RESEARCH ON EARLY CHINESE LACQUER BUDDHAS

PROCEEDINGS OF THE SIXTH FORBES SYMPOSIUM AT THE FREER GALLERY OF ART

Research on Early Chinese Lacquer Buddhas

Proceedings of the Sixth Forbes Symposium at the Freer Gallery of Art

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Edited by Donna Strahan and Blythe McCarthy

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Foreword

Although object conservation and conservation science have long stood at the center of the work of the Freer Gallery of Art and Arthur M. Sackler Gallery, more can and should be done to highlight the contribution they make to understanding the arts of Asia. *Secrets of the Lacquer Buddha* was the first of what we envision as a series of exhibitions to be presented by our Department of Conservation and Scientific Research. The second, currently in preparation, will focus on recent conservation work on a Coromandel (Kuancai) screen in the collection of the Freer Gallery of Art. Funding for that work was generously provided by Bank of America.

Research on Early Chinese Lacquer Buddhas presents the productive conjunction of exhibition and conservation work and research. Through focused discussions on the materiality, use, and context of lacquer Buddhist sculpture, the symposium offered the opportunity for interdisciplinary treatment of a rich and complex topic. Thought-provoking papers provided insights into the landscape of Buddhist practices in which sculptures carried meanings.

This volume marks the sixth Forbes symposium. The first was held in 2001, on the fiftieth anniversary of the Freer Gallery's initial pursuit of scientific endeavors and showcased the breadth of technical research on Asian art. Subsequent symposia have focused on such topics as the pictorial and sculptural arts of Asia and historic Asian ceramics. The series is supported by the Edward W. Forbes Fund. This bequest to the Freer Gallery of Art was made by John Thacher in honor of his former colleague, Edward Waldo Forbes, a past director of the Fogg Art Museum at Harvard University and an early proponent of applying technical examination to the study of art.

This is the first volume of the Forbes symposium series made available both as a download from our website and in book format, a practice we started in 2020 to ensure the widest possible distribution of the research of our conservators and scientists. In this and many other ways, the National Museum of Asian Art is meeting the needs of the twenty-first century in research, presentation, and discussion of the arts and cultures of Asia.

Chase F. Robinson
Dame Jillian Sackler Director
Arthur M. Sackler Gallery and Freer Gallery of Art
National Museum of Asian Art

Acknowledgments

This *Sixth Forbes Symposium on Scientific Research in the Field of Asian Art* focused on fabrication methods of early Chinese lacquer buddhas. It was held in conjunction with a special exhibition entitled *Secrets of the Lacquer Buddha* in the spring of 2018. Unforeseen was the arrival of the COVID-19 pandemic in early 2020 that would slow the work on the publication but made us realize that both an online publication and a printed book would reach a broader audience.

As with all the Forbes symposia, I wish to acknowledge the incredible amount of work by my colleagues in the National Museum of Asian Art who were willing to pitch in to make the Sixth Forbes Symposium a success. It would not have been possible without the tremendous participation of staff members in the Department of Conservation and Scientific Research who were involved with each stage of the implementation of the symposium. Special thanks are extended to my co-editor Andrew W. Mellon Senior Scientist Blythe McCarthy. Alison Schorr, management support specialist, deserves particular mention for her oversight and management of logistics as well as keeping the presenters informed. Outside of the department, Herb Bulluck, Andy Finch, and Hutomo Wicaksono took care of all audiovisual needs and ensured a smooth symposium, and Reid Hoffman and Nancy Hacskaylo created a beautiful cover design for the book. I would like to thank Julian Raby, Richard Kurin, and Chase F. Robinson for their support of the exhibition, symposium, and this publication. I especially want to thank all the authors for their hard work in preparing papers for presentation and publication even with all the disruptions caused by the pandemic. Finally, much appreciation goes to Ann Hofstra Grogg for her careful editing of the published volume.

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Introduction

Asian lacquer is a unique tree resin that has been used since ancient times and continues to be used today to create a wide variety of objects. It has been used to waterproof baskets, to make tableware, to decorate coffins, and to make sculptures. Historical records indicate that lacquer trees have been cultivated since the second century BCE. Of all the objects made using lacquer resin, Buddhist sculpture is the rarest to survive. This publication explores the history, use, and fabrication of lacquer Buddhist sculptures by bringing the conservator, conservation scientist, and art historian together.

The Sixth Forbes Symposium on Scientific Research in the Field of Asian Art, held on 25–26 March 2018, was designed as a smaller focus meeting on the topic of early Chinese lacquer buddha sculptures. It coincided with the special exhibition *Secrets of the Lacquer Buddha*, held 9 December 2017–10 June 2018 at the Arthur M. Sackler Gallery. The exhibition united for the first time the three most important early Chinese lacquer buddha sculptures known to exist. They are currently located in the United States at the Walters Art Museum, Baltimore, the Freer Gallery of Art, Washington, and the Metropolitan Museum of Art, New York. Because of their fragile nature, this was the first time any of the sculptures had left their museums.

The exhibition provided an opportunity to closely study and analyze how and of what these unique sculptures were made. In addition to these three late sixth- and seventh-century sculptures, we were able to study an eighth-century bodhisattva head from a private collection and a thirteenth-century Yuan dynasty bodhisattva sculpture in the Freer Gallery of Art. These allowed us to compare lacquer sculpture techniques across eight centuries. Together, the five sculptures offer insights into the relationship between the use of lacquer as a sculptural medium and religious practice during this formative period in East Asian Buddhism. This scientific research provided core subject matter for the focused symposium, benefiting also from the historians who presented background on these sculptures and addressed their function. Additionally, present-day practices were presented. The series of lectures discussed additional Buddhist lacquer sculptures and provided an overview of a tradition of lacquer Buddhist sculptures in East Asia. All the papers presented are included in this volume.

All five sculptures studied were fabricated with the same lacquer technique, known as *jiazhu* 夾紵 in Chinese, which roughly means “binding layers of hemp”. The English term “dry lacquer” has been commonly used to describe this method. It probably refers to the addition of powdered materials mixed in the lacquer resin to make it less fluid, essentially drying it out. Instead of “dry lacquer,” this publication uses the terms wood-core or hollow-core technique to describe the fabrication methods. The word “dry” has been omitted to improve accuracy and readability.

The keynote lecture surveyed lacquer Buddhist sculpture from the sixth to the eighth century. Other papers gave a broader context, including early Chinese texts that discuss lacquer techniques, a Yuan dynasty bodhisattva in the Freer Gallery of Art collection, lacquered bodies as relics that are found throughout much of East Asia, as well as present-day practices such as mummification, and enclosing the deceased’s ashes in clay *tsha tshas*.

In the past these sculptures were individually studied using x-ray radiography and polarized light microscopy, but this publication presents the results of new analyses. These include the lacquer tree species used for each sculpture as well as what materials were added to each lacquer layer. Through the use of proteomics, the ground bone used in all the sculptures was identified by its animal species.

It is hoped that all this new information may be helpful for future investigations into ancient Chinese lacquer techniques.

Donna Strahan

Lacquer and Buddhist Sculpture in East Asia, Sixth–Eighth Centuries

Denise Patry Leidy

ABSTRACT Lacquer sculptures are much rarer than those made in other materials. Moreover, the appearance of lacquer as a medium for Buddhist sculpture in China in the late sixth and early seventh centuries parallels the expanding interest in different types of relics, particularly those alluding to the physical presences of learned masters, that characterizes East Asian Buddhism during this critical period for history and practice.

Introduction

Unlike those crafted in stone, metal, or clay, Chinese Buddhist sculptures in lacquer are extremely rare. The three earliest known examples, dating from the late sixth to the early seventh century, are all life-size and all in the United States. One is in the collection of the Walters Art Museum in Baltimore (pl. 1, p. 12); a second is in the Freer Gallery of Art in Washington, D.C. (pl. 2, p. 13), and the third is in the Metropolitan Museum of Art in New York (pl. 3, p. 14). The Walters buddha is the earliest preserved example of a sculpture made using the wood-core lacquer technique. The Freer and Metropolitan buddhas are the earliest extant sculptures produced with the hollow-core lacquer technique. In addition to illustrating stylistic changes that occurred in Chinese Buddhism, the three striking sculptures also reflect the relationship among the development of lacquer as a Buddhist medium, the rise of new practice traditions, and the growing interest in religious portraiture during a seminal period in East Asian Buddhism.

The Walters Buddha

Acquired in the early 1920s from the Japanese dealer Yamanaka Sadajirō (1866–1936) (Siren 1925, 3: pl. 547) and said to be from the Great Buddha (Dafosi) Temple in Zhengding, Hebei province, China, the Walters buddha sits with legs crossed in a posture symbolic of meditation (see pl. 1). The position of the arms indicates that the missing hands were one above the other on the lap, a gesture (*dhyana* mudra) that is also meditative.

The Walters buddha is depicted wearing traditional Indian clerical clothing: a rectangular piece of cloth wrapped around the waist (barely visible), another rectangular garment draped over the left shoulder, and a third outer robe, or shawl, which also falls from the left shoulder (Rhie 1993). Traces of pigment on the upper undergarment's hem indicate that a pattern in shades of orange, red, white, green, and blue decorated the border. The shawl is patchwork with red areas bordered in green (Strahan 1993; Strahan, in this volume).

Understood to symbolize asceticism and renunciation, patchwork is also read as a reference to the life of Buddha Shakyamuni (born Siddhartha Gautama around 563 BCE), the founder of Buddhism, who gathered discarded rags to use as clothing. Such shawls, while technically known as *samghati*, are also called *kasaya*, a Sanskrit term that means "dull color." The most important piece of clothing worn by a monk (Kieschnick 1999) and often awarded during ordination, shawls are cataloged by the odd numbers of stripes and patches—for example, seven stripes and twenty-one patches—in their construction.

Traces of gilding on the face, upper torso, and right arm indicate that the Walters buddha once had gold "flesh." Golden skin is one of the thirty-two major and eighty minor marks that characterize the physically perfect body of either a spiritually advanced being, such as a buddha, or a divine ruler (*chakravartin*). While all these symbols are recorded in texts, only a few—such as a protuberance at the top of the head (*ushnisha*) that signifies supernal understanding, elongated earlobes, and hair in snail-shell-like curls—are typically featured in images of buddhas.

The curls are missing on the Walters buddha. Originally, they may have been painted or made using a combination of lacquer and putty and then individually attached to the head. It is worth noting, however, that simple, flat hair is typical of Chinese Buddhist sculpture from the late sixth and early seventh centuries, and not all representations of buddhas made at that time showed the snail-shell curls.

Stylistically, the Walters buddha belongs to a tradition found primarily in northeastern China in the second half of the sixth century (Ho 1968–69). The buddha's rounded but not particularly articulated physique, full but flat face, and long, arched eyebrows typify sculptures from the first decades of the Sui dynasty (581–618). The rendering of clothing folds as thin, flat lines with no sense of depth—as

Figure 1. *Buddha Shakyamuni, China, Sui dynasty (581–618), dated 582, limestone with traces of pigment, 51.1 × 24.8 × 17 cm. Freer Gallery of Art, Gift of Charles Lang Freer, F1912.86.*

Figure 2. *Digitally altered image of the Metropolitan Museum of Art buddha (pl. 3) re-creating its original colored appearance. Photo courtesy of Hutomo Wicaksono.*

shown in both the Walters buddha and in a stone example dated 582 (fig. 1)—is also typical of works produced at that time.

An open cavity in the back was, as is often the case with Buddhist icons, most likely filled with dedicatory material that served both to consecrate the sculpture and to enliven or activate it. Consecratory material in Chinese sculpture can include texts, textiles, semiprecious stones, and grains, as well as cloth reproductions of human organs. The use of such material, understood to symbolize the presence, charisma, and teachings of the Historical Buddha Shakyamuni, can be traced to some of India's earliest Buddhist monuments: burial mounds known as stupas, which mark the physical remains of Shakyamuni and other enlightened beings. These monuments, as well as certain early South Asian sculptures, contain both actual and symbolic relics of Shakyamuni and others, as well as objects that they used in their lifetimes (Willis 2000; Rhi 2005).

The Freer and Metropolitan Buddhas

Both the Freer (see pl. 2) and Metropolitan (see pl. 3) buddhas sit in meditation and wear standard Indic monastic garb, including undergarments and large shawls that fall from the left shoulders but leave the right uncovered. The buddhas' shawls are composed of red patches with dark bands (fig. 2), and the hems of their upper undergarments are painted. The undergarment of the Metropolitan buddha—which, although repainted, is the best preserved of the three—shows a band of either stylized clouds or *ruyi*, an auspicious design based on the shape of a certain fungi.

Like the Walters buddha, the Metropolitan buddha was acquired from Yamanaka and is thought to have come from the Dafosi Temple in Hebei province (Siren 1925, 3: pl. 548). The Freer buddha was purchased from Ellis Monroe, a New York dealer, in 1944. Both differ stylistically from the Walters sculpture and are later in date. Their articulated cheekbones, narrower shoulders, slight waistlines, and thinner, longer legs are comparable to works dating to the seventh century, such as a Buddhist plaque at the Metropolitan Museum of Art (fig. 3), when renewed awareness of contemporaneous Indic traditions began to appear in Chinese Buddhist art. Moreover, the folds of the shawls are deeper and more realistic than those on the Walters buddha's garment. Both the Freer and Metropolitan buddhas have gilded torsos, faces, and arms. Marks on the hairlines suggest that both sculptures' heads once were covered with snail-shell curls, presumably made of putty and lacquer.

Variations in the monastic shawls and the hand gestures suggest that the Freer and Metropolitan sculptures represent different buddhas. The shawl of the Freer buddha wraps across the waist; that of the Metropolitan buddha does not. The placement of the Freer buddha's arms indicate that the right hand rested on the right knee, while the left was held up in a gesture of reassurance known as the *abhaya* mudra. The hands of the Metropolitan buddha rested in the

Figure 3. *Plaque with Buddhist triad, China, Tang dynasty (618–907), first half of the seventh century, earthenware with traces of pigment and gilding, 13.3 × 9.8 cm. Metropolitan Museum of Art, Rogers Fund, 1930, 30.137.*

Figure 4. *Attendant bodhisattva, China, Tang dynasty (618–907), eighth century, hollow-core lacquer, 44 × 37 cm. Cleveland Museum of Art, Given in memory of Howard Parmelee Eells, Jr., by his wife Adele Chisholm Eells, 1983.86.*

lap in the *dhyana* mudra, a gesture likely also made by the Walters buddha. While it is not possible to identify the figures definitively, each probably represented one of the four buddhas most prominent in East Asia at the time: the Historical Buddha Shakyamuni; Amitabha, the focus of the Pure Land tradition; Maitreya, who will become the teaching buddha of the next cosmic period; and Bhaishajyaguru, who is associated with healing.

Lacquer and East Asian Buddhist Sculpture

Lacquer, which is an amazing material, was used as a protective covering in China as early as the Neolithic period and flourished as an artistic medium beginning in the Warring States period (475–221 BCE), when it was used to make coffins, boxes, and other vessels. Lacquer coffins, at times nested sets, as well as coffins of lacquer and jade, were thought to preserve the body of the deceased, as was the addition of mercury sulfide, or cinnabar, a colorant often used in lacquer.

The first written reference to the use of lacquer to make Buddhist sculpture occurs in a 406 recension of the *Lotus Sutra* (Saddharma pundarika sutra) by the Kuchean exegete Kumarajiva (344–413 CE), famed for his translations from Sanskrit to Chinese. Sixth- and seventh-century texts discussing the production in the mid-fourth century of five now-lost "portable" sculptures by Dai Kui (326–396 CE), a gentleman-polymath and fervent Buddhist, are the first references to the creation of lacquer icons (Soper 1959, 19–20; T. 55, 2145: 92b). Once displayed in the Waguan Temple in present-day Nanjing, these extraordinary buddhas, produced after years of thought and planning, emitted continuous light, a reference to their potency and miraculous abilities. The description of these five sculptures as "portable" is interpreted as a reference to the use of the hollow-core lacquer technique for their manufacture: once the core is removed, such sculptures are amazingly light. Additional references to lacquer sculpture are found sporadically in texts from the fifth and sixth centuries (Soper 1959, 255). It is interesting to note that most refer either to sets of sculptures or to the exceptional height of some of the works, suggesting that commissioning lacquer sculpture was inherently the purview of high-ranking individuals and clerics.

An eighth-century sculpture of an attendant bodhisattva (fig. 4) in the Cleveland Museum of Art provides further evidence for the use of lacquer as a sculptural medium in China during the Tang dynasty (618–907). The Cleveland bodhisattva was once part of a larger assemblage of figures, and the full face and features and voluminous physique, clearly defined waist, and long legs, and the use of the clothing to define the body illustrate a Chinese style that developed in the eighth century and spread to Korea and Japan, as did the hollow-core lacquer technique. Seventh-century sculptures of the guardians of the four cardinal directions in the Taimadera Temple in Nara are the earliest preserved Japanese examples of hollow-core lacquer

Figure 5. *View of stupas, Lingquansi Monastery, Mount Bao, Henan province.*

Figure 6. *Stupa with Monk Jingzheng, dedicated 594, Lingquansi Monastery, Mount Bao, Henan province.*

Figure 7. *Stupa with Dharma master Kan (d. 637), Lingquansi Monastery, Mount Bao, Henan province.*

Figure 8. *Portrait of Monk Hong Bian (d. 862), China, Gansu province, Dunhuang complex, Cave 16, clay with pigments, h. 94 cm. The Mellon International Dunhuang Archive.*

construction. In the first half of the eighth century, this method of manufacturing Buddhist sculptures was widely used in ateliers at imperial temples such as Tōdaiji and Tōshōdaiji, based in the capital city of Nara, the center for Buddhist practice in Japan at the time.

Lacquer, Portraiture, Relics, and Mummification

The sixth to the eighth century—a period marked by the flowering of lacquer Buddhist sculpture throughout East Asia—was an era of significant political, cultural, and economic ties among the nations of East Asia. Chinese translations of Buddhist texts, Chinese practice traditions, and Chinese styles in sculpture and painting, which echoed contemporaneous South and Central Asian imagery, served as the epicenter for a multinational artistic style, disseminated by monks and, at times, artists of various nationalities, throughout East Asia. This period also saw the development of distinctively Sinitic Buddhist practice traditions and their adoption in Korea and Japan. These included Pure Land, dedicated to the Buddha Amitabha; Tiantai, based on the *Lotus Sutra*; Huayan, based on the *Flower Garland Sutra* (Avatamsaka); and Chan (Zen) Buddhism. Like the short-lived Three Stages (Sanjiejiao) sect that flourished in the late sixth century, traditions such as Pure Land and Tiantai accepted the widespread belief that the sixth century was the final or degenerate age of Buddhism, when the practice began to decline before disappearing over time.

Desire for rebirth in a Pure Land or paradise, such as that of Amitabha—and a renewed interest in becoming a Buddha and escaping the endless cycle of rebirth—spurred the development of new imagery and styles, as well as the growth of religious portraiture in a variety of media at the time (Croissant 1990; Foulk and Sharf 1993). Like sculptures and paintings of Shakyamuni, such portraits, either actual or imaginary, preserved and disseminated the charisma and spiritual understanding of enlightened teachers. Some of the earliest evidence for the representation of historical practitioners appears at the Three Stages site of Lingquansi Monastery on Mount Bao near the city of Anyang in Henan province, which houses more than two hundred mortuary niches (fig. 5), most containing stupas with ash remains (Adamek 2016; Henan Sheng Gudai Jianzhu Baohu Yanjiusuo 1991). Inscriptions identify the figures seated in the stupas and discuss the gathering of cremated remains and their interment in boxes at the base of the stupas (or pagodas).

Architectural details help differentiate the stupas from one another, and changes in posture, gesture, and clothing further individuate the deceased. For example, the monk in Niche 4, dedicated in 594, who is identified as a certain Jingzheng, wears a large clerical shawl over his shoulders and sits in meditation with his hands resting on his lap (fig. 6). On the other hand, the Dharma master Kan, who died in 637 and was interred in 638, wears the shawl over his shoulders but not his chest (fig. 7). He is also wearing a stole tied at the left and is seated behind a three-legged table used for writing and reading and as a prop for sitting upright. Both

Figure 9. *Mummy of Huineng (638–713), mixed media, h. 79.4 cm. Photo courtesy of Alamy Inc., New York.*

monks and laypeople were interred at Baoshan, and the "presence" of a multitude of advanced adherents rendered the site sacred and a world apart from the everyday.

Ashes were also interred within clay portraits, known as "bone-ash images." A life-size sculpture of Hong Bian (d. ca. 862) in Cave 16, the fabled library cave, in the great complex at Dunhuang in Gansu province, shows an individual seated in meditation with a full face, pursed lips, and wrinkles around his eyes and forehead (fig. 8). His biography, recorded in a nearby stele dated 851, states that he served as the chief of monks in the area, helped to restore the site, and was awarded a purple robe—a symbol of status—by the emperor. His ashes, gathered in a purple silk bag, were placed with other consecratory objects and a dedicatory text in a small open cavity in the back of the sculpture (Croissant 1990, fig. 3).

Self-mummification, in which the corpse of an enlightened being is accidentally or deliberately preserved, is undeniably the most dramatic practice to emerge from the parallel interest in relics and portraiture in East Asia from the sixth to the eighth century (Ritzinger and Bingenheimer 2006; Friedland 2015). The famous monk-pilgrim Xuanzang (ca. 602–664) recorded seeing such self-preserved beings during his journeys through Central Asia and India in his *Great Tang Records of the Western Regions* (Da Tang xiyu ji), written around 646, after his return to China (Ritzinger and Bingenheimer 2006, 44).

It is probably not coincidental that the earliest records of self-mummified individuals date to the sixth century, the period characterized by an interest in preserving the remains of the special dead. The *Biography of Eminent Monks* (Gaoseng zhuan), compiled around 530 by the monk Huijiao (447–534 CE), lists four examples of monk-adepts who were so spiritually advanced that their bodies did not decay at death: Heluojie (d. 298 CE), Shan Daokai (d. ca. 360 CE), Bo Sengguang (d. 385 CE), and Zhu Tanyou (d. 390s CE) (Ritzinger and Bingenheimer 2006, 51). By the late sixth century, when the body of Zhiyi (538–597) was found miraculously intact in his tomb on the south side of Mount Tiantai, the notion that the physical body of spiritually advanced practitioners would not decay was well established (Ritzinger and Bingenheimer 2006, 62).

Evidence for the use of lacquer to help conserve such mummies first appears in the early seventh century, at around the same time as visual evidence for the use of the hollow-core lacquer technique, as in the Freer and Metropolitan sculptures. Nearby villagers discovered the body of Daoxiu (d. 627), an ascetic who lived in a hut near Mount Li in Shaanxi province, sitting upright in meditation. To preserve the corpse, they covered it in cloth soaked with lacquer. His body was subsequently moved to a mausoleum in the unnamed village (Ritzinger and Bingenheimer 2006, 67). The body of Daoxin (d. 651), a Chan patriarch, was similarly protected and displayed on Mount Huangshan in Hubei province, as were the bodies of other masters in this East Asian tradition (Faure 1992).

The earliest extant example of a self-mummified corpse is that of Huineng (638–713), the sixth patriarch of Chan (Zen) Buddhism and author of the influential *Sixth Platform Sutra*. His corpse remains today, garbed in a yellow robe and a red shawl (fig. 9), in the Nanhua Monastery, where he taught, in Shaoguan in Guangdong province (Xu 1987; Matteini 2009). The *Biography of the Great Master of Caoqi* (Caoqi dashi zhuan, ca. 781) states that on 8 September 714, Huineng's corpse was taken out of an urn in which it had been desiccating for more than a year and then covered with glue and lacquer before being enshrined in a stupa.

A life-size sculpture of the Chinese monk Jianzhen (Japanese: Ganjin) (688–763) (fig. 10) attests to the spread of religious portraiture to Japan in the eighth century. Jianzhen, who founded the Tōshōdaiji Temple in Nara mentioned earlier as a center for the production of hollow-core lacquer sculptures, is revered as the founder of the Ritsu practice tradition, noted for its emphasis on the monastic code. He was blind when he reached Japan in 755 after five failed attempts, some derailed by government interference and others due to the hazards of travel. The hollow-core lacquer portrait was produced about a year after his death, possibly because his attempt at self-mummification, inspired by his visit to see Huineng's mummy around 748, failed. It also has been suggested that the textile used in the making of the sculpture was originally one of Jianzhen's garments, another means of making the sculpture a physical equivalent of this famous monk (Sharf 1992, 62).

Figure 10. *Portrait sculpture of Monk Jianzhen (Ganjin), Japan, Nara, Tōshōdaiji, Nara period (710–94), ca. 763, hollow-core lacquer with pigment, h. 79.4 cm. Yale University Library Visual Resource Collection.*

At least one additional Japanese hollow-core lacquer portrait dates to the second half of the eighth century: a life-size sculpture of the monk Gyōshin (fig. 11), an abbot of Hōryūji in Nara, who played a critical role in the Japanese cult of Prince Shōtoku Taishi (574–622). Like Jianzhen, the bald and middle-aged Gyōshin is in meditation and is holding a staff. The portrait of Jianzhen is kept in the Founder's Hall at the Tōshōdaiji; that of Gyōshin is in the Dream Hall, or Yumedono, which he commissioned at Hōryūji. Both icons preserved the appearance and the charisma of these important abbots, and they continue to serve as the foci of devotion.

