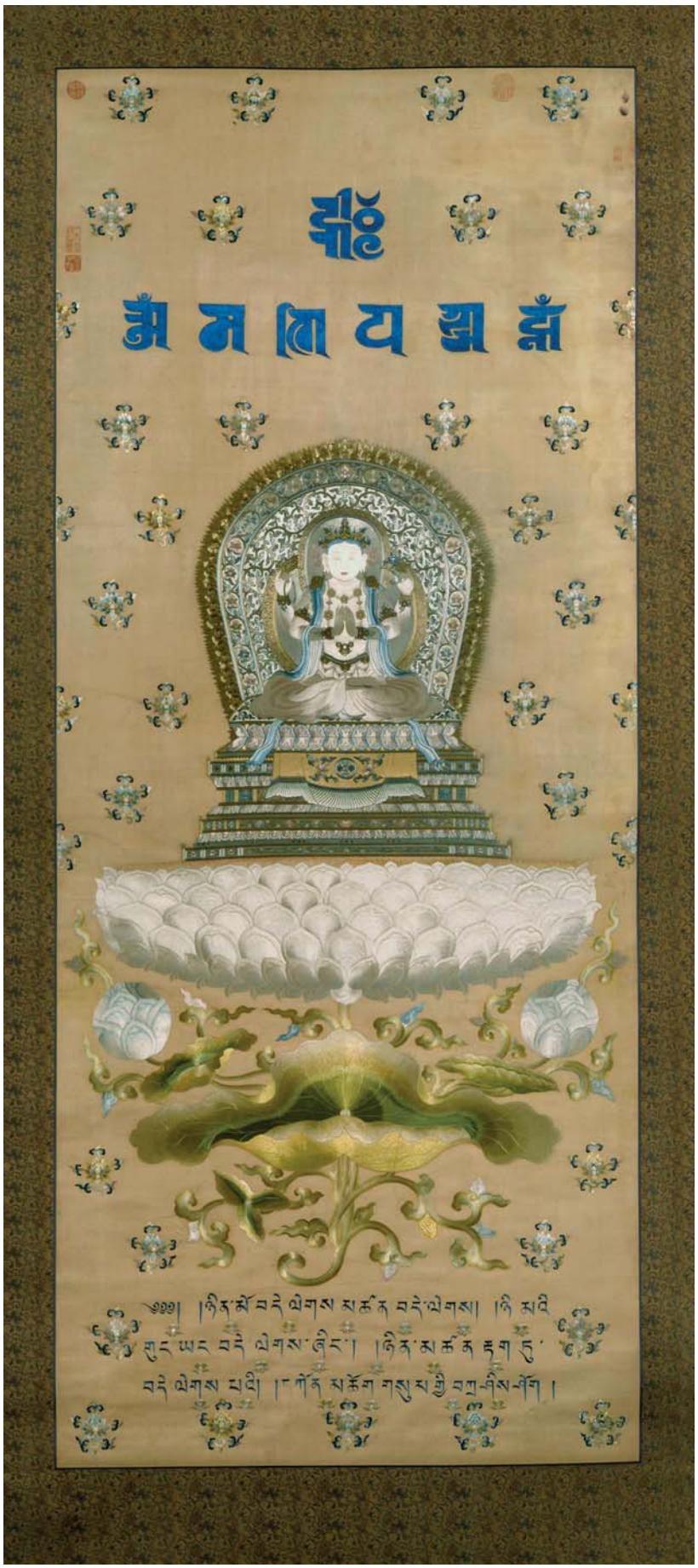

Figure 11. *The Bodhisattva Avalokiteśvara of the Six Syllables*, Qing dynasty (1644–1911), reign of the Qianlong emperor (1736–1795), *c.*1758. Embroidery on silk, 209.5 × 86.7 cm. Gift of the Walter and Phyllis Shorenstein Fund, 1984.4. Image: © Asian Art Museum, San Francisco (used by permission)

the emperor and perform religious services for his deceased parents. Exchanges of gifts played an important role in the diplomatic relationship between Tibet and the Ming court, and Buddhist figures made in imperial workshops were among the emperor's gifts to Tibetan religious leaders in the Yongle and Xuande periods (AD 1403–1435) [5]. About 300 Buddhist figures made in the Yongle and Xuande periods are in museum and private collections across the world [5, 8]; however, those of the Yongle period outnumber those of the Xuande period.

The reign mark on the Buddha in the BM collection was incised into the top of the lotus-petal pedestal (Figure 2), the position in which it is usually found on comparable figures, including the Speelman Buddha. As with other figures from this period, the inscription is written from left to right instead of from right to left as was common. This may be related to an intended Tibetan readership, whose language is read from left to right [5]. The reign mark is also incised in the correct calligraphic form of the period; for example the character *nian* 年 has a diagonal dot to the left of the long vertical stroke instead of the short vertical stroke now used in writing this character [4, 9].

There should be a sealing plate at the bottom of the lotus-petal pedestal but it has been damaged or lost in many figures [5]. The sheet metal panel sealing off the hollow base, which probably contained consecratory relics, is usually painted red using vermilion or cinnabar [5, 10]. All the Yongle Buddhist figures in the Palace Museum in Beijing that have been studied by Hu have a sealing panel [9]. Although the figure from the BM collection studied here does not have such a sheet metal panel covering its base, traces of adhesive present on the inner surface of the lotus pedestal (Figure 10) suggest it was originally present, but that it and the relics inside the base went missing prior to acquisition by the Museum. The plate was probably held in place by screws placed through the holes in the base beneath the lowest band of granulation. Such holes are also found on the Speelman Buddha, where screws placed through them hold a plate in place that conceals the relics inside the figure (although the screws, sealing plate and content may post-date the Yongle period). The Speelman Buddha contains 25 sutra scrolls wedged in place by wooden tablets inside a wooden container. According to Weldon, the use of screws is not the usual method to secure the plate, which employed "a number of cuts in the base rim that catch the plate and secure it" [2], but for the BM and Speelman Buddhas the content and sealing plate may have been so heavy that screws were needed to hold the plate in place [2].