The use of the hollow-core technique to make Buddhist sculptures continued, primarily in China, from the ninth to the fourteenth century, and some of the sculptures produced after the eighth century further illustrate the role of such icons in housing and safeguarding the bodies of the self-mummified and other relics. In 1996, scientists found a mummy (fig. 12) inside a sculpture of a seated monk (fig. 13) while working on the piece at the Drents Museum in the Netherlands (Bruijn et al. 2015). An inscription written on the bolster that supported the mummy identifies the figure as Zhang Liuquan, a prelate in the Chan tradition who

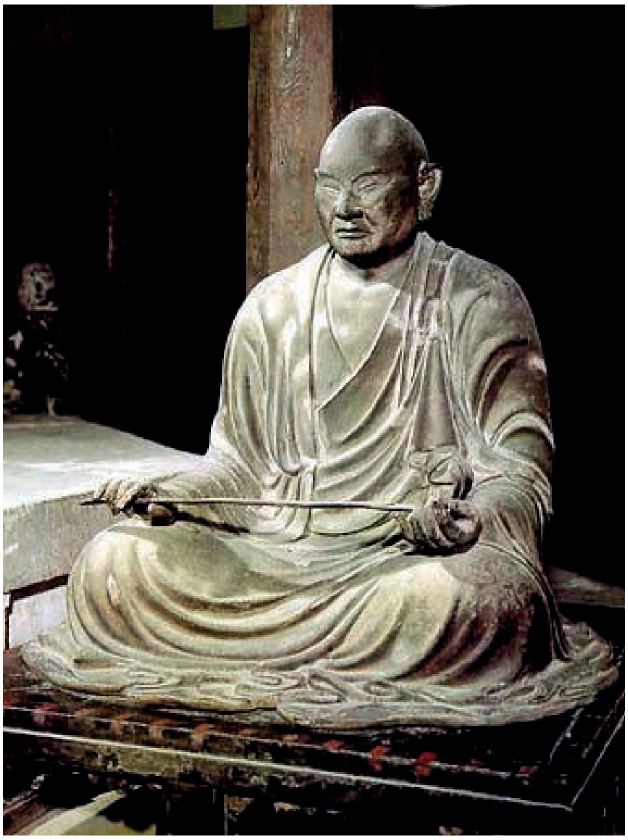

Figure 11. Portrait sculpture of Monk Gyōshin, Japan, Nara, Hōryūji, Nara period (710–94), second half of the eighth century, hollow-core lacquer with pigment, h. 88.9 cm. After Heibonsha Survey of Japanese Art *(New York: Weatherhill, 1976–80), 4: fig. 142.*

Figure 13. Portrait of Monk Liuquan (d. ca. 1100), China, Yuan dynasty (1279–1368), ca. 1272–84, hollow-core lacquer with gilding, h. 79.4 cm. After Mumien: Der Traum vom ewigen Leben*, ed. Alfried Wieczorek and Wilfried Rosendahl (Mannheim: Reiss-Engelhorn-Museen, 2015), 337, fig. 1.*

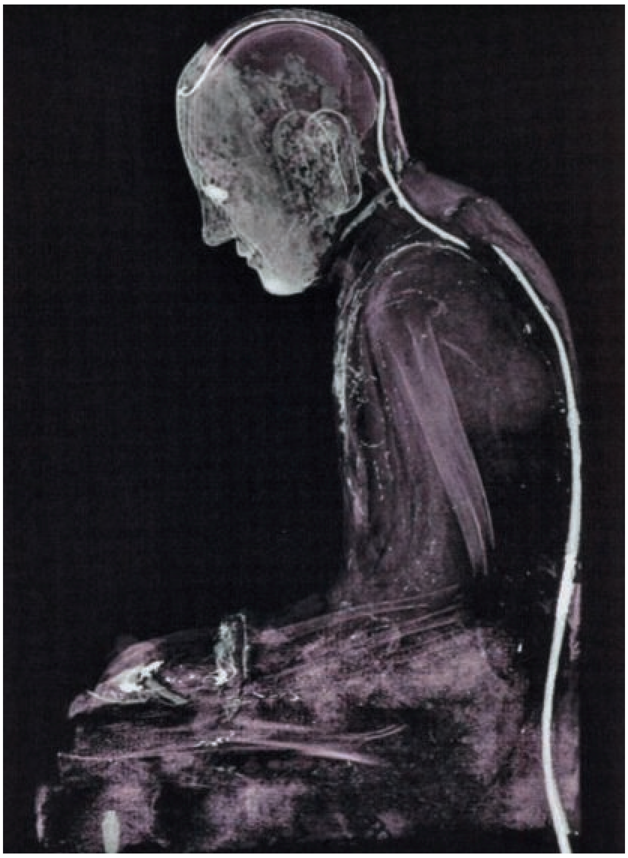

Figure 12. Mummy of Monk Liuquan (inside fig. 13). After Mumien: Der Traum vom ewigen Leben, *ed. Alfried Wieczorek and Wilfried Rosendahl (Mannheim: Reiss-Engelhorn-Museen, 2015), 338, fig. 2.*

died at age 30 or 40, around the year 1100. The sculpture shows a partially bald monk seated with his hands resting on his knees. He wears a Chinese-style robe (a garment that became standard attire for monks in China around the tenth century) under a monastic stole tied with a clasp at the right. Lush floral scrolls fill both the robe and the stole, and raised coiling dragons, presumably of lacquer and putty, decorate the sleeves and the waistline.

Imaging of the sculpture showed that Liuquan's organs had been removed and replaced with substitutes similar to those sometimes found in sculptures of buddhas. Carbon 14 testing of the remains yielded a date range from 1092 to 1149, while a similar test for the textile used in making the covering sculpture provided a range between 1272 and 1284. It seems likely that the hollow-core lacquer sculpture, made more than a hundred years after Liuquan had self-mummified, conserves the (presumably) self-mummified cleric in the same way that lacquer coats mummies. The distinctive features, particularly the broad nose and receding hairline, suggest that the artist may have followed a sculpted or painted portrait that was available in the thirteenth century and is now lost, although it is presumably possible that the remains were sufficiently intact to serve as the basis for re-creating Liuquan's appearance.

Finally, a sculpture showing Buddha Shakyamuni (fig. 14) at a noncanonical moment in his hagiography, when he descended from mountains after years of arduous practice, in the collection of the University of Pennsylvania Museum

Figure 14. *Buddha Shakyamuni, China, Yuan dynasty (1279–1368), fourteenth century, hollow-core lacquer with gilding, 81 × 83.8 × 61 cm. University of Pennsylvania Museum of Archaeology and Anthropology, Purchase from C. T. Loo, 1923, C405A.*

of Archaeology and Anthropology (Fernald 1927), provides additional evidence of links between hollow-core lacquer sculpture and relics. Several Chinese-language sutras—a fragment of a text written in Tibetan on blue paper, a bag of perfumed ashes, and another that held five silver reproductions of organs—once filled this sculpture. Although it is now lost, the bag of ashes is particularly intriguing. It seems likely that the ashes, such as those placed in the clay portrait of Hong Bian discussed earlier, were those of an individual, presumably a monk or some other person who had achieved enlightenment, becoming a Buddha.

With this in mind, it is also worth noting that some sixth-century texts define certain lacquer sculptures as *ren zhong fo* (person inside buddha) or *ren zhong xiang* (person inside image) (Soper 1959, 202). These terms are understood as references to Vairocana because sculptures and paintings representing this buddha, which also first appear in China in the sixth century, are covered with small figures that represent his generative role in the cosmos (Rei 1959; Rei 1999). However, it is also possible that "person inside buddha" and "person inside image" can be read literally as a reference to the placing of relics of various types, including mummies, ashes, or symbolic relics such as organs, inside religious sculptures.

Conclusions

The flowering of the use of lacquer for sculptures from the sixth to the eighth century, the contemporaneous interest in relics, and the parallel development of Buddhist portraiture attest to the importance of preserving the appearance and spiritual advancement of monks and other adepts in China at that time. The discovery of the lacquered corpse of a twelfth-century monk and of the bag of ashes in the fourteenth-century sculpture in Philadelphia provide rare evidence for the use of hollow-core lacquer sculptures as containers for both physical bodies and relics such as ashes. While speculative, it is certainly possible that early lacquer buddhas, particularly hollow-core examples such as those in the collections of the Freer and the Metropolitan, may also once have held the remains, if not necessarily the bodies, of the special dead.

References

Adamek, Wendy. 2016. Meeting the inhabitants of the Necropolis at Baoshan. *Journal of Chinese Buddhist Studies* 29: 10–49.

Bruijn, Erik, Amelie Alterauge, Stephanie Zesch, Ben Heggelman, Sylvia Mitschke, Francesca Coletti, Wilfried Rosendahl, Albert Zink, and Vincent T. Van Vilsteren. 2015. Die Mumie in Inneren: Eine übermodellierte Mumie eines buddhistichen Mőnchs. In *Mumien: Der Traum vom ewigen Leben*, ed. Alfried Wieczorek and Wilfried Rosendahl, 337–42. Mannheim: Reiss-Engelhorn-Museen.

Croissant, Doris. 1990. Der Unsterbliche Leib: Ahneneffigies und Reliquienporträt in der Portätplastik Chinas und Japans. In *Das Bildnis in der Kunst des Orients*, ed. Martin Kraatz, Jürg Meyer zur Capellen, and Dietrich Seckel, 235–68. Stuttgart: Franz Steiner.

Faure, Bernard. 1992. Relics and flesh bodies: The creation of Ch'an pilgrimage sites. In *Pilgrims and sacred sites in China*, ed. Susan Naquin and Chün-fan Yu, 150–89. Berkeley: University of California Press.

Fernald, Helen. 1927. A Chinese Buddhistic statue in dry lacquer. *Museum [University of Pennsylvania Museum of Archaeology and Anthropology] Journal* 18(3): 284–94.

Foulk, Griffith T., and Robert H. Sharf. 1993. On the ritual use of Ch'an portraiture in medieval China. *Cahiers d'Extrême Asie* 7: 149–219.

Friedland, Sarah Nelly. 2015. Buddhistische Mumiem in Asien. In *Mumien: Der Traum vom ewigen Leben*, ed. Alfried Wieczorek and Wilfried Rosendahl, 159–64. Mannheim: Reiss-Engelhorn-Museen.

Henan Sheng Gudai Jianzhu Baohu Yanjiusuo. 1991. *Baosheng Lingquansi.* Zhengzhou: Henan Renmin Chubanshen.

Ho, Waikam. 1968–69. Notes on Chinese sculpture from Northern Ch'i to Sui, pt. 1, Two seated stone buddhas in the Cleveland Museum of Art. *Archives of Asian Art* 22: 6–55.

Kieschnick, John. 1999. The symbolism of the monk's robe in China. *Asia Major* 12: 9–32.

Matteini, Michele. 2009. On the "true body" of Huineng. *RES: Anthropology and Aesthetics* 55–56 (Spring–Autumn): 41–60.

Rei, Yoshimura. 1959. Roshena Hōkai Ninchūzō no Kenkyu. *Bijutsu Kenkyu* 203: 14–28.

Rei, Yoshimura. 1999. Roshena Hōkai Ninchūzō Sairon. *Bijutsu Kenkyu* 242: 27–49.

Rhi, Juhyung. 2005. Images, relics, and jewels: The assimilation of images in the Buddhist relic cult of Gandhara, or vice-versa. *Artibus Asiae* 65: 169–211.

Rhie, Marilyn M. 1993. The Walters Art Gallery Chinese lacquer buddha: Dating, regional style, and iconography. *Journal of the Walters Art Gallery* 51: 89–101.

Ritzinger, Justin, and Marcus Bingenheimer. 2006. Whole-body relics in Chinese Buddhism: Previous research and historical overview. *Indian International Journal of Buddhist Studies* 7: 37–94.

Sharf, Robert H. 1992. The idolization of enlightenment: On the mummification of Ch'an masters in medieval China. *History of Religions* 32(1): 1–31.

Siren, Osvald. 1925. *Chinese sculpture from the fifth to the fourteenth centuries.* 4 vols. New York: Scribner.

Soper, Alexander Coburn. 1959. *Literary evidence for early Buddhist art in China*. Ascona, Switzerland: Artibus Asiae.

Strahan, Donna K. 1993. The Walters Chinese wood-and-lacquer buddha: A technical study. *Journal of the Walters Art Gallery* 51: 105–20.

T. = Takakusu Junjirō and Watanabe Kaikyoku, eds. 1924–35. *Taishō shinshū Daizōkyō* [Taishō Revised Tripitaka]. 100 vols. Tokyo: Taishō Issaikyō Kankōkai.

Willis, Michael. 2000. *Buddhist reliquaries from ancient India*. London: British Museum Press.

Xu Hengbin. 1987. Nanhuasi Liuzu Huineng Zhenshen kao [A study of the Genuine Body Statue of the Sixth Patriarch Hui Nêng in the Nan Hua Temple]. *Journal of the Institute of Chinese Studies of the Chinese University of Hong Kong* 18: 47–68.

Plates

Plate 1. *Buddha, ca. second half of sixth century, wood-core lacquer, 105.1 × 73.1 × 55.1 cm. Walters Art Museum, Baltimore, 25.9.*

Plate 2. *Buddha, late sixth–early seventh century, hollow-core lacquer, 99.5 × 72.5 × 56.7 cm. Freer Gallery of Art, Smithsonian Institution, Washington, D.C., Purchase—Charles Lang Freer Endowment, F1944.46.*

Plate 3. *Buddha, probably Amitabha, seventh century, hollow-core lacquer, 96.5 × 68.6 × 57.1 cm. Metropolitan Museum of Art, New York, Rogers Fund, 1919, 19.186.*

Plate 4. *Head of bodhisattva, eighth century, hollow-core lacquer, 45.8 × 25.2 × 22.5 cm. Private collection.*

Plate 5. *Attendant bodhisattva, mid- to late thirteenth century, hollow-core lacquer, 58.5 × 43.3 × 29.5 cm. Freer Gallery of Art, Smithsonian Institution, Washington, D.C., Purchase—Charles Lang Freer Endowment, F1945.4.*

Exploring the Techniques of Early Chinese Lacquer Buddhas

Donna Strahan

ABSTRACT Three rare Chinese lacquer buddhas dating from the late sixth to the seventh century are located in the United States. This article provides the results of a detailed analysis of the construction, repairs, and internal features of these three buddhas and of two later period bodhisattvas. Though they were fabricated over an eight-hundred-year span of time, the same traditions and similar techniques and materials were used in all five sculptures. While the design styles of the sculptures may have changed over time, the techniques varied little.

Introduction

The Freer and Sackler united for the first time the most important early Chinese lacquer buddha sculptures known to exist. These sculptures were explored in tandem with the exhibition *Secrets of the Lacquer Buddha*, on view at the Arthur M. Sackler Gallery from 9 December 2017 through 10 June 2018. Working from both art-historical and scientific perspectives, *Secrets of the Lacquer Buddha* provided an opportunity to determine how and of what these unique sculptures were made. In addition to lacquer techniques, the construction, repairs, and internal features of the sculptures were investigated (Strahan and McCarthy 2018). The research reported here offers a holistic view of early Buddhist lacquer sculptures, demonstrating the complexity and sophistication of these works.

The Five Sculptures

The three lacquer buddha sculptures studied are life-size and date from the late sixth to the early seventh century. One is in the Walters Art Museum in Baltimore (pl. 1, p. 12); a second is in the Freer Gallery of Art in Washington, D.C. (pl. 2, p. 13); and the third is in the Metropolitan Museum of Art in New York (pl. 3, p. 14). The two later period lacquer bodhisattva sculptures studied are an eighth-century head in a private collection (pl. 4, p. 15), and a small thirteenth-century sculpture in the Freer (pl. 5, p. 16). The Walters buddha is the earliest preserved example of a sculpture made using the wood-core lacquer technique. The other four sculptures were produced with the hollow-core lacquer technique. None of the sculptures contain any remaining consecratory material inside their hollows (for more details on these sculptures, see Leidy, in this volume, and McCarthy, also in this volume).

Although this study included only five sculptures, they offer insights into the relationship between the use of lacquer as a sculptural medium and religious practice during the formative period in East Asian Buddhism from the sixth to the thirteenth century. Together, the five sculptures allowed a comparison of lacquer sculpture techniques across eight centuries.

The Walters Buddha

The Walters buddha (see pl. 1) was acquired in the early 1920s from the Japanese dealer Yamanaka Sadajirō (1866–1936) and believed to be from the Great Buddha (Dafosi) Temple in Zhengding, Hebei province, China (Siren 1925, 3: pl. 547). Stylistically, its rounded body, full flat face, and long arched eyebrows typify sculptures from the first decades of the Sui dynasty (581–618) (Rhie 1993). Its head lacks curls. Originally they may have been painted on or individually created using a lacquer putty. An open cavity in the back was most likely filled with dedicatory material that served to consecrate the sculpture (see fig. 9a). Originally, a panel would have sealed off this cavity, but it is now missing.

The Freer and Metropolitan Buddhas

Like the Walters buddha, both the Freer buddha (see pl. 2) and the Metropolitan buddha (see pl. 3) sit in meditation. The Metropolitan buddha was also acquired from Yamanaka and like the Walters is thought to have come from a Dafosi Temple in Hebei province (Siren 1925, 3: pl. 548). The Freer buddha was purchased in New York from Ellis Monroe in 1944. Both differ stylistically from the Walters buddha, especially in being narrower and thinner, and are later in date—the Freer buddha from the late sixth–early seventh centuries and the Metropolitan buddha from the early seventh century. Neither has any curls remaining on the heads. The place where hair should be remains rough and unpainted, and it is likely that lacquer putty curls were once individually adhered. The irregular holes in the backs of these two hollow-core buddhas were probably made by robbers removing consecratory materials (see figs. 9b and c).

The Bodhisattva Head

The eighth-century bodhisattva head (see pl. 4), which was not on view in the exhibition but was part of the study, illustrates the continuing Chinese response to imported Indian and Central Asian traditions first seen in the Freer and Metropolitan buddhas. The bodhisattva's full face and features and the elaborate chignon covering the *ushnisha* typify art of the mid-Tang dynasty (618–907). This head, which was once part of a monumental sculpture, represents a classic type of East Asian Buddhist sculpture. Fragments of the hair are present above the ears and the middle of the forehead. What remains is combed locks with no evidence of curls. The back of the head is missing, providing access to the interior of the face.

The Yuan Bodhisattva

Finally, the study included a thirteenth-century bodhisattva in the Freer (see pl. 5) from the Yuan dynasty (1279–1368). Historical and stylistic evidence suggests it was made by the sculptor Anige (1245–1306) or his entourage. It is believed to have been made in China at the Yuan court and thus is a marriage of Nepalese style and the hollow-core lacquer technique. It is the smallest sculpture of those studied. The locks of hair are piled on top of his head. The sculpture is complete with few losses and minimal repair (for a detailed study, see Jing, in this volume).

Buddhist Lacquer Techniques

Not much is known about early Buddhist lacquer techniques because so few sculptures exist. It was thought that early Chinese lacquer buddha sculptures were expensive and fragile; through scientific analysis, this assessment is now confirmed, but many questions remain. Though they were created over an eight-hundred-year period, were the same traditions, similar techniques, and similar materials used in all five sculptures? Could the materials be used to shed light on the sculptures' use as reliquaries? And could the Metropolitan and Freer buddhas have been made in the same workshop but by different hands? Or was each one the work of a single artist? While this study was not able to answer all these questions, it did uncover substantial new insights.

Lacquer sculpture is a very difficult, time-consuming, and expensive craft. The first step is to create a core onto which the lacquer can be sculpted. As noted, the Walters buddha is the only one in the study constructed on a wood core. It was carved from a solid, joined wood structure. The Freer and Metropolitan buddhas, the bodhisattva head, and

Figure 1. *Tapping a lacquer tree in Japan. Photo courtesy of Shuichi Noshiro, Forestry and Forest Products Research Institute.*

the Freer bodhisattva are hollow-core lacquer sculptures, formed over clay cores that were removed prior to completing the sculptures.

Once the core is completed, layers of cloth strips wet with lacquer are applied, helping to create a more detailed, three-dimensional form. All five sculptures were fabricated with the same technique often called the dry lacquer technique. In Chinese it is known as *jiazhu* 夾紵, which roughly means "binding layers of hemp". The English term "dry lacquer" probably refers to the addition of powdered materials mixed in the lacquer resin to make it less fluid, essentially drying it out and making it easier to work with. In this article (and others in this volume), the word "dry" has been omitted to improve accuracy and readability.

Asian lacquer is a resin. This sticky substance is essentially a water-in-oil emulsion that sets by polymerization to become tough, flexible, and durable. It is produced from the sap of a number of trees belonging to the Anacardiaceae family. Regardless of the type of sap used, the refining and fabrication techniques of lacquer are similar. The main tree species that produces the resin used to make lacquer, known as *Toxicodendron* (formerly *Rhus vernicifera*) *vernicifluum* and in the cashew family, is cultivated in China, Japan, and Korea. Raw lacquer tree resin is toxic and causes a poison ivy–like contact dermatitis that may be severe and even fatal.

The tree is usually tapped in summer and the sap purified and condensed to form a paste (fig. 1). Excess water

Figure 2. *Computerized tomography scanning of the Freer buddha at the National Museum of Natural History, Smithsonian Institution.*

present in the sap is evaporated by slow warming. Lacquer is then divided into processed and unprocessed grades. The processed lacquer is further divided into plain lacquer, to which additives such as extenders and coloring materials are added, and black lacquer, to which color from iron filings or soot is added (Webb 2000, 8).

Once purified and applied to a surface, lacquer requires a temperature of 20–28°C and high relative humidity (more than 65% is best) to harden into an impervious film. Lacquer objects are usually made of multiple layers of lacquer, and many weeks of work, even up to a year, may be required to complete a single object. Each layer must cure before the next layer can be applied. Once set, lacquer produces a tough, resistant coating.

When lacquer is applied to an object, the first or lowest layer is often bulked with fillers to seal and fill flaws in the support. Fillers vary depending on the support: examples include raw or fired powdered clays, sawdust, starch, ground-up dried lacquer, seashells, bone ash, and wood ash.[1] Then thinner layers are applied. The lacquer sculptures we studied were completed with brightly colored paint and gilding.

Chinese classical texts and historical documents produced over hundreds of years mention lacquer, but few of them contain in-depth fabrication details (Wang 1983, 165–66; Watt and Ford 1991, 15–39; Chang, in this volume). Fortunately, recent developments in analytical techniques have made it possible to identify many of the materials used in Asian lacquer objects, including the five sculptures researched (Schilling et al. 2016; Schilling, in this volume).

Methods of Study

Multiple analytical methods were used to answer questions concerning the structure and composition of the lacquer sculptures.

X-ray radiography and computed tomography (CT) scans were used to study the sculptures' construction, joining methods, repairs, and other features not visible on their exteriors (fig. 2).[2]

Binocular and plane-polarized light microscopy (PLM) were employed to study minute samples removed from the sculptures (figs. 3 and 4). Using known reference materials for comparison, these techniques can identify unknown substances. They helped to identify the cloth on the sculptures as well as to examine the lacquer, lacquer layers, lacquer inclusions, and pigments. Cross-sections and dispersed samples of pigment and lacquer were examined using reflected, transmitted, polarized, and ultraviolet light microscopy. Stains were applied to selected lacquer samples and viewed under the microscope in both visible and ultraviolet light to help identify components in each lacquer layer.[3]

Figure 3. *Donna Strahan studying the Freer buddha under binocular microscope.*

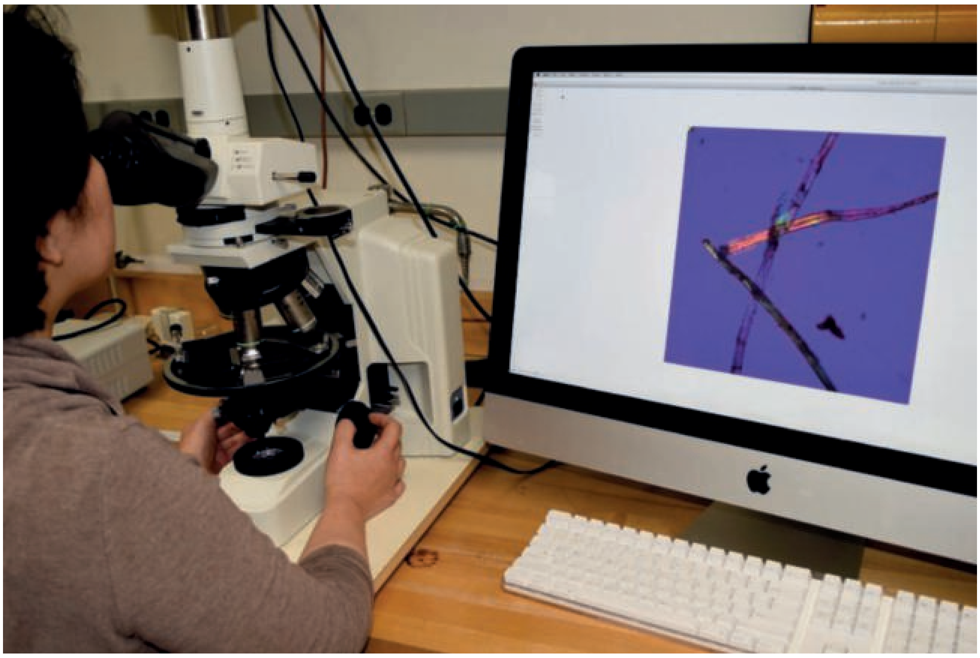

Figure 4. *Scientist using polarized light microscope to identify fibers.*

X-ray fluorescence (XRF) analysis is a nondestructive analytical technique used to determine the elemental composition of inorganic materials. It helped confirm the identification of pigments and the material used for the eyes, which could not be sampled (fig. 5).[4]

Scanning electron microscopy (SEM) allows magnification far beyond that attainable with a light microscope. When the SEM is equipped with energy dispersive x-ray spectroscopy (EDS), it is capable of identifying individual elements. This technique was used to isolate inorganic elements present in the lacquer layers. The information obtained confirmed many of the findings from PLM. In addition, elemental distribution maps were produced to confirm the location of specific elements within cross-section layers. SEM images were an additional aid in identifying morphological features of various inclusions, such as bone in the lacquer.[5]

Fourier transform infrared spectroscopy (FTIR) obtains an infrared spectrum of a material for identification. It was used to understand the components of the individual textile layers and their relationship with the clay core.

Pyrolysis–gas chromatography mass spectroscopy (Py-GCMS) was used to identify all the organic components mixed in each lacquer layer. The National Institute of Standards and Technology's Automated Mass Spectral

Figure 5. *Matthew Clarke performing x-ray fluorescence analysis on the Freer buddha's eye.*

Figure 6. *Blythe McCarthy analyzing lacquer samples by pyrolysis–gas chromatography mass spectroscopy.*

Deconvolution and Identification System (AMDIS) was used for deconvolution and identification of the data, and the expert system RAdICAL (Recent Advances in Characterizing Asian Lacquer), developed at the Getty Conservation Institute, was used for interpretation (Schilling et al. 2016, 3–27) (fig. 6).[6]

Proteomics is a field of molecular biology that studies the proteins in organisms. In proteomics, proteins in a material (in this case, bone) are broken up into their component peptides. The molecular weight of the peptides together with the sequences of amino acids that they contain can be compared to databases of known protein sequences to identify animal species.[7]

Materials

Wood

As a wood-core lacquer sculpture, the Walters buddha's core is made entirely of wood, with clay filler used in the lips, ears, textile folds, and possibly the eyelids. It is composed of twelve pieces of solid, carved wood pegged together with wood dowels and iron nails (Strahan 1993). The back was hollowed out, providing a large cavity that probably held dedicatory material. The wood panel that originally covered

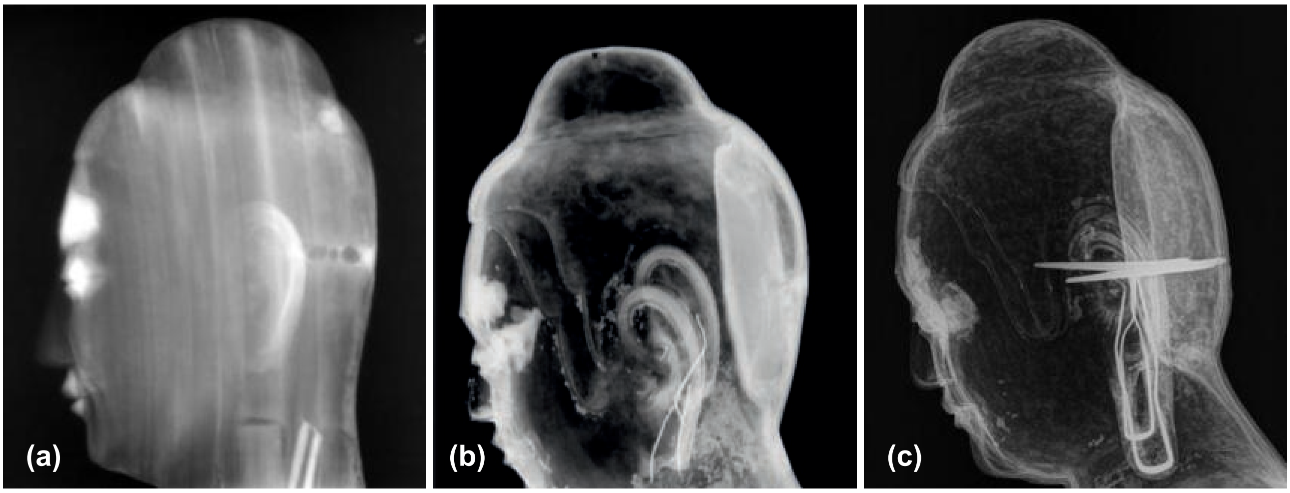

Figure 7. X-ray radiographs of side view of the heads of the three life-size buddhas. **a.** *Walters buddha.* **b.** *Freer buddha.* **c.** *Metropolitan buddha. Repairs to the third eye, and nails or holes through the wood blocks in the heads for holding halos are revealed. Photo* **a** *courtesy Walters Art Museum; photo* **c** *courtesy Metropolitan Museum of Art.*

Figure 8. X-ray radiograph of Freer bodhisattva, revealing wire armature in fingers.

the cavity is now missing. There is no visible coating sealing the inside of the open wood cavity in the back.

The Metropolitan buddha, both Freer sculptures, and the bodhisattva head are hollow-core lacquer sculptures. They are hollow from the top of the head through the torso cavity and open on the bottom. Wood pieces are used for support in both buddhas, although not always in the same location. Both buddhas have narrow wood pieces enclosed in textile running around the interior edges of their bases, providing structural support to a location that receives much wear and for securing a cover over the open bottom. Some wood pieces are later replacements, but those wrapped in textile are original.

Additionally, embedded in the textile of the Metropolitan buddha are three wood boards running vertically up the buddha's back, acting as a spine. The Freer buddha does not have any wood in its back. However, the Freer buddha's forearms are formed from two planks of wood butt-jointed just below the elbow. No wood was used in the arms of the Metropolitan buddha; they are hollow. Nor is there any wood in the smaller Freer bodhisattva; presumably because of its small size it did not need internal support. Its arms are also hollow.

The bodhisattva head does not contain any wood because it is only a fragment of a much larger sculpture—nearly 228 centimeters (7½ feet) tall if it was a seated sculpture.[8] No doubt wood was used to support certain areas of such a large sculpture.

The Freer and Metropolitan buddhas have vertical wood slabs in the back of the heads, encased in the textile strips. In x-ray radiographs, two large, horizontal nail holes can be faintly seen penetrating the boards of the Freer buddha (fig. 7b). The Metropolitan buddha has the remains of two large iron nails in the holes (fig. 7c). Two similar holes are present in the same location of the Walters buddha's wood head (fig. 7a). These were probably used to hold now-missing halos. All three buddhas have repairs covering the holes. The back of the head is missing from the bodhisattva head; therefore, it was not possible to determine whether a halo ever existed.

The hands of all three life-size buddha sculptures are missing. They would have been attached separately and made of either wood or lacquer with wire armatures in the fingers similar to the method that was used in the Freer bodhisattva (fig. 8).

Both the Freer and Metropolitan sculptures have irregular holes (approximately 12 cm in diameter) in the middle of their backs (figs. 9b and c). These were probably made for the robbing of dedicatory material. The hole in the Metropolitan buddha is off center, toward the right, and so it avoids the wood armature running up the back. As noted

Figure 9. *Reverse of three life-size buddhas.* **a.** *Walters buddha.* **b.** *Freer buddha.* **c.** *Metropolitan buddha.*

Figure 10. *The hollow interior of the bodhisattva head reveals the multiple textile strips and thinness of the face.*

Figure 11. *Positive 3-D print of interior of bodhisattva head revealing the shape of the now removed core.*

above, the Walters probably had a wood panel covering the cavity (fig. 9a) so it was not necessary to make a hole to access the dedicatory material.

In the past, carbon 14 dating was carried out on wood from the Walters and Freer buddhas.[9] The results are broad (Walters: range of 420–645 CE; Freer: range of 474–574 CE) because the size of the trees and the locations where the samples were taken do not provide a date for when the sculptures were made but rather only for some point when the tree was growing. Additional carbon 14 dating on the

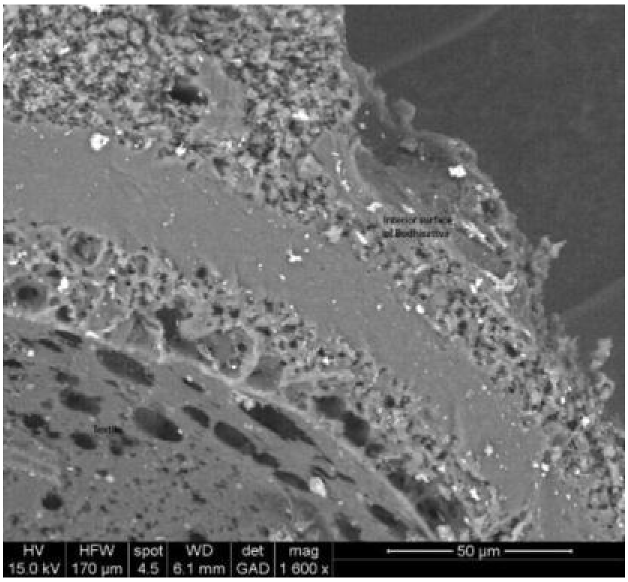

Figure 12. *Backscattered electron image of cross-section of material removed from interior of bodhisattva head. The interior layer at top is residual clay from the core and contains protein; the middle layer is lacquer; the bottom layer is the interface between the lacquer and the textile.*

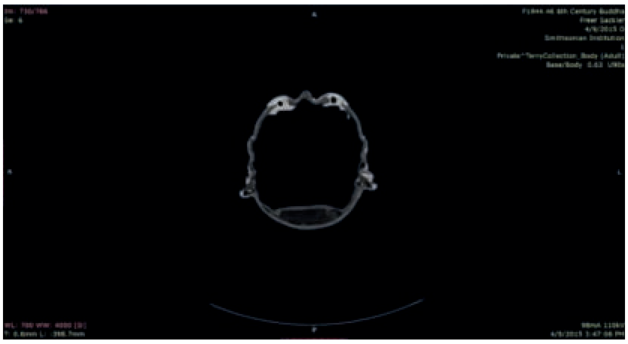

Figure 13. *CT scan of the Freer buddha, showing white areas that are clay used to bulk out the drapery folds.*

Figure 14. *Close-up of the textile strip's weave structure on the interior of the Freer buddha.*

textile or lacquer would give more accurate dates. One fiber and two textile samples from the Freer bodhisattva were carbon 14 dated. The average of the three results attributed it to the mid- to late thirteenth century (Jett 1997).

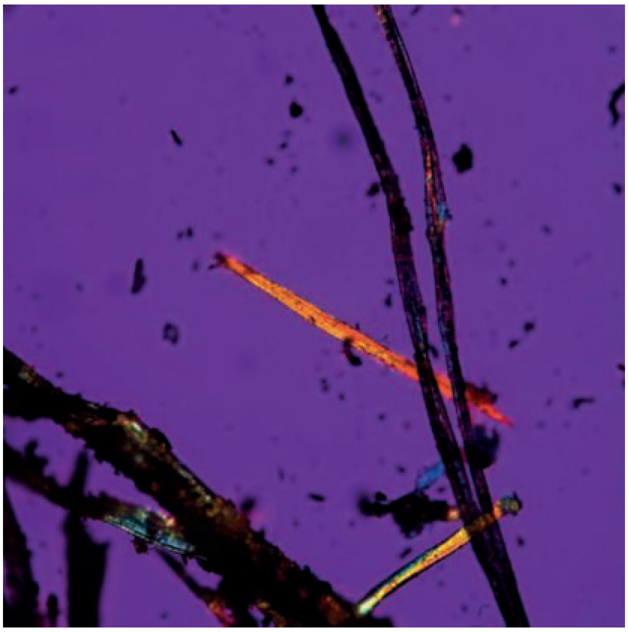

Figure 15. *Identification of the hemp fibers was confirmed under the polarized light microscope. Here the fiber is viewed under crossed polarized light with a gypsum plate. It is yellow when turned 90° from extinction.*

Clay Core Material

The development of hollow-core lacquer sculptures was an improvement over the wood-core lacquer technique. Without wood, objects became insect impervious, since lacquer is toxic. They also became lighter. The Freer and Metropolitan buddhas each weigh only about 30 pounds (13.6 kg), while the Walters buddha weighs more than twice as much. Finally, the hollow bodies provided space for depositing consecratory materials.

To begin a hollow-core lacquer sculpture, an artist makes a clay core in the shape of the desired image. In the buddhas and the bodhisattva head, an internal armature was likely needed to support the clay during fabrication. Once a sculpture was nearing completion, the clay core and armature were removed, leaving a hollow shell.

The bodhisattva head is essentially a mask: it is completely open in the back, providing access for study. To determine the level of detail in the head's original clay core, Smithsonian Exhibits made a 3-D scan of its interior and exterior (fig. 10).[10] Then a positive print of the interior scan was created (fig. 11). It revealed that a surprising amount of detail was carved in the original clay core. Examination of the interior of the Metropolitan and both Freer sculptures revealed that their cores were not as detailed, perhaps because of their smaller size, but it was not possible to scan the tight space.

All four sculptures have clay in between drapery folds and/or in noses, ears, lips, and eyelids to form fuller dimensions. Only the bodhisattva head still contains accessible clay clinging to the interior of the face, in the recesses of the lips, chin, and nose. A sample revealed it to be a gray-tan unfired clay with a fine texture. The clay is uniform in particle size with no added organics visible in SEM images; however, a large carbon peak was present in EDS spectra.

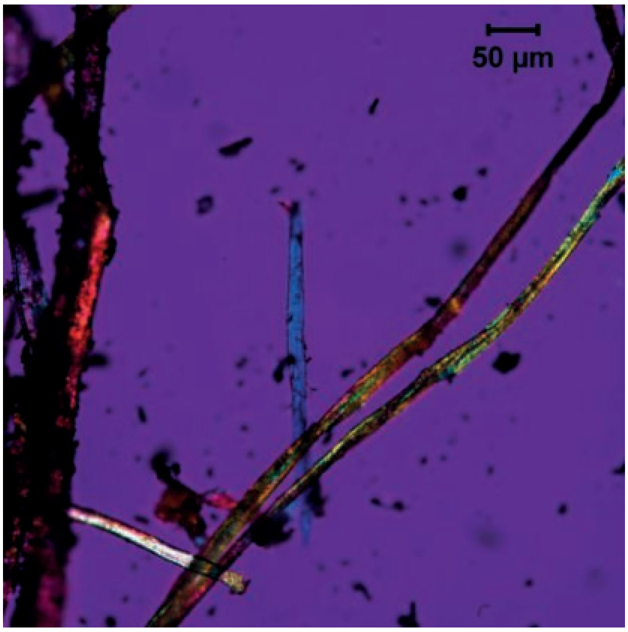

Figure 16. *Here the fiber is viewed under the same conditions as figure 15, but it becomes blue when turned 90° in the opposite direction, confirming it as hemp.*

Figure 17. *X-ray radiograph of the bodhisattva head showing where the separate top section of the head was attached above the forehead. Similar attachments can be seen in the x-ray radiographs of the other hollow-core Freer and Metropolitan buddhas (see figs. 7b and c).*

The carbon is from the lacquer that was used to adhere the textile onto the clay (fig. 12).

In all the sculptures, the textile was bulked with clay to form naturalistic folds in the robes. This technique is especially evident in the x-ray radiographs and CT scan of the Freer buddha (fig. 13). In the Freer buddha, EDS found aluminum between the textile fibers in the weave at the base of the lacquer, confirming that clay was used on the textile.

Textile and Fibers

Once the wood or clay core of the sculptures was completed, it was covered with cloth strips wet with lacquer. The textile provided the dried brittle lacquer with more flexibility and strength. It also made the lacquer more durable, helping to prevent loss, especially when the wood core expanded and contracted during changes in relative humidity. However, the movement of the wood does cause the lacquer to crack or fracture, especially over wood joins.

Strips of plain-woven textile were dipped in lacquer and placed over the core piece by piece (fig. 14). Small individual strips allowed for more control over shrinkage or stretching of the textile than a larger piece of fabric would have. Cloth layers were built up, and, when needed, additional strips were used to create folds in the drapery and enhance other details over the core. The strip ends that could be identified did not have selvages. The ends and sides of the textile were often already frayed and unraveling when they were applied. Some locations have as many as six layers of cloth; others have only two.

The textile strips were of varying lengths. All textiles have an S-twist to the fibers, except for those in the Freer bodhisattva, which have a Z-twist. The thread counts for the sculptures are: Walters, 12–16 threads per square centimeter; Freer buddha, 10–15 threads per square centimeter; Metropolitan, 10–12 threads per square centimeter; bodhisattva head, 8–12 threads per square centimeter; Freer bodhisattva, 12–15 threads per square centimeter. The fibers from all five sculptures were identified by PLM as bast fibers with crystalline nodes. The fibers' colors further identified all of them as hemp when examined under polarized light using the first-order gypsum plate and compared with known samples (Goodway 1987; Haugan and Holst 2013) (figs. 15 and 16).

The structure of the larger, hollow-core lacquer sculptures—the Freer and Metropolitan buddhas and the bodhisattva head—was built in two phases. In the first phase, lacquer-soaked textile strips were applied to the clay cores. The tops of the heads were either left open or cut off after this phase cured. Once the textile layers with lacquer cured, the clay core was removed both through the top of the head and through the open bottom. The open top of the head provided access to the interior of the face. At this point, the eyes—including the third eye, now missing and filled in four of the sculptures—were set in; the Freer bodhisattva did not have a third eye. The larger bodhisattva head has an additional cloth square adhered over the back of the eyes to help hold them in place.

After work on the interior was complete, phase two began. The top section of the head was reattached or made separately and attached. The separate attachment is clearly seen on the interior of the sculptures and in x-ray radiographs but is well hidden on the exteriors. Then more textile was added and, finally, lacquer layers (fig. 17; see also figs. 7b and c).

Figure 18. Close-up of pooled lacquer on the interior of the bodhisattva head.

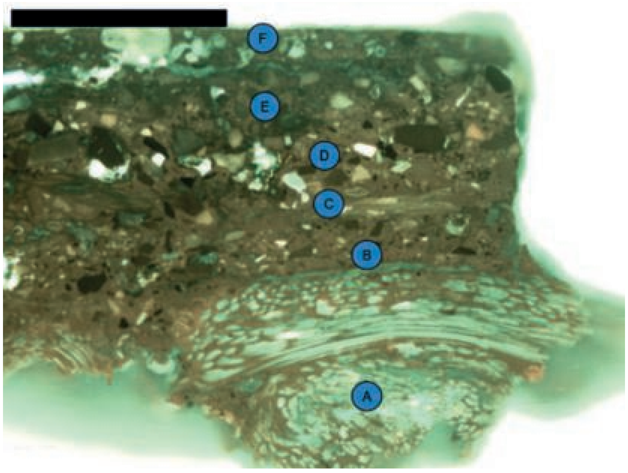

Figure 19. Image of the right half of a cross-section of the Freer buddha under ultraviolet light. The layers are lettered from the interior layer, which in this case is the textile (A). Scale bar = 500 µm. (See McCarthy, in this volume)

The smaller, Yuan bodhisattva was completed in one phase. Access to remove the clay was from the open bottom, through a square opening in the back, and from the forearms prior to attaching the hands. The sculpture is entirely hollow, including the arms and head, with no wood supports. The hands and fingers are made over a wire armature with a bulked lacquer putty creating their shape. On top of the putty layers, finer lacquer layers provide a smooth surface, similar to the ears of all the sculptures (see fig. 17).

The textiles in the interiors of all four hollow-core lacquer sculptures, originally in contact with the clay core, have a reddish-brown color. In the bodhisattva head, the reddish-brown material was applied as a liquid and pooled in some areas around the neck. A sample was taken from one of these areas (fig. 18), and the cross-section was imaged in both binocular and scanning electron microscopes (see fig. 12). GCMS identified lacquer and a protein glue in the sample. The sample was composed of three layers, which were then analyzed individually with FTIR.

The first layer of the sample from the interior of the bodhisattva head—the layer closest to the clay core—was the sole source of the protein seen in the GCMS analysis. This layer contains mostly residual clay from the core and soil, as confirmed by EDS, which found elements from clays: aluminum, silicon, magnesium, potassium, calcium, and iron, the source of the sample's red color.[11] The presence of protein only in this first layer suggests either that the core was formed of a mixture of clay and protein glue or that the clay was coated with a protein glue before the lacquer and textile were applied.

The next two layers in the sample from the bodhisattva's interior contain primarily lacquer: a thick, black, homogeneous lacquer in the second layer, and a bubbly, light brown lacquer in the third layer, which coated the textile. The bubbles in the third layer were formed when the lacquer was applied to the textile and air was trapped in between. The small amount of quartz, clay, and other particles found in this layer may have adhered to the lacquer coating before the textile was placed against the clay core. As there is interpenetration between the clay and the lacquer-coating layer, the coated textile must have been applied wet.[12] Certainly, it would have needed to still be wet to flexibly follow the clay core's contours.

Lacquer and Its Additives

Lacquer was used to apply the textile to the clay core as well as to form details of the sculptured surface. All five sculptures studied were made with *Toxicodendron vernifluum* lacquer species. The resin was commonly mixed with various materials to alter its properties depending on its use. The lacquer structure in all five sculptures includes multiple layers: a lacquer coating on the textile (A) to attach it to the core; a thin lacquer layer above the textile coating to seal and smooth it (B); a thick area of coarser material to provide bulk, composed of one to multiple layers (C) (D) (E); and finally the finer top layers (F) (fig. 19).

Lacquer layers from each of the sculptures were analyzed layer by layer to understand how the sculptures were made. A general description of the materials identified follows (for further details on the components in the layers of each sculpture, see McCarthy, in this volume).

Bone

The most prevalent inclusion in all five sculptures is ground, partially burnt bone (fig. 20). It was clearly used as a filler to bulk up the lacquer and to form a paste or putty. The bone particles were visible using microscopy, and their identification was confirmed by EDS in a scanning electron microscope.

X-ray maps, collected with EDS by scanning over the sample, show the distribution of different elements and were used to determine which layers contained bone. Figure 21 shows x-ray maps for calcium, phosphorous, and silicon for the bodhisattva head sample. The overall brightness of the calcium and phosphorous maps indicate that finely ground bone is present throughout the cross-section, and the large, bright areas in the middle and near the surface of the maps are large bone fragments (up to 120 µm diam.). The sharp-edged particles of ground bone vary from light to dark in color depending on the degree to which the bone was burned.

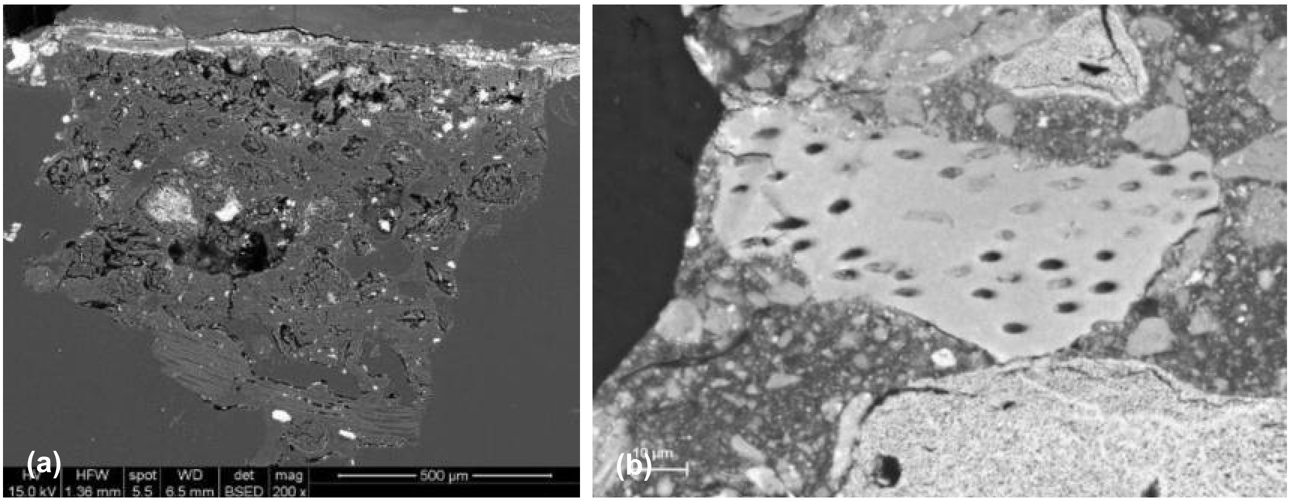

Figure 20. *Scanning electron microscope images of bone particles in lacquer layers of the Metropolitan buddha.* **a.** *Overall lacquer cross-section.* **b.** *Bone fragments. Photo courtesy Federico Carò, Department of Scientific Research, The Metropolitan Museum of Art.*

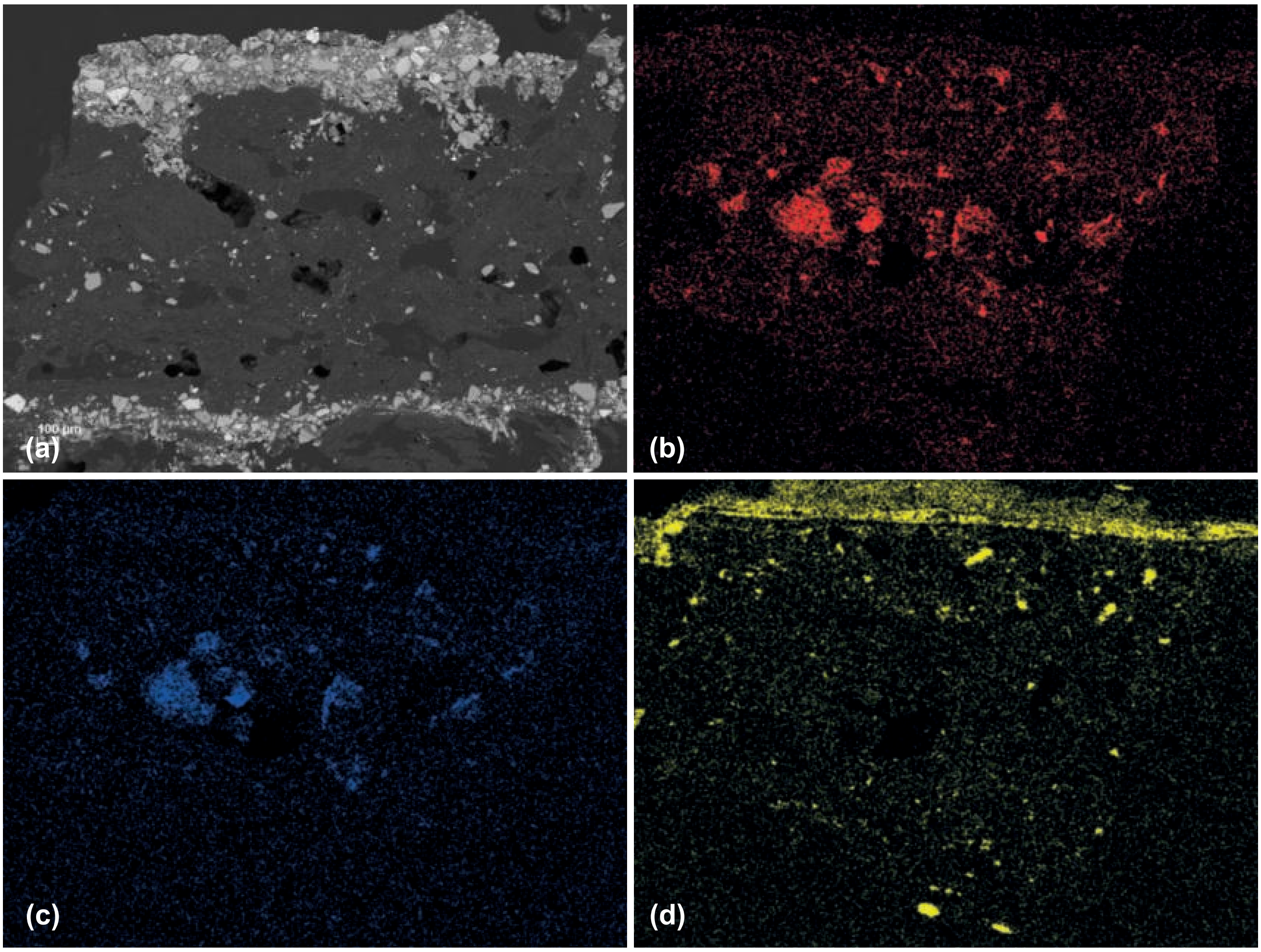

Figure 21. *Cross-section from the bodhisattva head showing the distribution of elements by EDS. The wide distribution of calcium and phosphorous signifies that bone is distributed throughout the sample* **a.** *Backscattered electron image of the cross-section.* **b.** *Calcium x-ray map.* **c.** *Phosphorous map.* **d.** *Silicon map.*

In all the sculptures, the bone fragments near the textile substrate are generally small, as would be expected to allow the lacquer to fill in holes and flaws in the textile and form a smooth, even surface. In the middle layers, the bone fragments are larger, as their primary purpose is to bulk up the lacquer. Toward the top surface, the bone fragments again decrease in size and amount, as necessary to form a smooth surface that could be polished. The bone near the surface tends to be more uniformly burned and black in color, possibly to blend with the darkened color of the lacquer that was colored by tannins and/or soot.

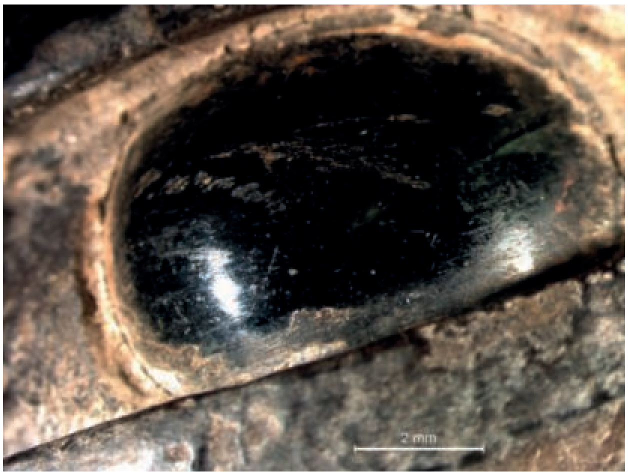

Figure 22. *Close-up view of the bodhisattva head's left eye.*

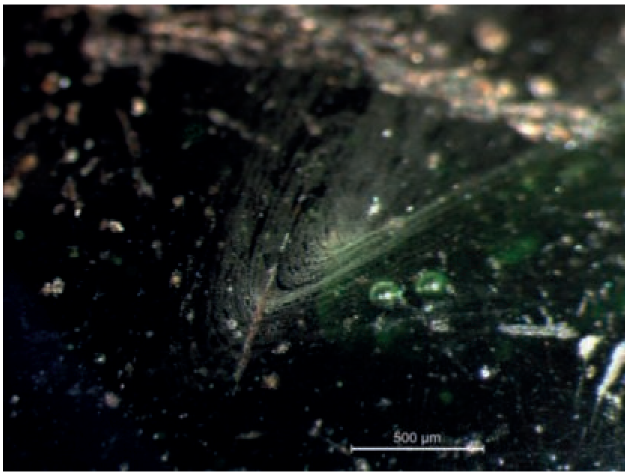

Figure 23. *Magnified view of eye in figure 22 with flow lines and bubbles in the glass.*

Ground burnt bone, although not common, has been used to bulk Chinese lacquer at least since the Warring States period (475–221 BCE): it was found in the foundation lacquer layers of a cart in a tomb burial dating to that time (Jin et al. 2012). Bone could be ground into a variety of sizes, from coarse to fine particles. Bone powder particles are nonabsorbent, lightweight, and nonreactive to the lacquer resin.