Brass was in use far earlier in Tibet than in central China and from the eleventh century onwards brass was used consistently for Tibetan statuary [11]. An early fifteenth-century cloisonné offering stand from Tibet was reported to contain 20.5% zinc and 5.5% tin [12]. Buddha figures made of brass were not thought to have been present in China until the middle to second half of the Ming dynasty [13]. However, studies of Buddhist figures from the Yongle and Xuande periods by Huang [5, 14], who claims that they all are made of brass by the lost wax casting method, has shown that this was not the case. A recent study of around 30 Buddha figures of the Yongle and Xuande periods in the Palace Museum in Beijing by Hu confirmed that they were all made in brass with most having a zinc content in the range 9–17% [15]. The zinc content (12.7%) of the Buddha in the BM collection studied here falls well within this range.

The alloy used for these Yongle Buddhist figures was more likely to be cementation brass rather than speltering brass,[1] since the transition from cementation to speltering brass in China probably occurred during the Wanli period (AD 1573–1620) [16], and from 1621 speltering brass was widely used in coin production [17]. The zinc content in the BM Buddha is consistent with cementation brass.

In all, the metal composition, the gilding and the casting technique of the Buddha are consistent with a figure of the Yongle period, as is its style. It is unlikely that it is a Tibetan copy of a Yongle statue as these are usually made of copper, are cruder and lack a reign mark [14]. The high quality of its manufacture probably also distinguishes the BM Buddha from later copies, such as those made in the Qing dynasty (AD 1644–1911) or from the 1980s [14], although some high quality pieces were made in the eighteenth century. The latest date range is, of course, also excluded by the known date of acquisition by the BM (1908).

Base and mandorla

While the Buddha can be dated to the Yongle period, the dates of the stepped base and the mandorla are less certain. The use of copper for their manufacture cannot be used as an indicator of date, as copper had been in use long before the Ming dynasty. However, a very low iron content (<0.1%) in the copper used for the stepped base and the mandorla suggests that they were probably made at a later date.

There are fifteenth-century and earlier comparable examples of such bases and mandorlas in Buddhist art. For example, the Yamantaka-Vajrabhaira in an embroidered silk thangka dating from the early fifteenth century in the Metropolitan Museum of Art, New York is framed by a flaming mandorla, but more significantly he stands on a lotus-petal pedestal that sits on a stepped base that resembles the base of the BM Buddha [18]. Another example can be found on the mid-fourteenth-century Cloud Platform, a marble architectural feature at Juyongguan, a major pass north west of Beijing [19]. Here a Buddha sits on a similar lotus-petal pedestal atop a stepped base. The mandorla is strikingly similar to those on the BM and Speelman pieces; it also consists of several scrolling bands, including a band with large scrolls framing the Buddha followed by another with smaller floral motifs and a flaming border. These examples lend support to a fifteenth-century date for the bases and mandorlas in the BM and Speelman pieces.

However, the comparative examples of bases and mandorlas that most directly match the BM and Speelman statues are nearly identical, and can be found on several Qianlong-period embroideries (reigned 1735–1796) that depict the Bodhisattva Avalokiteśvara of the Six Syllables [20]. Four such embroideries survive and are kept in: the Palace Museum, Beijing; the National Palace Museum, Taipei; the Potala Palace, Lhasa; and the Asian Art Museum, San Francisco, Figure 11 [21]. The base and mandorla of the BM and Speelman figures are thus more similar to those on the eighteenth-century textiles than to examples from the early Ming dynasty. The collection record for the *Bodhisattva Avalokiteśvara of the Six Syllables* in the Asian Art Museum states that the figure with its square

face, together with mandorla and base, is based on a Ming dynasty 'prototype' [21]. This suggestion provides a plausible scenario for understanding the BM and Speelman pieces. While the Buddha figures, both in the BM and in the former Speelman Collection, date to the Yongle period, the bases and mandorlas were probably added in the eighteenth century and these additions were consciously based on Ming dynasty examples, which may have survived only as representations on textiles and perhaps also in paintings. Such archaizing use of early Ming dynasty features, which also related to Tibetan Buddhism, was not without precedent during the eighteenth century. An example is offered by the Buddhist poems in Tibetan script seen on the San Francisco scroll (Figure 11), which appear on Xuande-period (AD 1426–1435) blue and white porcelain vessels [22].

Conclusions

The statue of the Buddha acquired by the BM in 1908 consists of three parts: the Buddha figure and its integrally cast lotus base, the stepped base and the mandorla. The Buddha is cast in brass by the lost wax method while the stepped base and the mandorla are made of copper with an engraved design. Analytical and stylistic analysis suggests that the Buddha figure is a product of the Yongle period, while the base and mandorla are not original to the figure but possibly eighteenth-century additions.

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Note

1. Cementation brass is made by mixing copper metal with zinc ores and charcoal in closed crucibles. The zinc ore is reduced to metallic zinc in the vapour phase and this diffuses into the copper to form brass. In contrast, speltering brass is made by mixing metallic zinc and copper.