Bone is composed of roughly 75% inorganic material and 25% organic material. Burning the bone would remove most of its organic components. However, residual proteins or other organics could help bond the bone to the lacquer matrix. It is clear that as one of the main ingredients, bone helped add body to the lacquer, creating a dough-like paste that made it easier to apply to vertical surfaces.

What kind of bone was used in these sculptures? Was it animal or human—perhaps the cremated remains of a monk? Attempts were made to answer these questions with DNA analysis. A sample of the Freer buddha was given to Robert Fleischer, research zoologist at the Smithsonian's National Zoo's ancient DNA laboratory. Unfortunately, he could not get a result, as the lacquer has its own DNA and the bone was partially burned, so most of the organic remains were destroyed.

The protein in the lacquer was then analyzed via proteomics to determine the bone species. Timothy Cleland, physical scientist at the Smithsonian's Museum Conservation Institute, ran the analysis and determined that the major source of bone protein in the lacquer of the bodhisattva head and the Freer bodhisattva was equid (horse or donkey), not human. Cleland also analyzed the source of bone protein in the Walters, Freer, and Metropolitan buddhas and found it to be bovid (cow).[13] However, since it is not possible to separate the bone from the remainder of the lacquer, further research is needed to determine whether other protein materials in the lacquer, such as animal glue, affected the proteomics results.

Miscellaneous Materials

Eyes

The eyes of all five sculptures are similar in that they are white with black, shiny pupils. The Walters buddha's eyes have both been replaced with restored eyelids. XRF analysis confirmed that they are calcium-rich but not glass.[14]

The eyes of the Freer buddha consist of black pupils set into the head with a white surround of clay or lacquer putty. The right eye was repaired at one time, but both pupils look to be the same material. This material is not completely opaque to x-rays. XRF on both eyes determined the eyes are glass with copper and iron present but no significant barium.[15]

The Metropolitan buddha's left eye is original; the right eye is restored, as confirmed by XRF analysis. The left eye is made of leaded glass with some copper and iron present and no significant barium, similar to the eyes of the Freer buddha and the bodhisattva head. It also has a stem out the back, similar to one extending out of one of the bodhisattva head's eyes. The left eye's white pigment was identified as primarily muscovite and quartz.[16]

The bodhisattva head's eyes are solid, dark green spheres, one of which has a stem extending out the back. Bubbles help confirm they are made of glass. The bubbles are round and not stretched, so they were not made from a pulled glass rod (figs. 22 and 23). XRF analysis confirmed they are comprised of leaded glass with some copper and iron present but no significant barium,[17] similar to the Metropolitan buddha's original eye and the Freer buddha's eyes. There is no evidence of restoration; therefore, both of the bodhisattva head's eyes must be original.

The Freer bodhisattva's eyes are original, small round balls identified by XRF as a potassium alkali glass.[18] No third eye is evident.

Ears

The ears of all five sculptures are constructed the same way. The earlobes are formed of U-shaped iron wires with a square cross-section. Although the Freer buddha has lost its earlobes, the remains of iron wires can be seen in x-ray radiographs. The Walters buddha has also lost its earlobes, but while there is no visible or radiographic evidence, wire likely was used in them as well.

The Metropolitan buddha still has earlobes, and the wires are visible in x-ray radiographs (see fig. 7c). The head of the bodhisattva also still has its earlobes. From the interior, the ends of the thick iron wires can be seen extending into the head (see fig. 17). Clay was applied over the wires of both the Metropolitan buddha and the bodhisattva head, with multiple lacquer layers covering the clay. The Freer bodhisattva still has iron wires running through the lobes and up around the top of the ear.

Pigment

After the multiple layers of lacquer were applied and cured, the sculptures were painted in realistic colors and designs. All five sculptures were originally painted following the same color scheme and design. Today much of the pigment that remains is barely visible, and the designs are highly fragmented. Sculptures were often restored or repainted multiple times during their service; therefore, it was not possible to characterize the remaining pigment on each sculpture to the same extent as other components.[19]

The flesh areas of all five sculptures were gilded over a pink paint layer on a white ground. This combination reflected how the historic Buddha's golden skin radiated in a physical manifestation of his achievement of Nirvana.

The ground layer has been identified as lead white on the three life-size buddhas and the Freer bodhisattva. The pink flesh color is a mixture of red lead and vermilion. Azurite blue was found on the hair of all five sculptures and identified by PLM and XRF analysis. The lips of all five have traces of vermilion red.

The Metropolitan buddha retains the most color. An altered image illustrates its reconstructed appearance (see Leidy, in this volume, fig. 2). The shawl is a patchwork in red squares, with wide, dark purple edging. The robe has an elaborate cloud pattern border in alternating blue and green on a red background. A number of the colors were analyzed by x-ray microdiffraction and XRF. The purple on the shawl has been identified as hematite, the orange-red as a mixture of red lead and cinnabar, the green as malachite, and the blue as azurite.

The Walters buddha's shawl has a painted red and green patchwork design. The robe is very indistinct. At the midriff, the remains of a central circular pattern can be detected. A polychrome band on the upper edge of the robe is painted orange, red, white, green, and blue (indigo) (fig. 24). The background of the robe is blue and green, as is the central circular design. The skin has a kaolin and calcium-rich ground with a pink tone mixed of white and red lead. Traces of bright blue azurite mixed with lead white, together with some tenorite (black), were found around the hairline.

The Freer buddha's shawl also has a painted red and green patchwork design; however, its color is much less distinct than that of the Metropolitan buddha. The robe also has orange-red squares with black bands around the edges. A ground layer under the gilding of the flesh was identified as lead white.[20] Visual evidence confirms at least three repaints.

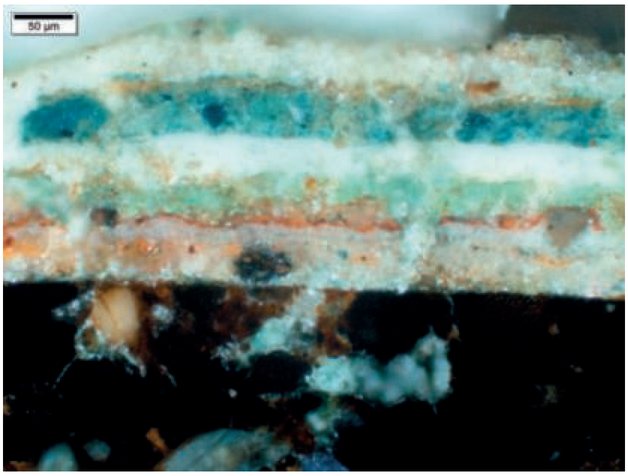

Figure 24. *Cross-section of paint layers from the decorative band on the Walters buddha, revealing multiple repaints.*

Figure 25. *Close-up of jewelry of the Freer bodhisattva, revealing color and gilding.*

The bodhisattva head has traces of pigment similar to those on the three life-size buddha sculptures. There is blue azurite in the hair, identified by PLM. The red in the lips was identified as vermilion by XRF. Traces of gilding remain on the "flesh" around the ears over a white ground.

The Freer bodhisattva's flesh was white massicot (lead oxide), with gold leaf over the top. Some of the jewelry was gilded and had various colored pastes in atacamite green and vermilion, imitating gems in settings (fig. 25). Holes around the top of the head once held a now-missing diadem.

Conclusions

This extensive study has confirmed that all five sculptures were made of expensive materials and that they were time-consuming to create. Although they were fabricated over an eight-hundred-year period, the same traditions, similar techniques, and similar materials were used in all five sculptures. While the sculpture styles may have changed over time, the techniques did not.

The techniques used were far more complicated than those used to create utilitarian lacquer objects. Along with the high quality of the materials and the rarity of the objects, this finding suggests that the five sculptures were fabricated in workshops that received imperial patronage or support from an elite group. The structure of lacquer workshops is unknown; nor was it possible to determine whether workshops operated out of monasteries or as private industries.

Four of the five sculptures originally had clay cores. All five have a similar plain-woven hemp textile for the base and support of the lacquer layers. All use the same species of lacquer, with no imported lacquer species from elsewhere in Asia. And all their lacquer layers begin with a coarse lacquer layer, followed by finer layers and, finally, several layers of the finest lacquer on top. Partially burnt bone was used in all five sculptures to bulk up the lacquer. The bone analyzed in all the sculptures was revealed to be not human but, as was found earlier in China, animal.

Future studies should be carried out on later period sculptures to extend the research and knowledge gained in this project.

Acknowledgments

The author is grateful to the Walters Art Museum, the Freer Gallery of Art, and the Metropolitan Museum of Art for allowing the technical study of their sculptures. The help of many colleagues was instrumental in completing this research. Special appreciation goes to the following: at the Walters Art Museum, Glenn Gates and Julie Lauffenburger; at the Smithsonian Institution, Brian Abrams, Matthew Clarke, Timothy Cleland, Tim Kirk, Christina Popenfus, Alison Schorr, Sabrina Sholts, Jan Stuart, Carolyn Thome, Keats Webb, and Hutomo Wicaksono; and at the Metropolitan Museum of Art, Federico Carò, Christina Hagelskamp, Daniel Hausdorf, and Vicky Parry.

Notes

1. Although there is debate on the origin of his text, Wang (1983, 44) includes brick powder, deer antler, bone ash, and shell ash among the ingredients that may be added to lacquer as fillers. See also Jin et al. 2012 for an analysis of bone ash particles in lacquer on chariots from the Warring States period (475–221 BCE).
2. X-ray radiography was performed at the Freer Gallery of Art and Arthur M. Sackler Gallery Department of Conservation and Scientific Research and the Metropolitan Museum of Art. Computed tomography (CT) scans were carried out on the Freer buddha by Sabrina Sholts, curator of physical anthropology at the Smithsonian's National Museum of Natural History.
3. PLM was performed at the Freer and Hirshhorn Museum and Sculpture Garden laboratories by Blythe McCarthy and Donna Strahan. Methods used to study cross-sections were those of Nanke Schellmann as taught in the "Recent Advances in Characterizing Asian Lacquer" (RAdICAL) workshop, 22–26 October 2012, Getty Center, Los Angeles, part of the Getty Conservation Institute's Characterization of Asian and European Lacquers project, http://www.getty.edu/conservation/our_projects/education/radical/radical_workshop.html. See Schellmann and Schilling 2013.
4. XRF was carried out at all three museums by scientists Glenn Gates, Walters Art Museum (performed XRF on the eyes only); Matthew Clarke, Freer Gallery of Art; and Federico Carò, Metropolitan Museum of Art.
5. SEM on the Metropolitan buddha was carried out by Federico Carò with an FE-SEM Zeiss Σigma HD, equipped with an Oxford Instrument X-MaxN 80 SDD detector. Backscattered images (BSE), EDS analysis, and mapping were realized in high vacuum at 20 kV. SEM on samples from the other four sculptures was performed by Blythe McCarthy and Timothy Rose using an FEI Nova NanoSEM 600 with a Thermo Fisher energy dispersive x-ray detector in high vacuum mode at the National Museum of Natural History's Department of Mineral Sciences. Software used for the EDS analysis was Thermo Fisher Scientific NSS v. 3.1. A gaseous analytical detector was used in variable pressure mode to image a sample of clay and red material from interior of the bodhisattva head.
6. Py-GCMS was carried out by Blythe McCarthy using a Frontier 2020 pyrolyzer and a Shimadzu QP2010 Ultra GCMS. Data were analyzed using NIST's AMDIS. Only compounds with match factors 80% or greater were considered. Further analysis was carried out using the Getty's RAdICAL spreadsheets.
7. Proteomics analysis was carried out on lacquer samples by Timothy Cleland, physical scientist at the Smithsonian's Museum Conservation Institute, using a Thermo Scientific Dionex Ultimate 3000 nano high-performance liquid chromatography system and a LTQ Orbitrap Velos mass spectrometer.
8. The bodhisattva head measures 45.8 cm tall. The height of its face was compared with that of the Freer buddha to estimate the original height of the full bodhisattva sculpture. The bodhisattva's face is 2.3 times taller than the Freer buddha's face (20 cm). Therefore, as a seated sculpture, the bodhisattva would have been approximately 228 cm tall, or nearly 7½ ft.
9. Walters buddha: A sample of wood from the interior of the body block was carbon 14 dated. The calibrated 2 sigma dated to 420–645 CE. In 1990, Forest Products identified the wood as a member of the Moraceae family, which includes mulberry, pipal, and fig or Ficus. Walters Art Museum Conservation Department records. Freer buddha: On 24 January 1964 wood chips from the inside end of the left arm were sent for carbon dating to Austin Long of the Smithsonian's Division of Radiation and Organisms. The report dates the wood at 510 CE (+/– fifty years, range of 474–574 CE). At the time there was speculation that the sample may have been from the inside of a large tree and therefore gave a result earlier than the sculpture itself. Freer Gallery of Art, Department of Conservation and Scientific Research object records. The wood type has not been identified. Metropolitan buddha: A sample of wood from inside the base was identified by Mechtild Mertz, Research Institute for Humanity and Nature, Kyoto, and Takao Itoh, Kyoto University, as from the Tilla family, which includes linden, limewood, and basswood. It grows in northern China. See Leidy and Strahan 2010, 220.
10. Carolyn Thome, an exhibit specialist at Smithsonian Exhibits, scanned the bodhisattva head and 3-D–printed a positive from the interior geometry.
11. A sample of pooled reddish-brown resin was removed from the interior near the right ear and was analyzed using Py-GCMS and FTIR.
12. Experiments by Takayuki Yamazaki, Aichi University of the Arts, and Fumio Okada, Kyoto University of Art and Design, found that a mixture of glue and lacquer penetrates the textile better than lacquer alone. However, individual

layers of protein and lacquer were found on the textile of the bodhisattva. Yamazaki and Okada 2014.

13. Timothy P. Cleland, Analysis of bone from Chinese lacquer buddhas, 2017, Smithsonian Museum Conservation Institute, report MCI#6777; Timothy P. Cleland, Analysis of bone from Chinese lacquer buddhas-1, 2017, Smithsonian Museum Conservation Institute, report MCI#6777.2.
14. The proper left eye was analyzed by Glenn Gates, conservation scientist at the Walters Art Museum, using the Elio XRF spectrometer at 50 kV, 60 µA, 200 seconds, without helium, without filters, 1 mm^2 analysis area.
15. Matthew Clarke, Freer Gallery of Art and Arthur M. Sackler Gallery conservation scientist, performed XRF on both of the Freer buddha's eyes on 5 October 2017.
16. Federico Carò performed XRF on the pupil of the Metropolitan buddha's eye using a Bruker Tracer III-SD at 40 kV, 30 µA, and with acquisition time of 30 seconds. Tony Frantz performed x-ray diffraction (XRD) on some of the pigments and white of the eye on 20 July 2017.
17. Matthew Clarke carried out XRF on the left eye on 9 January 2017.
18. Matthew Clarke carried out XRF on the eyes on 7 March 2018.
19. Pigment analyses were performed with PLM and XRF at each museum. Matthew Clarke and Donna Strahan analyzed pigments on the Walters and Freer buddhas, the bodhisattva head, and the Freer bodhisattva. Tony Frantz and Federico Carò analyzed the pigments on the Metropolitan buddha.
20. The blue pigment was identified by PLM by Elisabeth FitzHugh. Freer Gallery of Art Department of Conservation and Scientific Research object records, 30 April 1954. Paul Jett performed XRD on several colors. The white ground sample was identified as lead white (hydrocerussite). Freer Gallery of Art, Department of Conservation and Scientific Research object records, XRD film 4218, 21 September 1993. The red in the robe was identified as red lead. Freer Gallery of Art and Arthur M. Sackler Gallery Department of Conservation and Scientific Research object records, XRD film 4217, 20 September 1993.

References

Goodway, Martha. 1987. Fiber identification in practice. *Journal of the American Institute for Conservation* 26(1): 31.

Haugan, E., and B. Holst. 2013. Determining the fibrillary orientation of bast fibres with polarized light microscopy: The modified Herzog test (red plate test) explained. *Journal of Microscopy* 252(2) (November): 159–68.

Jett, Paul. 1997. A note concerning the radiocarbon dating of a Chinese dry lacquer figure in the collection of the Freer Gallery of Art. *Orientations* 28(10): 66–67.

Jin Pujun, Yali Hu, Xuliang Gu, and Xuegao Ji. 2012. *Jiuliandun chutu qiqi qi hui ceng zhizuo gongyi yanjiu* 九连墩出土漆器漆灰层制作工艺研究 [Research on the fabrication techniques about lacquer layers of lacquer wares excavated from Jiuliandun tombs]. *Jianghan Kaogu* 125(4): 108–13.

Leidy, Denise Patry, and Donna Strahan. 2010. *Wisdom embodied: Chinese Buddhist and Daoist sculpture in the Metropolitan Museum of Art*. New York: Metropolitan Museum of Art.

Rhie, Marilyn M. 1993. The Walters Art Gallery Chinese lacquer buddha: Dating, regional style, and iconography. *Journal of the Walters Art Gallery* 51: 89–101.

Schellmann, Nanke, and Michael R. Schilling. 2013. Validation of combined fluorescence microscopy and staining techniques for characterizing Asian lacquer cross sections. Paper presented at Asian Lacquer International Symposium, SUNY Buffalo State, Buffalo, N.Y.

Schilling, Michael R., Arlen Heginbotham, Henk van Keulen, and Mike Szelewski. 2016. Beyond the basics: A systematic approach for comprehensive analysis of organic materials in Asian lacquers. *Studies in Conservation* 61(3): 3–27.

Siren, Osvald. 1925. *Chinese sculpture from the fifth to the fourteenth century*. 4 vols. New York: Scribner.

Strahan, Donna K. 1993. The Walters Chinese wood-and-lacquer buddha: A technical study. *Journal of the Walters Art Gallery* 51: 105–20.

Strahan, Donna, and Blythe McCarthy. 2018. Construction from the inside out: Early Chinese lacquer buddha fabrication. National Museum of Asian Art website, https://asia.si.edu/essays/construction-from-the-inside-out-early-chinese-lacquer-buddha-fabrication.

Wang, Shixiang. 1983. *Xiushi lu jie shuo* 髹飾錄解說 [*On lacquering* comments]. Beijing: Wen wu chu.

Watt, James C. Y., and B. B. Ford. 1991. *East Asian lacquer*. New York: Metropolitan Museum of Art.

Webb, Marianne. 2000. *Lacquer: Technology and conservation*. Oxford: Butterworth-Heinemann.

Yamazaki, Takayuki, and Fumio Okada 山崎隆之, 高田文男. 2014. Shōsōin kanshitsu gigaku men no kōzō gihō ni tsuite no kenkyū: Shisaku jikken ni yoru kōsatsu 正倉院乾漆伎楽面の構造·技法についての研究 - 試作·実験による考察. [Structure and technique of *kanshitsu gigaku* masks at the Shosoin Treasure House: Study based on samples and experiments]. *Shōsōin hōko jimusho kiyō* 正倉院報告事務所紀要 [Bulletin of Office of the Shosoin Treasure House] 36: 1–30.

Lacquer Analysis of Five Buddhist Sculptures

Blythe McCarthy

ABSTRACT Five lacquer sculptures were studied to determine their lacquer composition and structure. The sculptures included three early buddhas and two bodhisattvas, ranging in date from the sixth to the mid- to late thirteenth century. *Toxicodendrum vernicifluum* lacquer was used for all sculptures (one with a wood substrate, and the rest hollow-core formed on textile), and bone was the most common fill material. The number of layers varied among the sculptures, partially due to sampling location, but all had coarser lower layers proceeding to finer upper layers. Comparison of chemical compounds found in the lacquer layers with those found in modern cow's bone suggests that the bone may have served additional roles beyond acting as a fill material.

Introduction

In conjunction with the exhibition *Secrets of the Lacquer Buddha*, on view at the Arthur M. Sackler Gallery from 9 December 2017 through 10 June 2018, studies of the lacquer layers on five lacquer sculptures were undertaken. The sculptures studied included three sixth–seventh century buddha sculptures—from the Walters Art Museum in Baltimore (pl. 1, p. 12), the Freer Gallery of Art in Washington, D.C. (pl. 2, p. 13), and the Metropolitan Museum of Art in New York (pl. 3, p. 14)—an eighth-century bodhisattva head from a private collection (pl. 4, p. 15), and a Yuan dynasty (1279–1368) bodhisattva from the Freer. Initial results were published online (Strahan and McCarthy 2018). This article adds results from a study of the Freer bodhisattva and reports results from a reexamination of the first four sculptures. Less certain results have been removed, in particular for pyrolysis–gas chromatography mass spectrometry (Py-GCMS). In this article, only Py-GCMS results with an 80% match or greater were considered.

Numerous Chinese classical texts and historical documents produced over several hundred years mention lacquer, but few contain in-depth fabrication details (Chang and Schilling 2016). In addition, there are uncertainties in the interpretation of historical Chinese literature. These result from the use of nonspecific poetic language to refer to materials used in lacquer production, changes over time in the meaning of Chinese words, and the uncertain identification of the texts being referenced by later authors. Fortunately, recent developments in analytical techniques, developed at the Getty Conservation Institute (see Schilling et al., in this volume), make it possible to identify many of the materials included in Asian lacquer objects (see also Schilling et al. 2016; Heginbotham et al. 2016).

A common structure for lacquer objects begins with a core, followed by foundation or ground layers that include clays, bone, sand, and other materials. Built up on this base are a series of foundation lacquer layers, intermediate lacquer layers, and finally increasingly fine finishing layers (Webb 2000). This article examines the structure of the five Buddhist sculptures, including identification of the type of lacquer used, determination of the number and type of layers and additives used, and identification of bulking agents such as fibers and particle inclusions. Similarities and differences among the five sculptures are discussed.

Information from Previous Studies of Lacquer Sculpture

Lacquer technology was used as early as the Neolithic and was well developed by the time of these Buddhist sculptures. The first evidence of lacquer use for Buddhist sculptures is the description in later texts of "portable" sculptures produced in the late fourth century (Leidy 2018), but there is little further information on lacquer sculpture and there are no excavated examples. For this reason, the present study was broadened with the inclusion of the Yuan dynasty bodhisattva.

The layer structure of the Walters buddha was published previously by Strahan (1993). She saw seven layers in a polished cross-section (Strahan 1993, fig. 12), including two layers of textile; however, figure 12 in her article appears to show a few more layers. In her study, samples removed from several locations on the sculpture were found to be similar in number and the overall thickness of the lacquer was confirmed to be approximately 3 millimeters. She found bone throughout the cross-section of the lacquer layers. Ground burnt bone, or bone ash, although not common, was used to bulk Chinese lacquer at least since the Warring States period

Table 1. *Sample locations.*

Walters buddha	area of "flesh" at the proper right edge of the back opening just above the robe and extending from the surface to the core
Freer buddha	proper left drapery edge along the bottom
Metropolitan buddha	proper left drapery edge near the bottom that extends completely through the sculpture, including the entire textile framework of the drapery fold
Bodhisattva head	area of "flesh" at the lower, proper right side of the neck along the back edge
Freer bodhisattva	drapery along the bottom at the front lower edge

(475–221 BCE), where it was found in foundation lacquer layers of burial objects (Jin et al. 2012).

One example of a later period Chinese lacquer sculpture with a wooden core that has been analyzed dates to the Ming dynasty (1368–1644) or later. Hsu and Sully (2016) published a cross-section that was taken to determine the stability of the lacquer during conservation treatment. The buddha was on a solid wood substrate, and the cross-section shows at least eleven layers above the ground layer, with a final layer of surface decoration. The components of the layers were not reported.

Information on Lacquer from Archaeological Evidence

It is not yet possible to determine if the methods used to produce Buddhist lacquer sculpture were independently developed or adapted from techniques used to produce other types of lacquer objects as, until recently, there has been limited information available on other types of lacquer objects from the periods following the Han dynasty (206 BCE–220 CE). While lacquer objects such as vessels, plates, utensils, and other tableware are commonly found in Warring States and Han dynasty burials, the number of lacquer objects found in burials decreased during the latter part of the Han dynasty in both the north and the south even as objects made of other materials, such as celadon ceramics, increased in number. This finding suggests that production of lacquer objects was decreasing at the time, and consequently there are few analytical studies of other types of lacquer objects available against which to compare the results found on the Buddhist lacquer sculptures.

However, Müller's (2019) recent research on lacquer objects from the Northern Dynasties (386–581 CE) suggests that instead of a reduction in lacquer production at the end of the Han dynasty there were changes in the type of objects made from lacquer. Based on evidence from paintings that have survived as later copies in multiple materials, from archaeology, and from texts, Müller suggests that lacquer production may have shifted to focus on the creation of materials used in daily life, which were not deposited in tombs and so leave little direct evidence in the archaeological record. Perhaps the Buddhist sculptures survived because of their size, importance, and location in temples.

Funerary objects do remain from northeastern China. Müller (2019, 56–57) cites one example of a painted lacquer screen with a lacquer frame from the tomb of Sima Jinlong (d. 484 CE) in Shanxi province. The frame is believed to have been produced in northern China. There is some disagreement over the site of production for the screen, with both northern and southern China suggested as possibilities. This is one of the few objects to have undergone technical study. Analysis of samples from undetermined locations (Li et al. 2009), but that Müller associates with the frame, found bone in both lacquer layers and "transitional" layers that appear similar to what in our study are called lower lacquer layers. This is a rare example of a technical study finding bone used in a lacquer layer. The frame (and possibly the frame and screen) is from the north and predates the earliest sculpture examined in the present study, suggesting the use of bone in lacquer seen by Strahan in the Walters buddha may have been adapted from use in other types of objects.

Lacquer objects from a similar time period in the south, the Six Dynasties (317–589 CE), have been surveyed by Kieser (2019), who has detailed the evidence for lacquer production there during this period. Kieser found many examples of lacquer fragments in southern tombs that had previously been mostly ignored. The number of fragments decreased over time, but they appeared in significant numbers until the fourth century. Kieser raises the possibility that differences in tomb construction and the character of burial soils may have affected the preservation of lacquerwares in southern tombs, and thus the accuracy of their numbers. As lacquer objects from these periods gain more attention, it is hoped that research into their materiality will provide additional information on lacquer techniques in use when the early Buddhist sculptures in the present study were produced.

Lacquer Layer Structure and Composition

Samples from the five sculptures under study were taken and prepared for technical analysis, as described in the appendix (for sample locations, see table 1). Portions of each sample were prepared as cross-sections. Microscope images of the five cross-sections are shown under ultraviolet light in the following figures. In all five, above the core—wooden for the Walters buddha and hollow for the others—is a textile underlayer, followed by thick, coarse layers of lacquer, with thinner layers of lacquer with finer inclusions applied above. In general, due to the black to brown color of most layers (see fig. 6), images taken under ultraviolet light proved to be most useful.

Table 2. *Materials found in the Walters buddha.*

Layer	Name	Description	Materials (chemical markers)
T	surface dirt	dark, uneven, sporadic, <10 µm thick layer; positive staining results for oils/lipids	N–T: ***Toxicodendron vernicifluum*, fatty acids from lacquer and bone or oil** (mono- and dicarboxylic acids), **glycerol** (propane, 1,2,3-trimethoxy- and 2,3-dimethoxypropan-1-ol)), **elemi resin**, **bone, or glue** (trimethyl phosphates, 1-H-pyrrole, 1-methyl-, 1H-pyrrole, 3-methyl-), **beeswax** (15-methoxypalmitic acid methyl ester), **possible soot** (pyrene)
S	coating 3	translucent white approx. 20 µm thick layer; possible weak staining results for oils/lipids	
R	red pigment	red pigment in white binder, approx. 20 µm thick layer; possible weak staining results for oils/lipids.	
Q	coating 2	white dense layer, approx. 20 µm thick; possible weak staining results for oils/lipids	
P	coating 1	white porous approx. 50 µm thick layer; possible weak staining results for oils/lipids	
O	lacquer 8	dark-colored approx.150 µm thick layer; dark bone particles, some appear gray or white in UV (10–120 µm); positive staining results for oil/protein in particles	
N	upper ground 4	light-colored porous approx. 100 µm thick layer; many 50 µm white bone particles that remain white in UV and occasional large white particles up to 120 µm; positive staining results for starch; positive staining results for oil/protein in matrix and in white particles	M and N: ***Toxicodendron vernicifluum*, fatty acids from lacquer and possibly bone** (mono- and dicarboxylic acids), **elemi resin**, **blood** (blood unverified 5, 6, and 10, protein unverified 8, trimethyl phosphate). **beeswax** (15-methoxypalmitic acid methyl ester), **tannins** (1,2,3,4 tetramethoxybenzene; acetic acid, methoxy-methyl ester)
M	lacquer 7	dark-colored 50 µm thick layer; black and white bone particles, small (20 µm) and large (120 µm); some darken, some lighten in UV; positive staining results for oil/protein in particles; positive staining results for oils/lipids	
L	upper ground 3	light-colored porous approx. 70 µm thick layer; white and black bone particles (20–30 µm)	***Toxicodendron vernicifluum*, fatty acids from lacquer and possibly bone** (mono- and dicarboxylic acids), **elemi resin**, **beeswax** (15-methoxypalmitic acid, methyl ester)
K	lacquer 6	dark-colored 35 µm thick layer; dark bone particles in two size ranges: approx. 5 µm and 20–30 µm; positive staining results for oils/lipids	K and J: ***Toxicodendron vernicifluum*, fatty acids from lacquer and possibly bone** (mono- and dicarboxylic acids), **possible cedar oil** (mayurone), **elemi resin**, **indeterminate protein**, **possibly glue or bone** (pyrrole), **beeswax** (15-methoxypalmitic acid methyl ester), **tannins** (1,2,4-trimethoxybenzene, 1,2,3,4-tetramethoxybenzene, acetic acid, methoxy-, methyl ester), **indigo** (indigotin)
J	upper ground 2	light-colored layer approx. 100 µm thick; white and black bone particles (10–30 µm)	
I	lacquer 5	dark-colored approx. 60 µm thick layer; mostly dark, bone particles appear black to gray in UV; positive staining results for oil/protein in particles; positive staining results for oils/lipids	H and I: ***Toxicodendron vernicifluum*, fatty acids from lacquer and possibly bone (**mono- and dicarboxylic acids), **elemi resin**, **cedar oil** (mayurone), **beeswax** (15-methoxypalmitic acid methyl ester), **tannins** (1,2,3-trimethoxybenzene, 1,2,4-trimethoxybenzene, acetic acid, methyl-, methyl ester)
H	upper ground 1	thin, light-colored approx. 60 µm thick layer; occasional bone particles approx. 50 µm; positive staining results for oil/protein in particles; positive staining results for oils/lipids	
G3	lacquer 4	dark-colored 140 µm thick layer; randomly oriented fibrous material (likely sawdust); large bone fragment approx. 90 µm extends from layer G1 into layer G3	***Toxicodendron vernicifluum*, fatty acids from lacquer and bone or oil** (mono- and dicarboxylic acids), **glycerol** (propane, 1,2,3-trimethoxy-), **elemi resin**, **cedar oil** ((R)-cuparene, mayurone), **indeterminate protein, probably bone or glue** (1-H pyrrole, 1 methyl-, unverified blood marker 1), **beeswax** (15-methoxypalmitic acid methyl ester), **possible sawdust** (glucoside), **tannins** (1,2,3-trimethoxybenzene, 1,2,4-trimethoxybenzene, 1,2,3,4-tetramethoxybenzene, acetic acid, methyl-, methyl ester; benzoic acid 2,3-dimethoxy- methyl ester)
G2	ground 2	thin, light-colored 40 µm thick layer, visible at the left of cross-section; small white and black particles 15 µm; it is part of one larger layer (G); area at surface of fiber (likely sawdust) is positive for starch	***Toxicodendron vernicifluum*, fatty acids from lacquer and possibly bone** (mono- and dicarboxylic acids), **elemi resin**, **cedar oil** ((R)-cuparene), **blood, bone. and/or glue**. (1H-pyrrole, 1-methyl-, blood unverified 1, trimethyl phosphate), **fibers** (glucoside), **beeswax** (15-methoxypalmitic acid methyl ester), **tannins** (1,2,3-trimethoxybenzene, 1,2,4-trimethoxybenzene, 1,2,3,4-tetramethoxybenzene, acetic acid, methyl-, methyl ester)
G1	lacquer 3	dark-colored less than 70 µm thick layer at left of cross-section contains randomly oriented plant fibers (possibly sawdust); area at surface of fiber stained positive for starch	
F	lacquer 2	dark-colored 90 µm thick layer; positive staining results for oil/protein in particles and in matrix around particles	E and F: ***Toxicodendron vernicifluum*, fatty acids from lacquer and possibly bone** (mono- and dicarboxylic acids), **elemi resin**, **cedar oil** (mayurone, (R)-cuparene), **bone or glue** (pyrrole, 1H-pyrrole, 1-methyl-, 1H-pyrrole, 3-methyl-; blood unverified 10), **fibers** (“paper”: 2-cyclopenten-1-one, 3-methyl-; paper unverified 1,4,6), **beeswax** (15-methoxypalmitic acid methyl ester), **tannins** (1,2,3-trimethoxybenzene, 1,2,4-trimethoxybenzene, 1,2,3,4-tetramethoxybenzene, acetic acid, methyl-, methyl ester)
E	lacquer 1	lighter, more porous lacquer layer 160 µm thick; has fine, reddish layer at top that may be a thin, separate layer; positive staining results for oil/protein in particles and around particles	
D	ground 1	160 µm thick layer; large particles; not in cross-section	not analyzed
C	textile and lacquer	275 µm thick layer; white and black particles (25–80 µm); particles appear white and shades of gray in UV; textile identified by fiber microscopy as hemp; lacquer intrudes into textile and contains black particles that appear white and shades of gray in UV; not in cross-section	not analyzed
B	lower lacquer	not in cross-section	not analyzed
A	textile	not in cross-section	not analyzed

Note: Materials are placed in bold for readability.

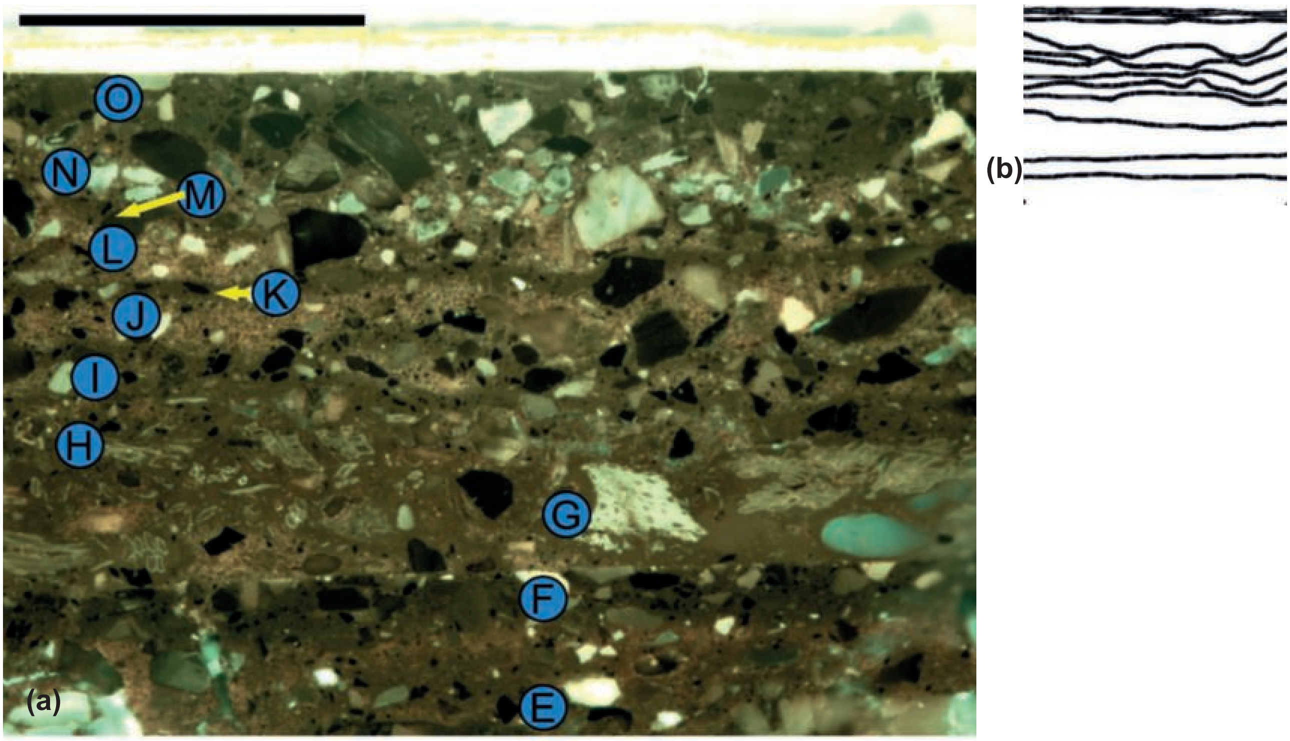

Figure 1. *Cross-section of lacquer sample from the Walters buddha (see pl. 1).* **a.** *Under ultraviolet light using Nikon filter B-2A. Scale bar = 250 µm.* **b.** *Drawing of the layers in the cross-section. All cross-sections are lettered from the interior layer to the surface.*

Because of the sculptural process, layers of lacquer vary from location to location, and sampling location determines the layer structure that will be visible in any sample, not unlike the variation in layers one would see for samples removed from a painting. While it seems likely that the final layer or layers were applied to an entire piece, differences between samples from robes (the Freer and Metropolitan buddhas, and the Freer bodhisattva) and samples from flesh (the Walters buddha and the bodhisattva head) may be due to differences in the number and thickness of lower layers as required by the sculpting process. Several possible techniques may have been used to shape the sculpture. For the Walters buddha, Strahan (1993) investigated the lacquer layers throughout the sculpture and found that the total thickness of the lacquer (0.3 cm) was consistent throughout the entire piece and that the wood core was used to define the shape. For the Freer buddha, CT scans show that the three-dimensional robe, with its naturalistic folds, was produced by adding clay to bulk up the textile additions (see Strahan, in this volume, fig. 13). These additions of clay were made locally and are not present throughout the sculpture. Combined results from microscopy and the Py-GCMS analysis are given in tables, and the layer structure and additives of the sculptures in this study are described below.

The Walters Buddha

Samples of the Walters buddha were taken from areas of flesh in the upper back at the proper right edge of the large opening (see Strahan, in this volume, fig. 9a). Samples extended from the surface to the wooden core. The cross-section from the Walters buddha is the most complex of those studied, with sixteen layers above the textile, starting with layer D through layer S, counting layer G as one layer (table 2). The top section layers are visible in the image (fig. 1). The cross-sections here and in all the tables are lettered from the interior layer to the surface. This figure shows several more layers than are shown in a cross-section studied by Strahan (1993, fig. 12).

The lack of sharp, even interfaces in the majority of layers suggests the lacquer was applied as a viscous paste that was not fluid enough for leveling so did not settle to form a flat surface. However, there is an unusually uniform and sharp interface between layers F and G. Particles at the interface appear cut, suggesting that this layer was polished before the next layer was applied—a standard practice in lacquer production today. Of the layers in the cross-sections we studied, this is the only such even interface.

The materials identified by Py-GCMS are similar across the interface. Both lower and upper layers contain chemical markers for *Toxicodendron vernicifluum* lacquer, cedar oil, tannins, protein, and bone.

The location where the sample was removed—next to the opening for consecrated items—provides an explanation for the large number of layers in the polished cross-section, as it is an area that would have been reinforced with additional layers either at the time the sculpture was made or at a later time when the back may have been opened and reclosed. To create the opening in the back of the sculpture, a rectangular section of wood was removed prior to lacquering. A cover was made to fit the length and width of the rectangular opening, likely using a piece of wood, perhaps formed from the piece removed. But the depth of the cover was kept less than the depth of the opening, so a cavity was formed in the sculpture, one that was closed later by the cover. The textile and lacquer layers A–F were then applied to the surface of the

Table 3. *Materials found in the Freer buddha.*

Layer	Name	Description	Materials (chemical markers)
F	lacquer 3	dark brown approx. 40 µm thick layer contains few bone particles, mostly black, up to 60 µm longest dimension; a few white	***Toxicodendron succedaneum*** (C_{17} catechol and C_{10} acid catechol), **fatty acids from lacquer and possibly bone** (monocarboxylic and dicarboxylic fatty acids (two markers C_9 and C_4)), **tannins** (1,2,3-trimethoxybenzene, 1,2,4-trimethoxybenzene, 1,2,3,4-tetramethoxybenzene, acetic acid, methoxy-, methyl ester)
E	lacquer 2	fine brown approx. 50 µm thick layer contains few bone particles; crack goes through center; possible positive staining results for oil/protein	***Toxicodendron vernicifluum,* fatty acids from lacquer and possibly bone** (monocarboxylic fatty acids and one dicarboxylic acid (C_9)), **tannins** (1 marker: acetic acid, methoxy-, methyl ester).
D	lacquer 1	dark brown approx. 150 µm thick layer contains many white and black bone particles, small (10–20 µm) and large (approx. 70 µm); contains fibers or second textile layer; positive staining results for oil/protein in particles; positive staining results for starch in edge around fibers	**fatty acids from bone** (mainly monocarboxylic, with C_4 dicarboxylic), **indeterminate protein** (benzene, (1,2-dimethoxyethyl), **possible wax** (hydrocarbons, fatty acids, and methyl tetratriacontyl ether)
C	ground layer	light-colored layer, 50 µm thick, contains many white bone particles approx. 30 µm; positive staining results for oil/protein in particles	**fatty acids possibly from bone** (monocarboxylic fatty acids)
B	dark brown layer	dark brown lacquer layer, approx. 90 µm thick, contains black bone particles, small (15 µm) and large (50 µm); EDS: calcium, positive staining results for starch	**fatty acids from bone** (mainly monocarboxylic (C_4 dicarboxylic)), **proteins from bone, blood, or glue** (pyrrole and blood unverified 11), **possible wax** (methyl tetratriacontyl ether)
A	textile and lacquer	textile identified as hemp with fiber microscopy; lacquer in between fiber bundles contains black particles approx. 5 µm thick, some of which appear white or gray in UV; positive staining results for oil/protein in the textile and a few small particles in the lacquer; positive staining results for starch in edge around textile fibers	***Toxicodendron vernicifluum,* fatty acids from lacquer, and possibly bone** (mono- and dicarboxylic fatty acids, **proteins** (unverified protein marker 8, blood unverified 10), **carbohydrates from textile and lacquer** (paper unverified markers 1,4, and 6), **starch** (furfural and schellmanose), **possible wax** (hydrocarbons, fatty acids, and methyl tetratriacontyl ether), **tannins** (1,2,3-trimethoxybenzene, 1,2,4-trimethoxybenzene, 1,2,3,4-tetramethoxybenzene, acetic acid, methoxy-, methyl ester, benzoic acid, 2,3-dimethoxy-, methyl ester), **phthalates**

Note: Materials are placed in bold for readability.

wood on both the sculpture and the cover. The layers visible in the cross-section suggest that at some time after the cover was set in place an effort was made to reinforce and hide the join at the edges of the rectangular cavity. There is a straight interface visible in the cross-section between layers F and G, indicating that the surface was sanded flat after the application of layer F. An additional large amount of fiber used in the lacquer formulation for layer G gave it the putty-like consistency needed to fill the join at the edges of the cover. As the materials in layer G (applied after layer F) are chemically similar to those found in layer F, layer G was likely added soon after the time of manufacture. This addition at the edges of the hole resulted in some of the extra layers of lacquer seen in the cross-section of this sample. The alternating light and dark layers above layer G may be from later repairs to this area, which would be a weak point for the lacquer, especially if the cavity was later opened and closed again.

In addition to the lacquer, bone, tannins, and cedar oil mentioned above, chemical markers for proteins, carbohydrates (fibers), indigo, and possibly soot were found. Markers for glycerol were found in layer G, and at the surface. While generally taken as an indicator of oil additions to lacquer, markers for glycerol were found in Py-GCMS analysis of modern bone, as described later in this article. Protein occurred in all layers as determined by staining of the cross-section. The protein may have come from bone, blood, and/or glue. Nonlacquer carbohydrates were found in lower lacquer layers, consistent with the chopped fibers seen in the cross-section that added bulk to the layers. Soot was found in the surface layer, either from soil or a pigment. Indigo in the sample found in layers J and K may be from the reuse of fibers from a dyed textile within the these layers. However, given the multiple ground-lacquer layer pairs (J and K, L and M, N and O, see fig. 1), indigo may be the remains of a decorative layer and provide evidence of refurbishment during the object's time of use. Certainly these layer pairs and the large number of layers present in the sample point to at least local repairs to the area around the consecratory hole, a fragile area of the sculpture, while it was in use. In the middle of the sculpture's back, repairs to this area may have had little effect on the colored surface decoration.

Elemi resin and beeswax from a 1938 conservation treatment were seen in all layers. A Walters Art Gallery laboratory record dated 31 March 1938 stated that the buddha was "covered with absorbent cotton . . . and swathed in muslin (cheesecloth) and tied with string. Placed in tank . . . [with] 300 lbs of beeswax; 180 lbs paraffin, and 120 lbs gum elemi face down." The buddha was in the wax tank at 162°F (72°C) for approximately 3½ days. When it was removed, it had gained 17 pounds (7.7 kg). The museum's records of the treatment were critical in making it possible to separate the conservation materials from the original lacquer components, but the treatment also made it impossible to tell if any waxes were present in the original materials. The presence of wax also interferes with identification of any oils added to the lacquer during the original production of the buddha sculpture. Chinese lacquer conservator Zhang (2008) has written that semidrying oils such as linseed or nut oils are used in China to restore luster to lacquer. Pine resin is used to consolidate wood substrates. Conservation treatments such as these could also account for some of the oils and cedar compounds seen in the analysis.

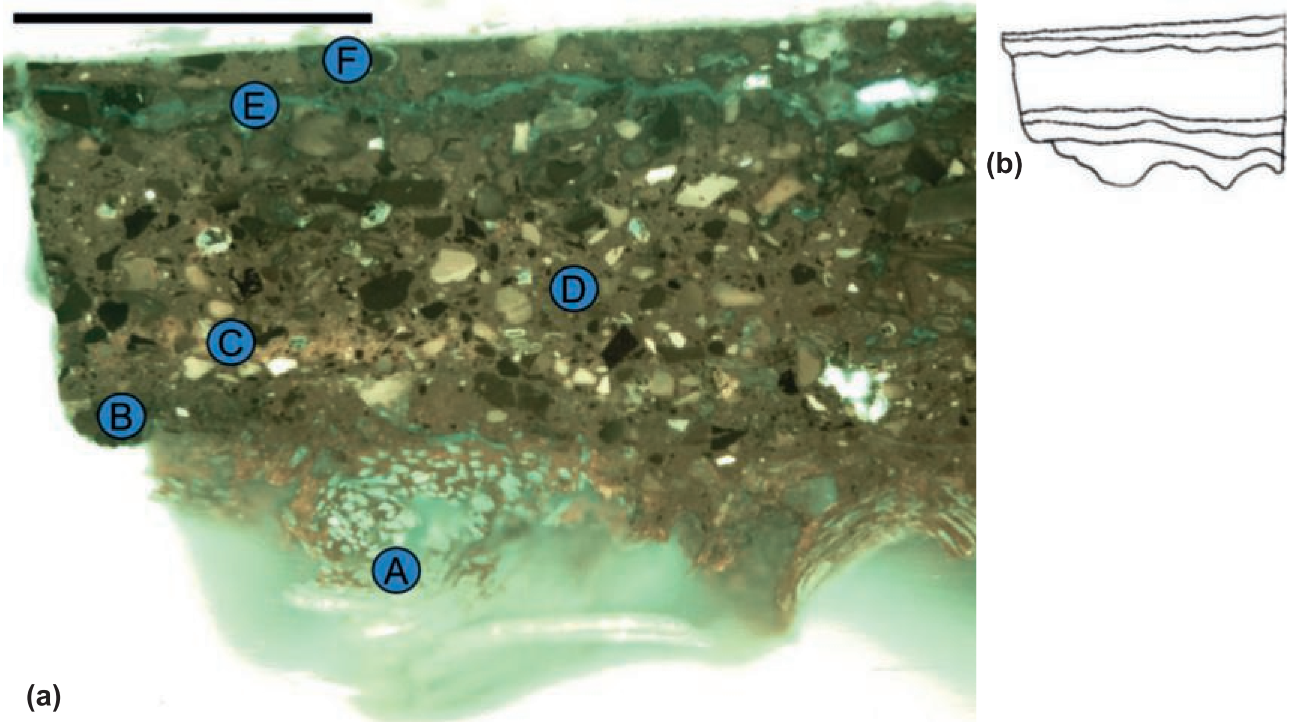

Figure 2. *Cross-section of left side of a lacquer sample from the Freer buddha (see pl. 2).* **a.** *Under ultraviolet light using Nikon filter B-2A. Scale bar = 500 µm.* **b.** *Drawing of the layers in the cross-section.*

The Freer Buddha

In this example, the sample was taken from the proper left edge of the drapery, at the bottom. The cross-section shows five lacquer layers above the textile (fig. 2; table 3). In analysis, not all layers were found to include lacquer, but where it was present it was generally *Toxicodendron vernicifluum*. One sample from the top layer had a C_{17} catechol indicative of *laccol* sap from *Toxicodendron succedaneum*. As this catechol is present only in the uppermost layer, it may be a restoration. Where it was not present, the majority of fatty acids were monocarboxylic fatty acids. There was bone throughout the layers, and some layers that did not contain *Toxicodendron vernicifluum* contained C_4 fatty acids, a compound seen in bone marrow as discussed later. In addition, chemical markers for blood were present, and the blood was confirmed by proteomics.[1] Hydrocarbons, fatty acids, and a single possible wax marker (methyl tetratriacontyl ether) are present in two interior layers as well as in the textile layer. Although this finding may suggest wax, phthalates—compounds used as plasticizers—were found, and Freer Conservation and Scientific Research laboratory records document that Renaissance wax was applied to the entire surface in 1969 during a conservation treatment, in addition to PVA (polyvinyl acetate) emulsion being brushed along the edges of the bottom of the sculpture.

The Metropolitan Buddha

Similar to the sample from the Freer buddha, the sample for the Metropolitan buddha was taken through a fold of drapery from its proper left edge (fig. 3; table 4), resulting in a section with lacquer on both sides of a textile-based interior support. Above the thick textile layer, labeled E in the cross-section, there are three finer layers (F–H). Bone is present in all three. The finest bone was found in the thin upper lacquer layer 2 (G), while the first upper lacquer layer (F) and the third upper lacquer layer (H)—the uppermost layer of the cross-section—contain small white and black bone particles. To achieve a smooth surface, a final finish lacquer layer without bone would normally be required, but bone was unexpectedly found to be present in the uppermost layer. However, the sample location may have affected the results. It was taken at the base of the sculpture, a place vulnerable to loss, and so the original final finish layer may be missing (see fig. 3).

In addition to the bone that is visible in the cross-section, staining of the cross-section and chemical marker compounds found with Py-GCMS indicate that mono- and dicarboxylic fatty acids from lacquer, bone, and/or oil, cedar oil, blood, starch, tannins, and possibly soot are present in lacquer layers. The compound α-cedrene was found in layer F, indicating the addition of cedar oil from trees of the family Cupressaceae or other fir trees. At this time, it is not possible to determine if glue is present, as the known marker proteins may also be found in bone. Tannins were found in all layers.

One finding unique to this sculpture was the identification of gum benzoin in samples from the textile layer C. Gum benzoin is used for incense, perfumes, and varnishes, where it is a minor component that adds gloss. It is said to add a reddish color to varnish (Webb 2000). The reason for its presence here is not clear, but as the textile substrate layer has no need for additional gloss it may have been used to add scent to the sculpture during production or use.

Table 4. Materials found in the Metropolitan buddha.

Layer	Name	Description	Materials (chemical markers)
H	upper lacquer layer 3	approx. 200 µm thick black surface layer of lacquer mixed with white and black bone particles of 30–90 µm; white particles are fewer and smaller than black; layer appears brown in UV; surface is rough, and upper portion may be missing; layer stained positive for oil/protein; a few particles stained positive for starch	inconclusive
G	upper lacquer layer 2	thin (50 µm or less), light-colored layer appears red-brown in UV with very fine black and white bone particles (20 µm or less); positive staining results for oil/protein, starch, and oil/lipids	***Toxicodendron vernicifluum*, fatty acids from lacquer, and possibly bone** (mono- and dicarboxylic fatty acids), **indeterminate proteins** (protein unverified 8), **tannins** (1,2,3-trimethoxybenzene, 1,2,4-trimethoxybenzene, acetic acid, methoxy-, methyl ester), **possible soot** (pyrene).
F	upper lacquer layer 1	approx. 100 µm black lacquer mixed with white and black bone particles of size 20–80 µm; more white particles than in layer G; layer appears brown in UV	***Toxicodendron verniciflluum*, fatty acids from lacquer, and bone and/or oil** (mono- and dicarboxylic fatty acids, methyl ketone (2-hexanone)), **bone or glue protein** (pyrrole, 1H-pyrrole, 1-methyl-, protein unverified 8), **cedar oil** (α-cedrene), **tannins** (1,2,4-trimethoxybenzene, acetic acid, methoxy-, methyl ester)
E	fiber and lacquer	very thick layer (>500 µm) of reddish-brown lacquer with textile; some of the fibers are solid, some appear filled with lacquer; large number of pores throughout; positive staining results for starch in layer around fibers	***Toxicodendron verniciflluum*, fatty acids from lacquer and bone and/or oil** (mono- and dicarboxylic fatty acids present and methyl ketones (2-hexanone and 7+2-nonanone)), **indeterminate resin** (longifolene), **bone or glue protein** (pyrrole, 1H-pyrrole, 1-methyl-, protein unverified 8), **possible blood** (blood unverified 5), **starch** (furfural, shellmannose, possibly from textile), **tannins** (1,2,3-trimethoxybenzene, 1,2,4-trimethoxybenzene, 1,2,3,4-tetramethoxybenzene, acetic acid, methoxy-, methyl ester)
D	lower lacquer layer 1	thin brown layer with small black bone particles a few µm in size; sharp edges and elongated shape as well as size range indicate grinding; a few light- to white-colored particles are more equiaxed in shape; some remain white in UV, while some appear dark; possible positive staining results for oil/lipids; EDS: calcium and phosphorus, not in figure	***Toxicodendron verniciflluum*, fatty acids from lacquer and possibly bone** (mono- and dicarboxylic acids), **indeterminate resin** (longifolene), **blood** (trimethyl phosphate, blood unverified 10), **protein from bone or glue** (pyrrole, 1H-pyrrole, 1-methyl-, protein unverified 8), **tannins** (1,2,3-trimethoxybenzene, 1,2,4-trimethoxybenzene, 1,2,3,4-tetramethoxybenzene, acetic acid, methoxy-, methyl ester)
C	textile	multithread woven textile appears tan to brown in visible light and white in UV; weave is visible as fibers in sample are in two perpendicular directions; impregnated with brown (yellowish brown in UV) material; positive staining results for starch (weak staining) and oil/lipids, not in figure	***Toxicodendron verniciflluum*, fatty acids from lacquer and possibly bone** (mono- and dicarboxylic fatty acids), **gum benzoin** (2-propenoic acid, 3-phenyl-, methyl ester; benzoic acid, methyl ester; benzoic acid, 4-methoxy-, methyl ester; benzaldehyde, 4-methoxy-), **protein and possible blood** (1H-pyrrole, 1-methyl-, blood markers unverified 5 and 6, benzyl nitrile, trimethyl phosphate), **tannins** (1,2,3-trimethoxybenzene, 1,2,4-trimethoxybenzene, 1,2,3,4-tetramethoxybenzene, acetic acid, methoxy-, methyl ester
B	brown lacquer	thick brown lacquer, not in cross-section	***Toxicodendron verniciflluum*, fatty acids from lacquer and bone and/or oil** (mono- and dicarboxylic fatty acids; a methyl ketone (2-hexanone)), **indeterminate resin** (longifolene), **possible blood** (protein marker 1 tofu or blood), **protein from bone or glue** (pyrrole; 1H-pyrrole, 1-methyl-), **tannins** (1,2,3-trimethoxybenzene, 1,2,4-trimethoxybenzene, 1,2,3,4-tetramethoxybenzene, acetic acid, methoxy-, methyl ester)
A	underlying layers	not sampled	not analyzed

Note: Materials are placed in bold for readability.

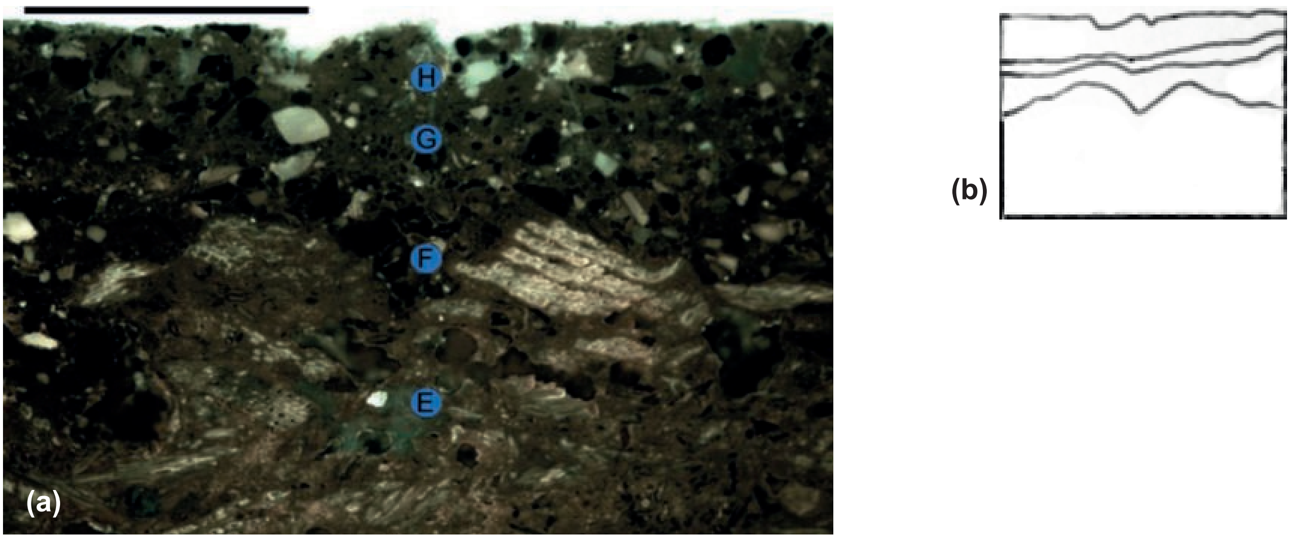

Figure 3. *Cross-section of the upper portion of the lacquer sample from the Metropolitan buddha (see pl. 3).* **a.** *Under ultraviolet light using Nikon filter B-2A. Scale bar = 250 µm.* **b.** *Drawing of the layers in the cross-section.*

Table 5. *Materials found in the bodhisattva head.*

Layer	Name	Description	Materials (chemical markers)
J	soil	dark surface layer, approx. 10 µm thick, darker than layer H; EDS: aluminum, iron, potassium, magnesium, oxygen, silicon, titanium, low carbon	H–J: ***Toxicodendron vernicifluum*** (from layer H), **fatty acids from lacquer and possibly bone** (mono- and dicarboxylic fatty acids), **indeterminate protein** (dimethyl sulfone), **possible resin** (aleuritic acid methyl ester, trimethyl ether, a compound found in, but not specific for, shellac), **tannins** (one marker: acetic acid, methyl-, methyl ester)
I	paint layer	thin layer appears colorless under visible and UV; EDS: aluminum, potassium, silicon	
H	upper lacquer 1	thin, dark layer less than 40 µm; no visible inclusions; EDS: sulfur	
G	upper ground 2	porous brown layer approx. 200 µm thick appears gray in UV and contains bone particles that are dark in visible light, with some white to yellow in UV light; particle sizes are smaller than in layer E or F and many have an elongated shape; many particles in 30–50 µm range but smaller are present; some calcium sulfate present. EDS: calcium, phosphorus, sulfur; positive staining results for protein (weak staining of matrix and discrete particles), starch (weak staining), oil/protein (particles and possibly matrix), and possibly oil/lipids	**fatty acids from bone and/or oil** (monocarboxylic fatty acid)
F	dark brown lacquer layer	dark gray-brown layer approx. 100 µm thick; most particles are dark in visible light, with one large white one at right; under UV, some particles remain black, some are white to light gray; a large particle appears yellow; EDS: higher silicon; positive staining results for oil/protein (in particles only)	**fatty acids from bone and/or oil (**mono- and dicarboxylic fatty acids), **bone or glue** (1H-pyrrole, 1-methyl), **tannins** (one marker: acetic acid, methyl-, methyl ester)
E	upper ground 1	reddish-brown layer approx. 400 µm thick contains black and gray bone particles with rounded edges that remain dark in UV, gray bone particles that lighten in color in UV, and gray to white bone particles that appear white to yellow in UV; many particles are very large, with several up to 120 µm longest dimension. EDS: calcium; positive staining results for protein, starch (darkening visible in UV), oil/protein (green cast and blue particles in visible light), and oil/lipids	**fatty acids from bone and/or oil** (mono- and dicarboxylic acids), **possible tannins** (acetic acid, methyl-, methyl ester)
D	brown lacquer 2	dense brown layer approx. 150 µm thick with white and black particles ranging in size from 20 to 80 µm in largest dimension; many large voids in the layer, and it appears to have the remains of fiber cross-sections that have been filled with lacquer; positive staining results for protein (weak staining), oil/protein, and oil/lipids (layer appears a uniform brown color except for fiber cross-sections, which remain yellow)	***Toxicodendron vernicifluum*, fatty acids from lacquer and possibly bone and/or oil** (mono- and dicarboxylic fatty acids), **protein from bone or glue** (1H-pyrrole, 1 methyl-), **tannins** (1,2,3-trimethoxybenzene, 1,2,4-trimethoxybenzene, acetic acid, methyl-, methyl ester)
C	textile	textile, bundles of fibers 75–150 µm diam. are white under visible light and yellow under UV; identified as hemp via fiber microscopy; positive staining results for starch, oil/lipids; high oil/protein content delineates individual fibers; oil/lipids seem to be in the space between fibers, possibly in lacquer saturating the fibers	**starch or textile** (schellmannose and paper unverified 6), **tannins** (1,2,3-trimethoxybenzene, 1,2,4-trimethoxybenzene, 1,2,3,4-tetramethoxybenzene, acetic acid, methyl-, methyl ester)
B	brown lacquer	dense brown layer with approx. 100 µm particle that is dark in both visible and UV light; layer appears to fill interstices of woven textile; positive staining results for oil/lipids	minor amount ***Toxicodendron vernicifluum,* bone and/ or glue** (1H-pyrrole, 1 methyl-. mono- and dicarboxylic fatty acids) **tannins** (1,2,3-trimethoxybenzene, 1,2,4-trimethoxybenzene, 1,2,3,4-tetramethoxybenzene, acetic acid, methyl-, methyl ester)
A	ground	not in cross-section	***Toxicodendron vernicifluum,* bone or oil (glycerol** (propane 1,2,3-trimethoxy-)), **bone or glue or possible blood** (pyrrole, blood unverified 5,6), **tannins** (1,2,3-trimethoxybenzene, acetic acid, methyl-, methyl ester)

Note: Materials are placed in bold for readability.

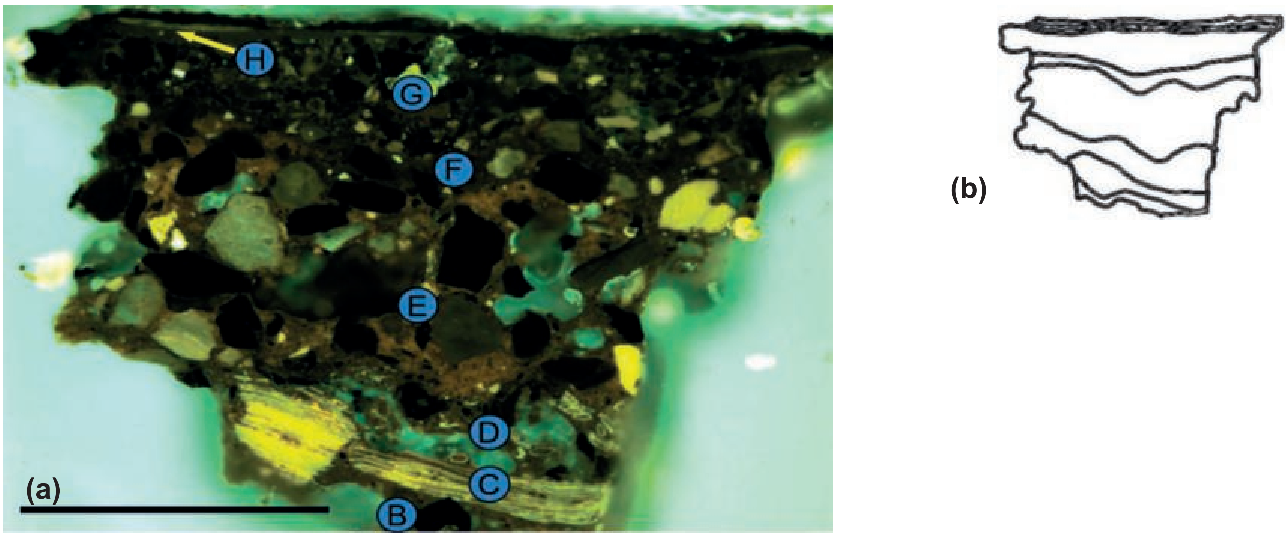

Figure 4. *Cross-section of lacquer sample from the bodhisattva head (see pl. 4).* **a.** *Under ultraviolet light using Nikon filter B-2A. Scale bar = 500 µm.* **b.** *Drawing of the layers in the cross-section.*

Table 6. *Materials found in the Freer bodhisattva.*

Layer	Name	Description	Material (Chemical Markers)
F	surface layer	colorless layer, 50 µm thick, positive staining for oil/protein	**fatty acids from bone or oil** (mono- and di-carboxylic acids), **proteins** (only one marker: d-proline), **tannins** (only one marker: acetic acid methoxy methyl ester), **phthalates** possibly from the sample container or a modern coating
Combined E and F	lacquer 4 and surface		***Toxicodendron vernicifluum*, fatty acids from lacquer and bone or oil** (mono- and di-carboxylic fatty acids), **glycerol** (propane, 1,2,3-trimethoxy- and 2,3-dimethoxypropan-1-ol)), **glue, and possibly bone** (pyrrole, 1H-pyrrole, 1-methyl-, hydroxyproline, d-proline, N-methoxycarbonyl-, methyl ester, pyridine, 1H-pyrrole, 3-methyl-, benzyl nitrile, indole, L-proline, 1-methyl-5-oxo-, methyl ester, fish glue marker 126/158, fish glue marker 126/158-2, protein 131-175, Mazzeo protein marker, protein 3 blood and glue, blood unverified markers 9 and 10), **tannins** (1,2,4-trimethoxybenzene, 1,2,3,4-tetramethoxybenzene, acetic acid, methoxy-, methyl ester)
E	lacquer 4	dark brown layer, 400 µm thick, with rounded silicate particles, 200 µm and sharp-edged bone particles (300 µm and less length)	***Toxicodendron verniciflluum***,di-carboxylic **fatty acids from lacquer and possibly bone (**mono- and di-carboxylic fatty acids), **blood, glue, and possibly bone** (trimethyl phosphate, protein 1, pyrrole, 1H-pyrrole, 1-methyl-, hydroxyproline, fish glue marker 126/158, fish glue marker 126/158-2, d-proline, N-methoxycarbonyl-, methyl ester, protein unverified 8, protein 56-141-156, blood unverified 1, protein 131-175, pyridine, 1H-pyrrole, 3-methyl-, 2-acetylpyrrole, 2,5-pyrrolidinedione, 1-methyl-, glycine, blood unverified 10, indole, L-proline, 1-methyl-5-oxo-, methyl ester), **tannins** (1,2,3-trimethoxybenzene, 1,2,4-trimethoxybenzene, 1,2,3,4-tetramethoxybenzene, acetic acid, methoxy-, methyl ester)
D	lacquer 3	dark brown approx. 400 µm thick layer with large gray to black elongated particles, up to 300 µm in length	not analyzed by Py-GCMS
C	lacquer 2	dark brown approx. 300 µm thick layer with up to 250 µm dark and small, dark particles up to 50 µm	***Toxicodendron verniciflluum*, fatty acids from lacquer and possibly bone (**mono- and di-carboxylic acids), **glue or bone** (protein 3 blood and glue, pyrrole, L-proline, 1-methyl-5-oxo-, methyl ester), **tannins** (1,2,3-trimethoxybenzene, 1,2,4-trimethoxybenzene, acetic acid, methoxy-, methyl ester)
B	lacquer 1	dark brown approx. 400 µm thick layer with black and white particles, large ranging 100–300 µm and small, up to 100 µm	***Toxicodendron verniciflluum*, fatty acids from lacquer and bone or oil** (mono- and di-carboxylic acids, methyl ketone-2-heptanone), **blood, bone, and/or glue** (trimethyl phosphate, blood unverified 5, 10, protein 3 blood and glue, pyrrole, glue marker (fish glue 126/158-2), methyl 1-methylpyrrole-2-carboxylate, glycine), **starch or textile carbohydrates** (starch unverified 1 and paper unverified 6), **tannins** (1,2,3-trimethoxybenzene, 1,2,4-trimethoxybenzene, 1,2,3,4-tetramethoxybenzene, acetic acid, methoxy-, methyl ester)
A	textile	textile; positive staining for protein in bottom half of sample	**fatty acids from lacquer and possibly bone** (mono- and di-carboxylic acids), **glue, bone, or blood** (pyrrole, 1H-pyrrole, 1-methyl-, blood unverified 10), **starch or textile carbohydrates** (schellmannose and starch unverified 1), **tannins** (1,2,3-trimethoxybenzene, 1,2,4-trimethoxybenzene, 1,2,4-tetramethoxybenzene, acetic acid, methoxy-, methyl ester)

Note: Materials are placed in bold for readability.

Alternatively, the gum benzoin may come from a brown material that impregnates the textile, as this material was included in the samples of textile analyzed. The gum benzoin may have been part of this brown material, in addition to the *Toxicodendrum verniciflluum* lacquer that was found.

The Bodhisattva Head

Similar to the Walters buddha, the sample for the head of the bodhisattva was taken from an area of flesh, the lower, proper right side of the neck along the back break edge. Five lacquer layers were found to be present above the textile, followed by a layer of paint and soil (fig. 4; table 5).

Toxicodendren verniciflluum was identified in the ground layer (A) as well as both upper lacquer layers and those lower in the structure. It was not found in lacquer layer (F), possibly due to sample size limitations. Finely ground bone is present throughout the cross-section of the bodhisattva. In the optical microscope, the sharp-edged particles of ground bone are seen to vary in color from light to dark depending on the degree to which the bone was burned. Almost all the visible particles are bone. A few scattered quartz, calcium carbonate, or silicate particles are visible with energy dispersive x-ray spectroscopy (EDS), mostly at the surface and likely due to soil.

In addition to the bone, fatty acids from lacquer, bone and/or oil, chemical markers for proteins from bone or glue, and tannins were found. In the textile layer, starch and other markers that may be attributable to the textile were present. Markers for blood and a single marker for glycerol, attributable to either oil or bone, were found in the ground layer.

The Freer Bodhisattva

In the Freer bodhisattva, a textile foundation followed by four lacquer layers and a nonlacquer surface coating were identified (fig. 5; table 6). Small particles in the textile foundation, likely bone, stained positive for protein. Bone fragments are visible in all layers but the surface coating. In Py-GCMS analysis of a single thread from the textile foundation, no *Toxicodendrum verniciflluum* was found. No lacquer had soaked into the fiber. Carbohydrates, tannins (tri- and tetramethoxybenzenes), and starch were present from the fiber. Protein markers are likely from the bone that stained positive for protein, but glue may also be present. Monocarboxylic fatty acids are present with only minimal dicarboxylic fatty acids, most likely from lacquer, bone, and/or oil.

All lacquer layers analyzed contain lacquer from *Toxicodendren verniciflluum* as determined by Py-GCMS.

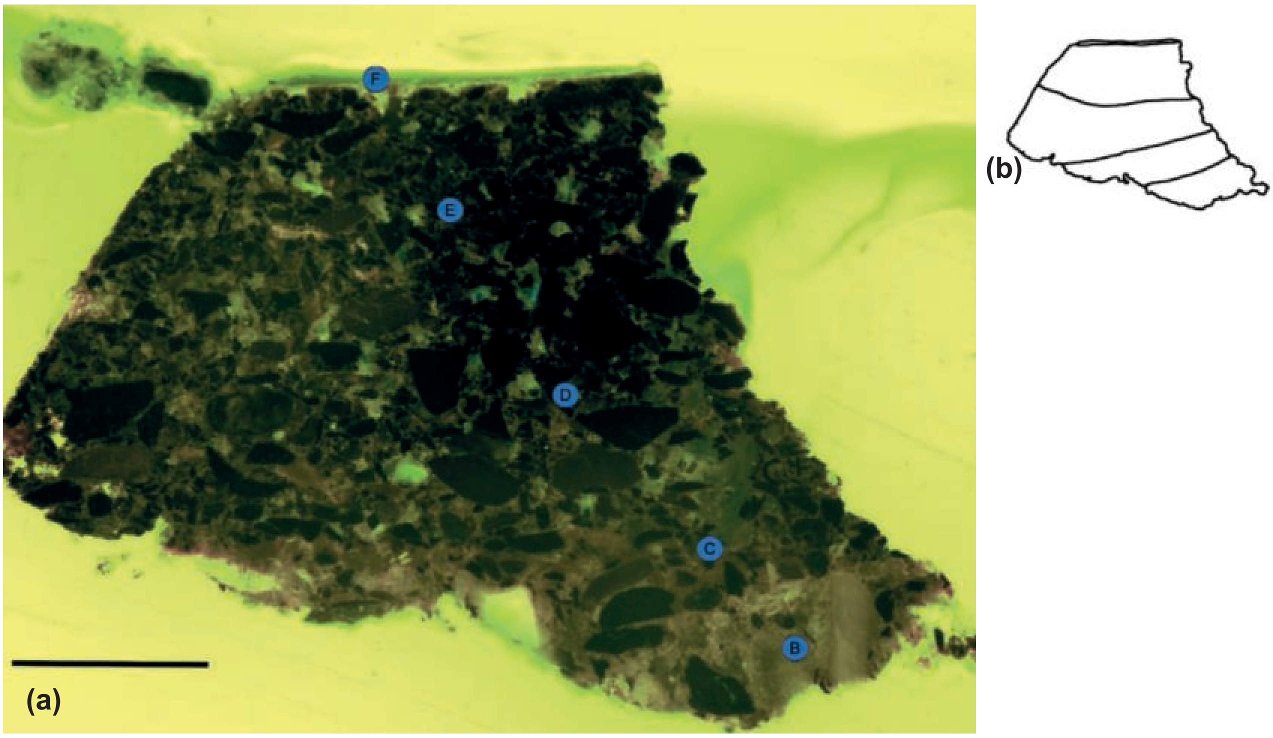

Figure 5. Cross-section of lacquer sample from the Freer bodhisattva (see pl. 5). **a.** *Under ultraviolet light using Nikon filter UV-2A. Scale bar = 500 µm.* **b.** *Drawing of the layers in the cross-section.*

The lowest lacquer layer, layer 1 (B), above the foundation, did not contain much if any filler, but trimethyl phosphate, found in both blood and bone, was present, as were tannins and protein marker compounds. The lacquer layers contain protein markers for blood and for glue.

A combined analysis of the top two layers—lacquer layer 4 (E) and the surface layer (F)—identified glycerol, possibly due to the addition of oil or inclusion of bone. As the colorless surface layer is quite thin, with minimal filler, the glycerol is likely associated with oil or bone added to lacquer layer 4 (E). The surface layer (F) did not contain lacquer; however, it did stain positive with Nile blue for oil/protein, and a single marker for protein, d-proline, was present, as well as one for tannins. As d-proline may come from saliva or bacterial activity and since it was found in the surface layer, it may not be original to the bodhisattva. The phthalates present could be from the sample container or suggest that this is a modern polymeric coating.

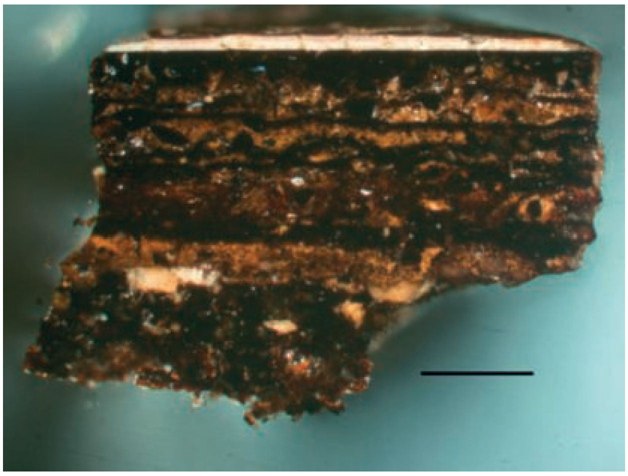

Figure 6. Cross-section of lacquer sample from the Walters buddha (see pl. 1) showing all layers taken in darkfield. Scale bar = 500 µm.

Discussion

As each of the five sculptures has a very different structure, it is difficult to compare their lacquer layers directly. The Walters buddha has sixteen diverse layers, the Metropolitan buddha has a thick layer with fibers, and the Freer buddha and the bodhisattva head include one thick lacquer layer with bone ash and mineral particles. Yet the sculptures also have the common feature of being fairly monochrome, as they are composed of varying shades of gray to black layers. The dark lacquer served as a substrate for decoration, and traces of pigment and gilding remain.

The lacquer structure in all five sculptures includes five types of layers: first, a coating on the textile to attach it to the core; second, a thin lacquer layer above the textile coating to seal and smooth it;[2] third, a thick area of coarser material to provide bulk, composed of one to many layers; fourth, a dark lacquer layer; and fifth, final finish layers, either dark or light in color. The number and purpose of lacquer layers are similar for all five sculptures if one takes into account the differences likely due to sampling location—i.e., the smooth flesh, the highly modeled robes, or an area that was purposefully cut and repaired. In particular, if the thin ground-lacquer layer pairs in the Walters buddha, the oldest of the group, are early restorations at what was likely a weak point in the structure and prone to cracking, the sixteen layers reduce to a number much more like the other sculptures (fig. 6). A repair to the Walters buddha in this area would have had minimal effect on surface decoration and thus preserves the likelihood that the remaining paint layers elsewhere on the surface are original.

Further similarities in the materials of the sculptures were readily apparent. All five sculptures were made with *Toxicodendron vernicifluum* lacquer (the *Toxicodendron succedaneum* found in a surface layer in the Freer buddha may be from a later repair). They all use partially burnt bone, and all have a layer that includes plant fibers or possibly sawdust.

The similarities of the sculptures in materials and techniques suggest a common practice in lacquer sculpture production. Indeed, the later manuscript *On Lacquering* (Xiushi lu), written by Huang Cheng in the sixteenth century with seventeenth-century annotations by Yang Ming and explained by Chang Bei (2014), describes foundation lacquer layers as providing support, intermediate lacquer layers that consolidate and smooth the foundation lacquer layers, and finish layers for decoration. This manuscript lists both bone and fibers as additives for foundation layers but does not mention their inclusion in other layers. Unlike in the sculptures studied here, where bone is used throughout, bone has only rarely been identified in the analysis of lacquer objects to date, and where it has been found it is generally in foundation or lower lacquer layers. Huang Cheng likens the foundation to soil (pt. 1, chap.1, entry 32), and the text describes a thick foundation layer of lacquer and powder. Yang Ming adds in his annotation, “When burnt, all things become part of soil from where they come.”[3] In another entry (pt. 2, chap. 17, entry 180), Huang Cheng lists bone as well as other materials for use in foundation layers. Yang Ming’s annotation to this entry mentions calcined bone as well as the character *jiao* 角, which can be translated as either calcined horn or antler but most likely refers to antler, as antler is formed of bone and calcining would result in residual ash, whereas horn is keratin and should more fully burn.[4] These passages from *On Lacquering* suggest bone ash continued in use in lacquer production in the sixteenth and seventeenth centuries.

Bone as Fill Material

The majority of the fill material for all five sculptures, excluding textile, was partially burnt bone or bone ash, as visible in the cross-sections using microscopy. Bone has been documented in foundation layers (Wang et al. 2017) and less commonly in lacquer layers (Li et al. 2009), as seen here. Although it would not be possible to differentiate bone from antler and both are described in *On Lacquering* as used for fill material, given the probable amount needed for the sculptures, bone is the most likely. This assumption has been confirmed by proteomics, which identified cow bone and horse bone in the sculptures, variously.

Bone consists mainly of collagen and the mineral hydroxyapatite, a calcium phosphate, in the form of small crystals. Of its dry mass, approximately 60–70% is mineral (Benson 2015). Bone contains proteins and lipids; blood vessels run through bones; and red blood cells are produced in the bone marrow. While the mineral hydroxyapatite has a density of approximately 3 grams per cubic centimeter—more than quartz, another common fill material, at 2.65 grams per cubic centimeter—the density of bone ranges from 0.9 to 1.4 grams per cubic centimeter. Bone is much lighter than other mineral fill materials and so a good choice for the “portable” sculptures. At the same time, bone ash has another possible benefit: any blood and proteins remaining after the formation of bone ash could also function as additives to the lacquer. The specific residual organics depend on how finely the bone was ground and how fully it was burned. While a variety of fragment sizes and colors from white to black were seen in the cross-sections, further research is needed to determine what proteins, fatty acids, and other compounds can survive the ashing process.

A modern long bone (compact portion) from a cow analyzed using Py-GCMS detected monocarboxylic and dicarboxylic fatty acids and chemical markers for glycerol, proteins (among them glue and blood markers), carbohydrates, sterols, and trimethyl phosphate (table 7). Similar compounds—i.e., a combination of cholesterol, protein markers, and trimethyl phosphate—have been found in lacquer samples containing blood at the Getty Conservation Institute.[5] Evidence for blood was found in the sculptures using Py-GCMS analysis. Additionally, we do know that some blood made its way into the sculptures, as animal proteins and human blood proteins were detected by proteomics at the Smithsonian Museum Conservation Institute. Blood may have been introduced as part of the bone or as a separate, intentional additive.

In this study, blood protein markers and trimethyl phosphate were seen in a lower layer of the Metropolitan buddha and in two upper layers of the Walters buddha. Protein markers for blood, but not trimethyl phosphate, were also visible in a ground layer of the bodhisattva head. Proteins have also been found in foundation layers in other lacquer objects (Miklin-Kniefacz et al. 2016).

Fatty acids were present in all five sculptures. Glycerol was found in samples from the Walters buddha and the two bodhisattvas. No glycerol was identified in either the Metropolitan or the Freer buddha; however, methyl ketones, another marker for oils, were found in the Metropolitan buddha. Chemical markers for glycerol (see table 7) are generally taken to indicate the addition of oil; here, however, glycerol markers were detected in the samples of cow bone and marrow that were analyzed by Py-GCMS. Thus the glycerol found may be associated with bone ash. After calcination (burning) to form the bone ash used in the lacquer, it is likely that many of the chemical markers seen in the bone samples here would be lost, and there were many fewer markers in the sculptures than were found in the cow bone. However, microscopy showed that some organics did survive, as bone particles turned blue in visible light and black in UV light after staining with Nile blue sulfate, a stain that reacts when proteins or lipids are present. In addition to the fatty acids, given the high amount of protein seen in the Py-GCMS results it also seems probable that protein remains in the partially burnt

Table 7. Chemical marker compounds in cow long bone and long bone marrow.

Marker Chemicals in Sample from Cow Bone	Differences in Marrow (same bone)
hydrocarbons, alkyl benzenes	**additional fatty acids** (C_4 dicarboxylic acid)
monocarboxylic fatty acids (C_{18} and $C_{18\text{-}1}$ in approximately equal amounts and small amounts of C_{14}, C_{15}, C_{16}, C_{17})	**additional proteins** (d-proline, N-methoxycarbonyl-, methyl ester, protein 131-175 (glue, egg white, yolk, casein), 2-aminopyridine, L-proline, 1-methyl-5-oxo-, methyl ester)
glycerol (propanol, 1,3-dimethoxy-, propane and 1,2,3-trimethoxy-, 2,3-dimethoxypropan-1-ol, 1,2-propanediol, 3-methoxy-)	**absent proteins** (L-proline, 1-methyl-, methyl ester, methyl pyrrole-2-carboxylate, benzyl nitrile, benzene, (1,2-dimethoxyethyl)-)
proteins (blood unverified 1, 5, 6, 7, 10, 11; glue unverified 3, protein unverified 8, protein 1 — tofu and blood, 1H-indole, 1,3-dimethyl-, protein 3 — blood and glue, pyrrole, 1H-pyrrole, 1-methyl-, protein 131-160 (casein, egg white), pyridine, 1H-pyrrole, 3-methyl-, L-proline, 1-methyl-, methyl ester, 2-acetylpyrrole, 2,5-pyrrolidinedione, 1-methyl-, methyl pyrrole-2-carboxylate, benzyl nitrile, benzene, (1,2-dimethoxyethyl)-, benzenepropanenitrile, indole, Mazzeo glue marker, pyrrolo [1,2-a] pyrazine-1,4-dione, hexahydro-, hydroxyproline)	**absent carbohydrate** (2-propanone, 1-methoxy-)
carbohydrates (2,3-butanedione, 2-cyclopenten-1-one, 3-methyl-, 2-propanone, 1-methoxy-)	
sterols (cholest-5-ene, 3-methoxy-, (3.beta.)-, cholesterol)	
trimethyl phosphate	

bone and is a source of proteins in the lacquer. However, for the proteins, it is likewise unclear what compounds might be lost during ashing.

Layers that did not contain *Toxicodendron vernicifluum* but did contain bone were found in the Freer buddha and the bodhisattva head. They were lighter in color than the lacquer-containing layers. They are also likely present in the Walters buddha, although in this case it was not possible to separate these layers from the adjacent lacquer-containing layers due to their thinness. These layers contain proteins, most likely acting as a consolidant. Markers for protein glue, a material formed by boiling skin or bone, were also found in the lacquer layers of all sculptures. Starting in the Northern Song dynasty (960–1127), there are references to mixing lacquer and glue (Heginbotham et al. 2016). Early texts advise the addition of protein glue to increase the adherence and durability of ground layers. While staining often gives positive results for proteins when bone fragments are present, both within larger bone fragments and in the areas surrounding them, suggesting the proteins may come from the bone ash, glue cannot be ruled out as a component of the lacquer layers. Thus proteins may be associated with glue, blood, or bone in many cases, and the results seen in the samples vary in the number of markers present. Further research is needed to determine if there are chemical differences between proteins and blood from bone vs. blood added separately, or vs. bone proteins processed into glue, or if differences result from heterogeneities and sample size limitations.

Other Additives

Markers for starch and other nonlacquer carbohydrates were found in the hemp textile layers of the Freer buddha, the bodhisattva head, and the Freer bodhisattva. Only markers for carbohydrates associated with lacquer were seen in the Metropolitan buddha; the textile layers of the Walters buddha were not analyzed. Plant materials (such as sawdust) as well as small amounts of quartz and other silicates were identified in the lacquer layers. Glucosides were found in the Walters buddha layer G, where fibers were visible in the cross-section. For all five sculptures, one or more layers stained positive for starch, identified by Py-GCMS. In some cases, positive staining for starch occurred specifically at the edges of fibers, as in the textile layer of the Freer buddha (layer A) as well as in interior layers with fiber pieces in the other sculptures. If the starch is added and not part of the fiber, starch at the fiber edge may have resulted in increased stiffness, as seen in a starched shirt today. More relevant for the cut fiber pieces, the starch may have helped strengthen the bond between fiber and lacquer, reducing the possibility of cracking. Starch could also have been used to thicken or provide more tackiness to the lacquer paste, or it could have originated from fibers used as bulking materials in the layers. Another additive that can come from several plant sources is tannins. These brown to black colorants were found in all five sculptures. In addition, one marker compound for soot was identified in upper layers of the Walters buddha.

Conclusions

This study documented the materials and layering of five lacquer Buddhist sculptures, all formed of multiple layers of *Toxicodendrum vernicifluum* lacquer with bone ash used as fill throughout both ground and lacquer layers. All lacquer microstructures began with a coarse lacquer layer that was followed by finer layers and, for samples taken from areas of flesh on the sculptures, with the finest lacquer on top. Samples taken from areas of drapery contained more textile and fewer lacquer layers.

The presence of bone ash in layers other than the foundation in the lacquer sculptures is a finding rarely documented for Asian lacquer objects. Its use in Buddhist lacquer sculpture was likely due to the need for a lightweight, hard material that was available in large amounts for the formation of life-size or larger "portable" sculptures. Bone ash also provided organics, visible from staining of cross-sections, that functioned as additives to the lacquer. The specific residual organics depend on how small the bone was ground and how fully the bone was burned. Future research is needed to determine what proteins, fatty acids, and other compounds can survive the ashing process and how these relate to the profile of chemical markers from other possible additives, such as blood and bone-based glue.

The techniques used to produce lacquer sculptures remained similar from the sixth to the late thirteenth century. The combined approach of looking at the cross-sections of the lacquer layers together with Py-GCMS analysis reveals the complex techniques that produced the apparently simple surfaces of the sculptures.

Appendix. Methods

Samples were removed from areas of loss on the four hollow-core lacquer sculptures and the one wooden-core sculpture, as detailed in table 1. In addition, samples were taken from frozen cow long bone and from its marrow. The samples were removed from the frozen bone by first drilling the surface and throwing away the powder from this first drill, then drilling deeper with a smaller drill bit to obtain samples that did not include surface material.

Portions of each lacquer sample were used to prepare cross-sections mounted in BioPlast resin. Stains (Amido black, Nile blue sulfate, potassium iodide, and Sudan black B) were applied to the cross-sections using methods developed by Schellmann (Schellmann and Schilling 2013). Both unstained and stained cross-sections were viewed under the microscope in visible and ultraviolet light to help identify components in each lacquer layer. Two microscopes were used. The first was a Leica fluorescence microscope type 020-525.026 with Leica 307-072.057 100 W mercury lamp and a Leica DFC425 camera. The second was a Nikon Eclipse LV100POL microscope with a Nikon Intensilight C-HGFI and a Nikon DS-Ri2 camera. Nikon UV-2A and Nikon B-2A fluorescence filter sets were used.

The remainder of each sample was adhered to glass slides and microexcavated and then analyzed by Py-GCMS. The bone and marrow samples were analyzed by Py-GCMS using the same conditions as the lacquer. A Shimadzu QP2010 Ultra GCMS with Frontier 2020 pyrolyzer running GCMS Solution version 450 SP1 software was used on subsamples from the five samples with an attempt made to analyze layers individually or in like groups. Samples were put in stainless steel eco-cups (50 µl size), and 3 microliters of a derivatizing agent—25% tetramethylammonium hydroxide (TMAH) in methanol—were added. The sample was allowed to react for 3 minutes, eco-sticks were added, and then it was placed in the pyrolyzer interface and purged with dry helium for 3 minutes. Analysis was carried out in single-shot mode with pyrolysis interface at 320°C and the pyrolyzer run for 6 seconds at 550°C. A trimmed HP-5MS column (30 m × 0.25 mm × 0.25 µm) was used for separation. Helium carrier gas flow was 1ml/minute. Split injector temperature was maintained at 320°C with split ratios from 10 to 50:1, dependent on sample size. A 3-minute cut time was used. The following temperature program was used: 40°C for 2 minutes, followed by a ramp to 300°C at 6°C/minute, then a 9 minute isothermal hold. The mass spectrometer (MS) transfer line was set at 300°C, source at 230°C, and the MS quad at 150°C. Mass data were acquired from 10–600 m/z at a scan speed of 1666. The spectrometer was tuned daily, and the electron multiplier set to the autotune value. The National Institute of Standards and Technology's AMDIS (Automated Mass Spectral Deconvolution and Identification System) was used for deconvolution and identification of the data with inclusion of all data with 80% or greater match. The expert system ESCAPE (Expert System for Characterization, using AMDIS plus Excel), developed at the Getty Conservation Institute, was used for interpretation.

Scanning electron microscopy (SEM) on samples from all but the Freer bodhisattva was performed at the National Museum of Natural History's Department of Mineral Sciences using a FEI Nova NanoSEM 600 with a Thermo Fisher energy dispersive x-ray detector in high vacuum mode. Software used for the energy-dispersive x-ray (EDS) analysis was Thermo Fisher Scientific NSS v. 3.1. A gaseous analytical detector was used in variable pressure mode to image a sample of clay and red material from the interior of the bodhisattva head. For the Freer bodhisattva, a Point Electronics modified FEI XL30 scanning electron microscope (SEM) with EDAX Octane Elect Plus energy dispersive x-ray spectroscopy (EDS) with Apex Advanced 1.3.1 software was used to identify elements present in the lacquer layers. In addition, elemental distribution maps were produced to confirm the location of specific elements within cross-section layers. SEM secondary electron imaging was used to examine particle morphology in the lacquer layers.

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Notes

1. Timothy P. Cleland, Analysis of bone from Chinese lacquer buddhas, 2017, Smithsonian Museum Conservation Institute, report MCI#6777; Timothy P. Cleland, Analysis of bone from Chinese lacquer buddhas-1, 2017, Smithsonian Museum Conservation Institute, report MCI#6777.2.
2. In listing errors of smoothing a wooden core, *Xiushi lu* entry 71 mentions "the lacquer-based paste, which is used to fill the depressed areas in the wooden core." A lacquer-based paste is also applied to the hollow-core sculptures where the textile must be smoothed out. Translations of the Chinese by Daisy Yiyou Wang are taken from the English annotated edition of Huang Cheng 黃成, *On Lacquering* (Xiushi lu 髹飾錄), annotated by Yang Ming 楊明, 1625; reprint, Beijing: Zhongguo Renmin daxue chubanshe, 2004. A translation by Daisy Yiyou Wang, annotated and edited by Blythe McCarthy and Daisy Yiyou Wang, with contributions from Linda Lin, is in preparation and will be published on the Smithsonian's National Museum of Asian Art website.
3. Translation by Daisy Yiyou Wang, as above.
4. Translation by Daisy Yiyou Wang, as above.
5. Data on blood in lacquer were presented in an Excel worksheet developed by Michael R. Schilling, Arlen Heginbotham, and Henk van Keulen for the Getty Conservation Institute and J. Paul Getty Museum research project "Recent Advances in Characterizing Asian Lacquers" (RAdICAL), © 2018 J. Paul Getty Trust. See Schilling et al., in this volume.

References

Benson, Lisa. 2015. Structure and composition of bone, posted 20 August 2015, https://www.slideshare.net/LisaBenson2/1-bone-structure-and-composition (accessed 26 March 2018).

Chang Bei 長北. 2014. *Xiushi lu yu dongya qiqi:Chuantong xiushi gongyi tixi yanjiu*髹飾錄與東亞漆器：傳統髹飾工藝體系研究 [*Xiushi lu* and East Asian lacquer: A study of traditional lacquer crafts]. Beijing: Renmin meishu chubanshe.

Chang, Julie, and Michael Schilling. 2016. Reconstructing lacquer technology through Chinese classical texts. *Studies in Conservation* 61(3): 38–44.

Heginbotham, Arlen, Julie Chang, Herant Khanjian, and Michael R. Schilling. 2016. Some observations on the composition of Chinese lacquer. *Studies in Conservation* 61(3): 28–37.

Hsu, Hsin-Hui, and Dean Sully. 2016. Fusing and refreshing the memory: Conserving a Chinese lacquered Buddha sculpture in London. *Studies in Conservation* 61, supp. 3: 124–30.

Jin Pujun, Yali Hu, Xuliang Gu, and Xuegao Ji. 2012. *Jiuliandun chutu qiqi qi huiceng zhizuo gongyi yanjiu* 九连墩出土漆器漆灰层制作工艺研究 [Research on the fabrication techniques about lacquer layers of lacquer wares excavated from Jiuliandun tombs]. *Jianghan Kaogu* 125(4): 108–13.

Kieser, Annette. 2019. Six Dynasties (220–589) lacquerware: A survey. In *Production, Distribution and Appreciation: New Aspects of East Asian Lacquer Ware*, ed. Patricia Frick and Annette Kieser, 64–84. Leiden and Boston: Brill, https://doi.org/10.1163/9789004384385_005 (accessed 3 January 2023).

Leidy, Denise Patry. 2018. Lacquer and Buddhist sculpture in East Asia, sixth–eighth century. National Museum of Asian Art website, https://asia.si.edu/essays/lacquer-and-buddhist-sculpture-in-east-asia-sixth-eighth-century (accessed 3 February 2023).

Li Tao, Yunfeng Xie, Yimin Yang, Changsui Wang, Xiaoyang Fang, Jilong Shi, and Qiuju He. 2009. Pigment identification and decoration analysis of a 5th century Chinese lacquer painting screen: A micro-Raman and FTIR study. *Journal of Raman Spectroscopy* 40:1911–18.

Miklin-Kniefacz, S., Martina Griesser, Walther Parson, Václav Pitthard, and Sabine Stanek. 2016. Searching for blood in Chinese lacquerware. *Studies in Conservation* 59, supp. 1: 252–53, https://doi.org/10.1179/204705814X13975704320477 (accessed 3 January 2023).

Müller, Shing. 2019. A preliminary study of the lacquerware of the Northern Dynasties, with a special focus on the Pingcheng period (398–493). *Early Medieval China* 25: 42–63, https://doi.org/10.1080/15299104.2019.1660087 (accessed 3 January 2023).

Schellmann, Nanke, and Michael Schilling. 2013. Validation of combined fluorescence microscopy and staining techniques for characterizing Asian lacquer cross sections. Paper presented at the Asian Lacquer International Symposium, SUNY Buffalo State, Buffalo, N.Y.

Schilling, Michael R., Arlen Heginbotham, Henk van Keulen, and Michael Szelewski. 2016. Beyond the basics: A systematic approach for comprehensive analysis of organic materials in Asian lacquers. *Studies in Conservation* 61(3): 3–27.

Strahan, Donna K. 1993. The Walters Chinese wood-and-lacquer buddha: A technical study. *Journal of the Walters Art Gallery* 51: 105–20.

Strahan, Donna, and Blythe McCarthy. 2018. Construction from the inside out: Early Chinese lacquer buddha fabrication. National Museum of Asian Art website, https://asia.si.edu/essays/construction-from-the-inside-out-early-chinese-lacquer-buddha-fabrication (accessed 26 February 2018).

Wang, Rong, Fei Nie, Jian-ming Chen, and Y. F. Li. 2017. Studies on the ground layer of lacquerwares from between the Mid-Warring States period and the Mid-Western Han dynasty unearthed in the Changsha region. *Archaeometry* 59:105–20.

Webb, Marianne. 2000. *Lacquer: Technology and conservation.* Oxford: Butterworth-Heinemann.

Zhang Lan. 2008. Contribution in Jane L. Williams, *The conservation of Asian lacquer: Case studies at the Asian Art Museum of San Francisco*, 20–22. San Francisco: Asian Art Museum—Chong-Moon Lee Center for Asian Art and Culture.

Highlights of Chinese Lacquer Research at the Getty

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ABSTRACT The Getty project to characterize Asian and European lacquers began with the relatively modest goal of differentiating lacquer types in furniture. In 2006, conservators at the J. Paul Getty Museum and scientists at the Getty Conservation Institute began a collaborative project to study the organic materials in these objects for the purpose of enriching catalog entries of the collection. Unexpectedly, the project has led to advances in lacquer scholarship, technical art history, organic analysis, and lacquer conservation. This article touches on project highlights, with special emphasis on the analytical protocol that was developed to study lacquer and the materials identified in Chinese export lacquered panels incorporated into the J. Paul Getty Museum furniture.

Introduction

The Getty project to characterize Asian and European lacquers began with the relatively modest goal of differentiating lacquer types in furniture. The collection of the J. Paul Getty Museum (JPGM) includes several pieces of French furniture dating to the mid-eighteenth century that incorporate panels of Asian lacquer as part of their surface decoration. In 2006, conservators at the JPGM and scientists at the Getty Conservation Institute (GCI) began a collaborative project to study the organic materials in these objects for the purpose of enriching catalog entries of the collection that would appear in a forthcoming art-historical publication (Wilson and Heginbotham 2021). Looking back on the unanticipated breadth of what has been accomplished since that time, we recognize that the project has led to advances in lacquer scholarship, technical art history, organic analysis, and lacquer conservation. This article touches on project highlights, with special emphasis on the analytical protocol that was developed to study lacquer and the materials identified in Chinese export lacquered panels incorporated into the JPGM furniture.

Development of Sampling and Analytical Protocols

There are vast differences between the materials and craft techniques of decorative lacquers made in Asia and in Europe (Webb 2000). Asian lacquers consist largely of sap from several trees within the Anacardiaceae family (henceforth referred to as Anacards) that grow throughout a number of specific geographical regions within Asia. The traditional lacquer known as *urushi* in Japan, *qi* in China, and *ottchil* in Korea is made from *urushiol* sap of *Toxicodendron vernicifluum*. Vietnamese and Taiwanese lacquer is composed of *laccol* sap from *Toxicodendron succedaneum*. Burmese and Thai lacquer consists of *thitsiol* sap from *Gluta usitata* and *Gluta laccifera*. The tree saps, composed mainly of catechols with long unsaturated side chains, are often processed by heating and stirring to reduce their water content prior to use (Kumanotani 1995; Lu et al. 2013). Other organic materials may be added to alter the working properties, appearance, and cost of the formulations (Lu and Miyakoshi 2015). Lacquers on objects are built up of multiple layers, each cured at high humidity and then air-dried, and the layers typically have specific compositions (Heginbotham et al. 2008). In contrast, European lacquers consist of complex mixtures of natural resins, drying oils, and organic colorants (Saverwyns et al. 2014). The materials are dissolved in an organic solvent and applied to the object, and a dry lacquer layer forms by solvent evaporation.

Given the diversity of materials used in lacquers, a crucial element of the project was the development of a robust analytical procedure suitable for both Asian and European lacquers. Pyrolysis–gas chromatography mass spectrometry (Py-GCMS) was the chosen analytical technique because of its prior use in differentiating the three Anacard tree saps and the materials in European lacquers. When pyrolyzed, most materials form numerous chemical compounds that are subsequently separated by GC into peaks and identified by their mass spectra. Of these, the compounds formed only by specific materials are considered "marker compounds," indicative of the presence of those materials in samples. For instance, substituted catechols are considered marker compounds for Anacard tree saps. The remaining compounds, formed by any number of materials, have no diagnostic value in material identification.

In many published Py-GCMS studies, Asian lacquer samples were analyzed with no sample pretreatment (Niimura et al. 1999), whereas the optimum results for European lacquers were obtained by treating samples with the chemical reagent tetramethylammonium hydroxide (TMAH) prior to pyrolysis in order to form more easily detected chemical compounds known as derivatives. For instance, methyl esters of fatty acids are more easily detected than the corresponding fatty acids (Robb and Westbrook 1963). After selecting Py-GCMS for sample testing, we decided to add TMAH to samples of both types of lacquer in order to take advantage of the vast body of marker compound information on a wide variety of European lacquer materials (Van Keulen 2014a; Koller and Baumer 1997), reasoning that the existing Py-GCMS literature on Asian lacquer, augmented by the far fewer studies of Asian lacquer using TMAH (Le Hô et al. 2012; Chiavari and Mazzeo 1999), would provide clues for deducing marker compound derivatives of *urushi*, *laccol*, and *thitsi*. If successful, this approach would result in a marker compound database encompassing all known organic materials in Asian and European lacquers.

An important component of the research was the development of a procedure for sampling individual lacquer layers for analysis. Isolation of sample material from a single layer made it possible to definitively identify the materials present in each layer, a step that is of utmost importance considering the complex layering structure of lacquers. Appendix 1 gives the details of the sampling method developed in the project. By 2008, a preliminary literature survey had been completed, a core set of reference materials had been assembled, and an improved procedure using thermally assisted hydrolysis and methylation with pyrolysis–gas chromatography mass spectrometry (THM-Py-GCMS) was presented (Heginbotham et al. 2008). Details of the analytical protocol (Schilling et al. 2016) appear in appendix 2.

After sample analysis, systematic processing of THM-Py-GCMS data files for lacquer samples presented a serious challenge. It is common for lacquer test results to have hundreds of GC peaks that vary widely in size. In an examination of sample test results for marker compounds, small peaks can easily be overlooked even by experienced users, resulting in misidentified sample compositions. To safeguard against this problem, we sought to develop a data-processing system that automatically searched sample test results for every marker compound present, regardless of peak size and the proficiency of users to recognize them. After some initial attempts, we settled on the Automated Mass Spectral Deconvolution and Identification System (AMDIS), a freeware GCMS data-processing system developed by the National Institute of Standards and Technology for detecting chemical weapon agents (Stein 1999). With minimal user interaction, AMDIS automatically identifies marker compounds by mass spectral library matching and Kováts retention index (Tarján et al. 1989), thus ensuring highly accurate and repeatable sample report results. AMDIS reports include peak areas of marker compounds that relate to their amounts present in samples. A Microsoft Excel workbook template developed in the project reads AMDIS sample reports and automatically generates diagnostic graphs and tables of marker compound peak areas, which users interpret with the aid of integrated reference information from Py-GCMS experts to identify sample composition. We coined the term ESCAPE (Expert System for Characterization using AMDIS plus Excel) to describe the data-processing system developed in this project (Schilling et al. 2016; Van Keulen and Schilling 2019).

Lacquer Analysis Workshop: RAdICAL

Increasing interest in our research led to the development of a GCI workshop series for conservators and scientists entitled “Recent Advances in Characterizing Asian Lacquers” (RAdICAL), through which we share the sampling and analysis methods developed at the Getty and the use of histochemical stains for mapping lacquer materials in cross-sections that was pioneered by Nanke Schellmann (2012). In the workshop, each conservator collaborates with a scientist to study a sample of a lacquered object from the conservator’s home institution, giving each team an opportunity to work together on a technical study of the object. In reviews of the workshop, most participants value the team experience highly. RAdICAL has helped expand the lacquer research network, with alumni initiating their own lacquer research projects (Matsen et al. 2017) and doctoral dissertations (Körber 2018; Chang 2020). Venues for RAdICAL workshops have included the Getty, Los Angeles (2012), the Institute for Preservation of Cultural Heritage at Yale, New Haven (2013), the Center for Research and Restoration of the Museums of France, Paris (2014), and the Cultural Heritage Agency of the Netherlands, Amsterdam (2017).

Aged Lacquer Reference Materials

It soon became apparent that our analytical protocol was revealing an unanticipated complexity in historic Asian lacquer formulations, as a wide range of unexpected and previously unreported materials were detected in lacquer in the JPGM collections. Our attention focused first on the surprising composition of seventeenth-century Japanese export lacquers in the J. Paul Getty Museum collection, and a summary of our results regarding these materials was first presented in 2009 (Heginbotham and Schilling 2011). With the potential of the new analytical protocol established in our minds, we then concentrated our efforts on expanding the range of materials and formulations in our reference collection.

To augment the collection of reference specimens in the analytical research, a set of lacquered replica panels with formulations consistent with Asian lacquerware was produced by Marianne Webb, a conservator in private practice and collaborator in the Getty lacquer research (Webb et al. 2016). After curing, the replicas were exposed to light and humidity in a light exposure chamber and subsequently cycled between high and low relative humidity

Figure 1. *Bernard II van Risenburgh, commode, Paris, France, ca. 1740, white oak, set with panels of red Chinese lacquer on a coniferous substrate, and sycamore maple painted with European lacquer, gilt-bronze mounts, brass and iron hardware and lock, brèche d'Alep top, 83.8 × 114.3 × 54.9 cm. The J. Paul Getty Museum, Los Angeles, 72.DA.46.* **a.** *Commode.* **b.** *Close-up of sampled area beneath mount. Red arrow indicates where the sample was taken.* **c.** *Cross-section in visible light illumination.* **d.** *Cross-section in UV-fluorescence illumination. Multiple layers of Asian lacquer (designated G-M) were identified in the cross-section, over which were applied European restoration coatings (N–R). Layers of the cross-section that were analyzed by THM–PyGCMS were the upper lacquer (I), the lower lacquer (H), and the ground (F; unlabeled, below G).*

environments in order to simulate natural aging processes (Keneghan 2011). These conditions accelerated the formation of surface defects that are typical of naturally aged lacquerware, such as cracking, blanching, discoloration, and sensitivity to water (Coueignoux and Rivers 2015). Crack formation intensified as a result of the relative humidity cycling, a finding that reinforces the importance of controlling the relative humidity in the environments where lacquerware is displayed or stored (Yamashita and Rivers 2011).

Much was learned from THM-Py-GCMS analysis of the degraded replica surfaces. A set of acidic, water-soluble marker compounds was identified as various isomers of carboxylated benzenes, which we have tentatively attributed to photodegradation of the cross-linked polymer network of substituted catechols, although the mechanism of their formation is uncertain (Schilling et al. 2016). The well-documented reduction in surface pH as lacquer degrades is at least partly due to the formation of these compounds (Schellmann and Rivers 2005; Webb 2011). Moreover, an abundance of carbohydrate marker compounds was identified in the degraded surfaces of the *laccol* replicas, which originate from pyrolysis of the polysaccharide fraction of the tree saps and for which *laccol* has the highest concentration compared to *urushi* and *thitsi* (Lu and Miyakoshi 2015). It was surmised that photo-oxidation reactions degrade the cross-linked catechol polymer, leaving the degraded surfaces enriched in the more light-resistant polysaccharides. In fact, carbohydrate pyrolysis products proved to be among the most persistent marker compounds for *laccol*, sometimes being the only detectable *laccol* markers in highly degraded lacquerware (Heginbotham et al. 2016; Schilling et al. 2016).

Chinese Lacquer in the JPGM Collections

Much of what we have learned about Chinese lacquer materials may be illustrated by examples of the Chinese export lacquer in the J. Paul Getty Museum collection. This section provides a description of the furniture, a discussion of the cross-sections, and a summary of the analytical results for the materials identified in each of the lacquer and ground (also known as foundation) layer samples. Additional sections provide detailed descriptions of how each material category in the objects was identified.

Van Risenburgh Commode

The first example (fig. 1) is a commode by Bernard II van Risenburgh (after 1696–ca. 1766), an outstanding Parisian cabinetmaker who worked in the Rococo style. He veneered the front and side of this French commode with thin sheets of Chinese red lacquer. Another specialized Parisian craftsman, as yet unidentified, painted the remaining wood surfaces of the carcass in imitation of a plain red lacquer, using the technique now generally known as vernis Martin. Van Risenburgh then applied gilded bronze mounts to cover and protect the seams of the Chinese red lacquer veneer. This work would likely have been commissioned by a Parisian decorator, or Marchand-mercier, for sale to his aristocratic clientele. Typically, a Marchand-mercier would acquire Chinese or Japanese lacquered objects such as cabinets, chests, and screens, and then deliver them to a cabinetmaker's workshop where they would be dismantled and the lacquer surfaces applied as veneers to contemporary forms.

A sample was removed from a screw hole beneath a gilded bronze mount on the front of the drawer for preparation of a cross-section and THM-Py-GCMS analysis of the layers. The cross-section illustrates the complexity of Asian lacquer, the variation in layer thickness, and the value of ultraviolet light illumination for revealing additional information about the layers, such as layer thicknesses. Multiple layers of Asian lacquer (designated as G–M) were identified in the cross-section, over which were applied European decorations and restoration coatings (N–R).

Dubois Secrétaire

The second example (fig. 2) is a secrétaire by Jacques Dubois (1694–1763), a descendant of a family of French *ébénistes* (cabinetmakers). When opened, the fall front of this secrétaire forms a writing surface, revealing red lacquered drawers and pigeonholes. The lacquer on the front of the secrétaire was taken from two adjacent panels of a Chinese folding screen, decorated with figures of European huntsmen, perhaps members of the Dutch East India Company. Before they were applied to the case, the lacquer panels were carefully thinned down to less than 1.5 mm in thickness using planes and scrapers. The side panels are also taken from a Chinese folding screen, while the plain red lacquer surrounding the imported panels was executed by French craftsmen. A sample removed from a screw hole beneath a gilded brass mount on the front of the cabinet revealed multiple layers of Asian and European lacquer, identified as Asian foundation (A), Asian lacquer (B and C), and European restoration (D–F).

Dubois Corner Cupboard

The final example (fig. 3) is one of a pair of corner cupboards also made by Jacques Dubois. Each has a bowed front and is fitted with a single lockable door, and the corners are set with gilded brass mounts. The doors are set with panels of Chinese black lacquer featuring three tones of gold and touches of red. The lacquer on the cupboard we examined depicts a large open temple held up by columns and occupied by several figures. The cross-section from under a gilded mount showed that the Chinese lacquer was originally applied to a leather substrate, which allowed it to later be used as veneer on the curved wooden surface (Hagelskamp et al. 2016). The layers of the Chinese panel in the cross-section were identified as leather (C–E), ground (F), transparent lacquer (G–I), and pigmented lacquer (K).

Figure 2. *Jacques Dubois, secrétaire, Paris, France, ca. 1755, white oak and sycamore maple veneered with panels of red Chinese lacquer on Japanese arborvitae and painted with European lacquer, interior drawers of sycamore maple and Japanese arborvitae, gilt-bronze mounts, brass and iron hardware and locks, brèche d'Alep top, replacement silk velvet and trim, 102.8 × 114.3 × 38.4 cm. The J. Paul Getty Museum, Los Angeles, 65.DA.3.* **a.** *Secrétaire.* **b.** *Close-up of sampled area beneath mount. Red arrow indicates where the sample was taken.* **c.** *Cross-section in visible light illumination.* **d.** *Cross-section in UV-fluorescence illumination. Multiple layers of Asian and European lacquer were revealed, identified as Asian foundation (A), Asian lacquer (B and C), and European restoration (D–F). Layers identified in the cross-section that were analyzed are upper lacquer (C), lower lacquer (B), and ground (A).*

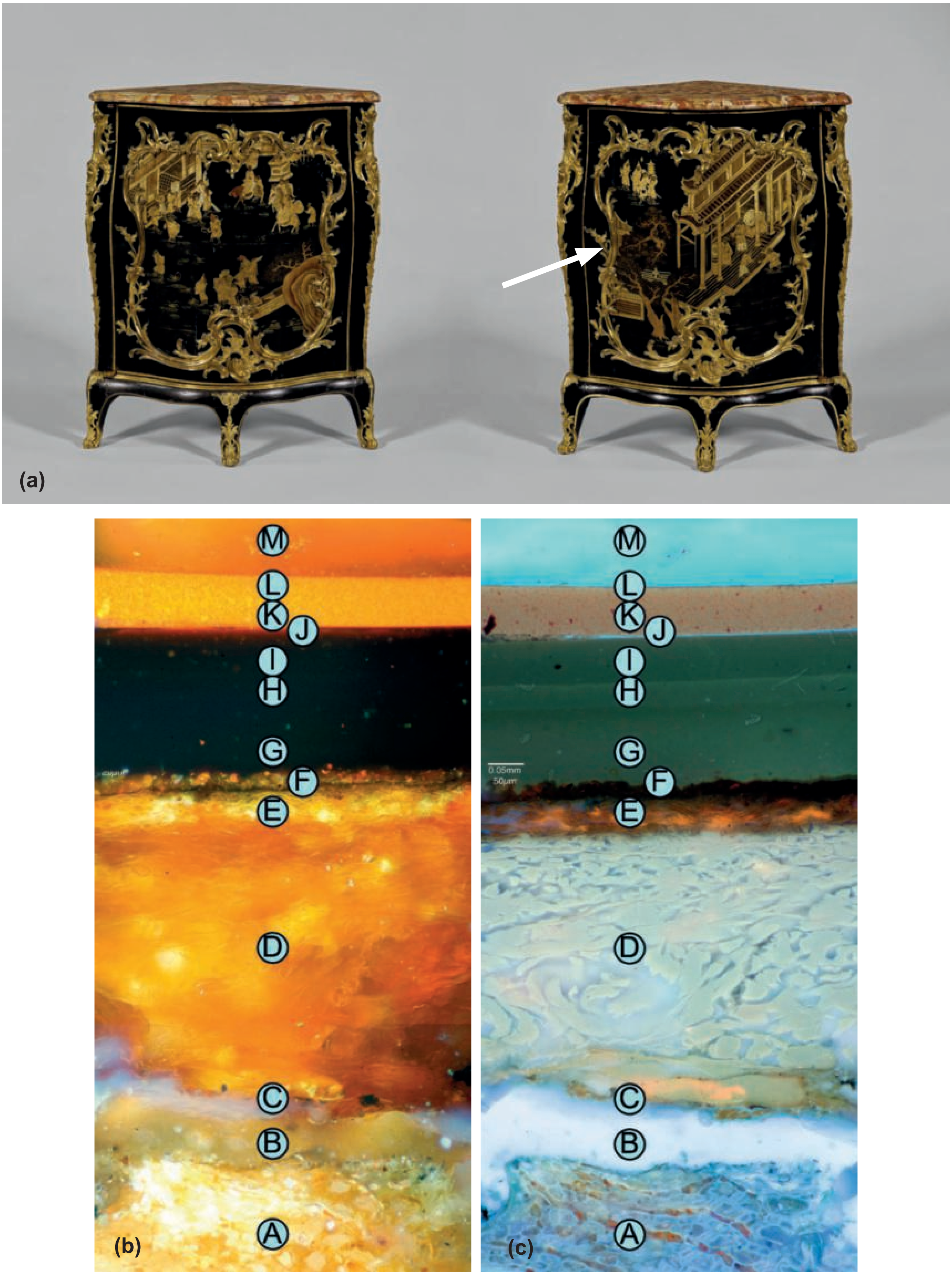

Figure 3. *Jacques Dubois, one of a pair of corner cupboards, Paris, France, ca. 1755, white oak veneered with pear and bloodwood, set with leather panels of Chinese black lacquer and painted with European lacquer, gilt-bronze mounts, brass and iron hardware and locks, brèche d'Alep top, 97.2 × 80 × 58.7 cm. The J. Paul Getty Museum, Los Angeles, 78.DA.119.2.* **a.** *Cupboard; arrow points to sample location.* **b.** *Cross-section in visible light illumination.* **c.** *Cross-section in UV-fluorescence illumination. The layers in the cross-section were identified as wood (A), glue (B), leather (C–E), Asian ground (F), Asian lower lacquer (G), Asian middle lacquer (I), Asian upper lacquer (K), and European restorations (L and M). The layers analyzed by THM-Py-GCMS included the ground and the upper, middle and lower lacquer layers.*

Table 1. *Summary of analytical results for objects in this study.*

Layer	Van Risenburgh Commode	Dubois Secrétaire	Dubois Cupboard
	72.DA.46	65.DA.3	78.DA.119.2
Upper lacquer	drying oil (P/S 2.2) *laccol* (gestalt markers and carbohydrates) cedar oil (*beta*-cedrene and cedrol)	drying oil (P/S 1.8) *laccol* (gestalt markers and carbohydrates)	drying oil (P/S 3.2) *laccol* (gestalt markers and carbohydrates)
Middle lacquer			heat-bodied drying oil (P/S 2.9) *laccol* (gestalt markers and carbohydrates)
Lower lacquer	drying oil (P/S 2.2) cedar oil (*beta*-cedrene, cedrol, mayurone, and cuparene) *laccol* (gestalt markers and carbohydrates)	drying oil (P/S 2.2) *laccol* (gestalt markers and carbohydrates)	drying oil (P/S 3.0) *laccol* (gestalt markers and carbohydrates) cedar oil (*beta*-cedrene and cedrol)
Ground	drying oil (P/S 2.2) blood (0.96 correlation coefficient) cedar oil (cedrol)	blood (protein markers with 0.96 correlation coefficient, saturated fatty acids with P/S 2.3) cedar oil (cedrol)	drying oil *laccol* (carbohydrates)

Classes of Materials Found in JPGM Objects

Table 1 summarizes the analytical results for the foundation and lacquer layer samples from the JPGM objects. The results illustrate a remarkable consistency in materials and techniques in seventeenth-century Chinese lacquer craft tradition and have been verified by other studies (Petisca 2019). The next sections provide overviews of each of the classes of materials detected in the JPGM objects with an emphasis on how the materials were identified.

Anacards

In the analysis of Chinese lacquer formulations in the JPGM furniture, the first material category to be considered is the Anacard tree sap. THM-Py-GCMS of the three types of Asian lacquer produces a number of diagnostic compound categories that originate from pyrolysis of the cross-linked polymer matrix, whose members vary in chain length: hydrocarbons, substituted catechols, substituted phenols, alkyl benzenes, and acid catechols. *Thitsi* produces two additional categories: phenyl catechols and phenyl phenols (Niimura et al. 1999; Lu and Miyakoshi 2015). In ESCAPE reports of lacquer samples, users identify the species of tree sap from gestalt graphs, which are Excel stacked area graphs of AMDIS report results for the various Anacard compound categories. *Urushi* and *laccol* are differentiated primarily by the distribution of acid catechols and catechols. *Urushi* is recognized by an abundant C_8 acid catechol (mazzeic acid) and C_{15} catechol, whereas *laccol* has an abundant C_{10} acid catechol (arlenic acid) and C_{17} catechol. Gestalt graphs for *thitsi* show a prominent series of alkyl benzenes (C_3 to C_{13}), mazzeic acid, and C_{15} catechol. Phenyl catechols of C_{10} and C_{12} are often, but not always, present in aged *thitsi* (Tamburini et al. 2017).

In the three JPGM objects, *laccol* was identified in every lacquer layer. Figure 4 is the gestalt graph for the Van Risenburgh commode for the upper lacquer layer. The graph shows abundant arlenic acid and C_{17} catechol. Due to the well-known presence of *Toxicodendron vernicifluum* in China, it had long been assumed that Chinese lacquer had always been made from its tree sap. Recent studies have challenged this common assumption, however. Lacquer obtained from *Toxicodendron succedaneum*, commonly referred to as *laccol* lacquer, has been discovered on many Chinese lacquer objects produced for export (Heginbotham et al. 2016; Petisca et al. 2011; Frade et al. 2009). This detection is supported by parallel archival research revealing that large quantities of *laccol* from what is now northern Vietnam was offered to the Chinese imperial court as tributary gifts in the Ming dynasty (1368–1644) (Chang and Schilling 2016). This finding confirms that Chinese artisans did have access to Vietnamese *laccol* lacquer, confounding the conventional wisdom regarding lacquer use and availability. In addition, recent studies revealed that the *Toxicodendron succedanea* tree is also present in Guangxi province, so the *laccol* lacquer discovered in the export lacquer objects may have also been obtained from southern China (Wan et al. 2007).

Oils

Oil is one of the key materials in the Chinese lacquer manufacturing tradition, and lacquer artisans of the past were not only required to be trained in lacquer making but also needed to master the skills of oil production. The addition of oil into lacquer not only affects the drying rate of the lacquer but also its hardness, viscosity, and the luster of the final surface (Zhang 1992).

The historical literature mentions a number of oils that have been used to make lacquerware. The earliest citations

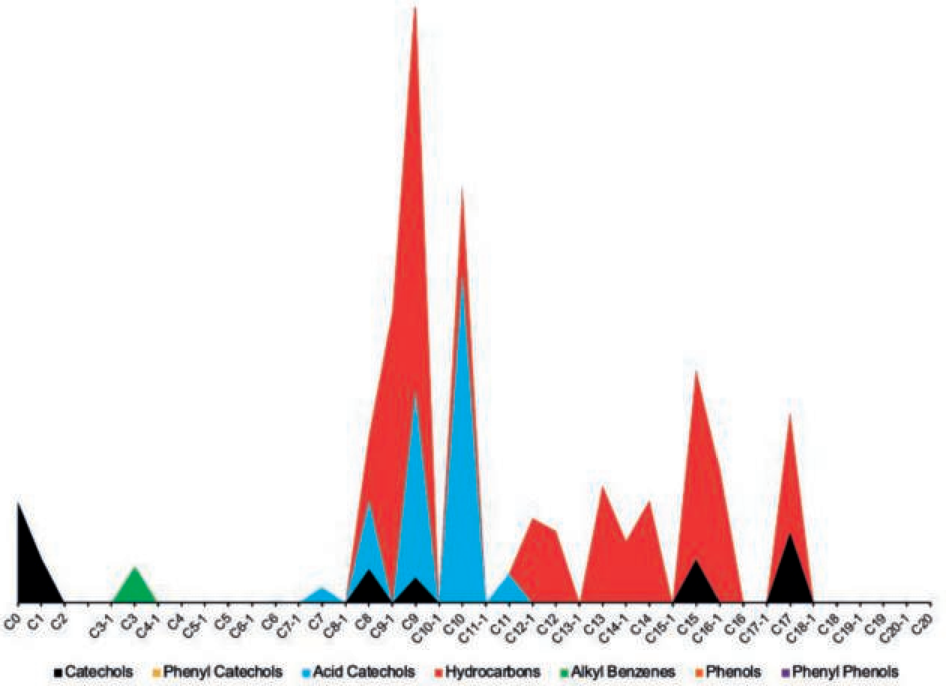

Figure 4. *Gestalt graph results for the Van Risenburgh commode layer I, showing abundant C_{10} acid catechol and C_{17} catechol that are typical of laccol.*

found for the addition of oil to lacquer go back to the late Han dynasty (206 BCE–220 CE) and appear to refer to perilla oil, which is pressed from the seeds of *Perilla frutescens* (Chang and Schilling 2016). Many believe that perilla oil was the dominant oil used in early times, although some scholars suggest that it may have been confused with tung oil in early texts (Cheng and Zhang 1991). Chinese tallow tree oil, a drying oil also referred to as stillingia oil, is pressed from the seeds of *Sapium sebiferum*. As the tree's main distribution is in southern China, tallow tree oil is produced within the Zhejiang, Jiangxi, Guangxi, Hunan, and Hubei provinces, which are also notable for their lacquer production. This oil is noted extensively in Chinese sources for its excellent drying properties (Song [1637] 1966). Tung oil, a drying oil produced from pressing the seeds of *Vernicia fordii*, is undoubtedly the most widely mentioned oil in lacquer formulation. The first unambiguous mention of tung oil's usage in lacquer can be found in a text from the Southern Song dynasty (1127–1279) (Cheng and Zhang 1991). A nondrying oil associated with lacquer making is pressed from the seeds of *Brassica rapa* plants. Rapeseed oil (primarily from *Brassica rapa* var. *oleifera*) is mentioned in the literature for cleaning brushes (Webb 2000), for polishing lacquer surfaces (Chang and Schilling 2016), and as a lacquer additive (Sawaguchi 1966).

Oils form a number of significant marker compounds in THM-Py-GCMS, which are tabulated in ESCAPE and displayed as bar graphs. Saturated monocarboxylic fatty acids (most prominently C_{16} and C_{18}) and glycerol are present in all triglyceride seed oils used in lacquers. In addition, drying oils form a homologous series of dicarboxylic fatty acids (DFAs) during the drying process by autoxidation of their abundant unsaturated fatty acids, with C_9 (azelaic acid) being the most abundant member. The distribution and overall abundance of DFAs are affected by the extent of drying, which depends on the position of the oil-containing layer within the layered lacquer structure. For example, oxygen readily diffuses into upper lacquer layers, thereby promoting autoxidation and the formation of DFAs, whereas smaller amounts of DFAs form in lower lacquer and ground layers. The final category of drying oil marker compounds is alkylphenyl alkanoates, abbreviated as APAs. They are formed from highly unsaturated linolenic acid and eleostearic acid by bodying perilla or tung oils at elevated temperatures in closed vessels that exclude atmospheric oxygen (Evershed et al. 2008). In Asian lacquer test results, APAs are indicative of this special type of heat-bodied drying oils.

Peak area ratios of the C_{16} (palmitic) and C_{18} (stearic) monocarboxylic fatty acids, commonly used to identify drying oils (linseed, walnut, and poppyseed) in traditional Western easel paintings (Mills 1966), may in certain instances have application for identifying oils in lacquer. Regarding the drying oils used in Chinese lacquer, the palmitic/stearic (P/S) for perilla oil ranges from 2 to 4, which is somewhat broad. As the P/S for tallow tree oil is approximately 3 (Chen et al. 1987), lying in the middle of the range for perilla oil, tallow tree oil cannot be differentiated in lacquer with any specificity. The P/S ratio for tung oil of approximately 1.0 makes it unique among the drying oils commonly used in Chinese lacquer, and it often contains high levels of APAs indicative of heat bodying. Rapeseed oil has a P/S ratio between 2 and 3, a ratio that overlaps with perilla oil and tallow tree oil but can be distinguished by docosenoic acid ($C_{22\text{-}1}$) and, in dried films, unusually high amounts of tridecanedioic acid (C_{13}) relative to the other dicarboxylic fatty acids (Van Keulen 2014b).

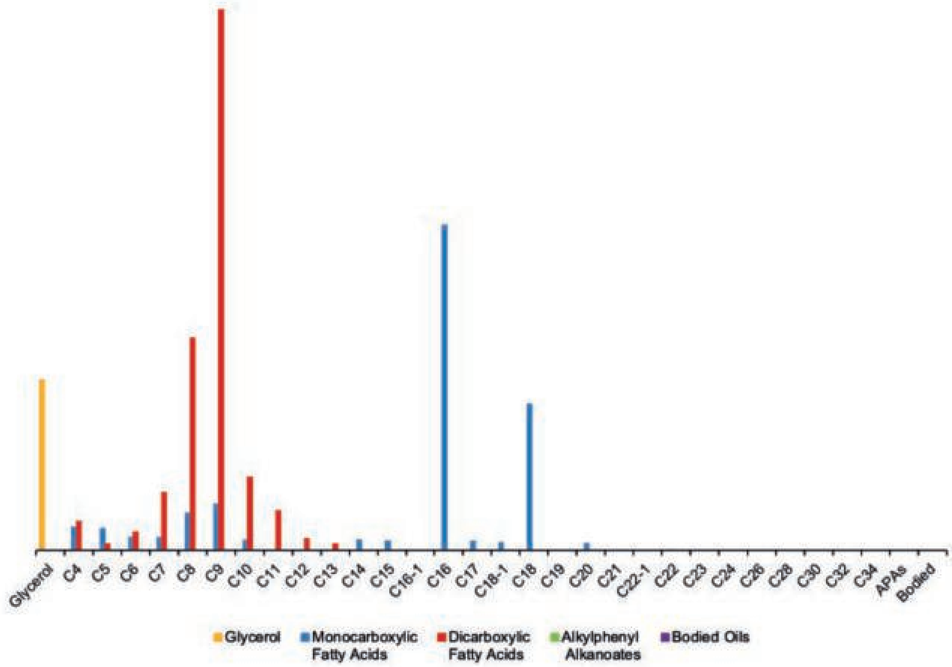

Figure 5. *Fatty acid and glycerol results for the Van Risenburgh commode layer I, which are also typical for the Dubois secrétaire.*

In the three JPGM objects, drying oils were identified in every lacquer layer sample, and bar graphs of the results reveal two distinct patterns of marker compounds. One pattern is exemplified by the Van Risenburgh commode layer I (fig. 5), for which every lacquer layer of it and of the Dubois secrétaire has an average P/S ratio of 2.2, which falls within the range of perilla oil.

In contrast, the lacquer layers of the Dubois corner cupboards have an average P/S ratio of 3.1, which overlaps with tallow tree oil and perilla oil (see fig. 6 for layer I), and a small amount of APAs and 12-methoxy-9-cis-octadecenoic acid (a traditional marker for bodied oil) from partial heat bodying is also present. In addition, the samples contain modest, yet consistent, amounts of C_{20}, C_{22}, and C_{24} saturated monocarboxylic fatty acids that do not correlate to rapeseed oil or the aforementioned drying oils. We have observed similar fatty acid profiles in two mid-nineteenth-century Chinese folding lacquered screens (A.10963a, b) from the National Museum of Denmark (Mogensen et al. 2017), a late eighteenth-century Chinese carved lacquer screen (71,233) from the Museum of Ethnology in Vienna (unpublished study at the GCI), and lacquered wall panels from the Schönbrunn Palace in Vienna, Austria (unpublished study at the GCI).

One intriguing possibility that needs further investigation is that safflower oil may have been used in these objects, either in a pure form or in admixtures with drying oils. Safflower, known as *hong hua* (literally, "red flower") in traditional Chinese medicine, has a long history of use as a source of red textile dye, which is extracted from the flower petals. Safflower is widely cultivated in Sichuan, Gansu, Shaanxi, and Shanxi, where lacquer is also produced (eFloras 2022). In the Chinese literature on lacquer, the only references to safflower use the unusual terms "safflower water" and "double safflower water," which have yet to be fully understood but may indicate some form of safflower oil (Julie Chang, personal communication, August 2021). The creation of safflower oil was documented in a sixteenth-century Chinese herbology volume, which indicates that its seeds are washed, mashed, and fried into "liquid" (Li and Luo 2003). The oil can then be consumed, applied to a wheel hub, or used as candles (Li and Luo 2003). The composition of the oil expressed by safflower seeds depends upon the variety of safflower. Some produce seed oil high in linoleic acid that makes it suitable as a paint medium which, like walnut and poppyseed oil, tends not to yellow over time (Oelke et al. 1990). Safflower oil has a P/S ratio of around 2.5, which overlaps with perilla and tallow tree oil but can be broadly distinguished from other oils by modest amounts of C_{20}, C_{22}, and C_{24} saturated monocarboxylic fatty acids (La Nasa et al. 2021). Safflower oil has been formulated into artists' tube colors and was used by the Abstract Impressionist artist Willem de Kooning (1904–1997) to alter the properties of certain of his paints (Lake 2010). If safflower is indeed the source of the oil in these objects, it would evidence an unexpected and widespread usage in Chinese export lacquer. This topic merits further research into historic literature, analysis of safflower oil cultivated in China, and study of the aging characteristics of lacquer replicas that incorporate safflower oil.

Cedar Oil

One of the more puzzling findings from our studies of Chinese lacquer has been the frequent detection of the sesquiterpene compounds cedrol and *beta*-cedrene. These compounds were identified in unpublished studies at the

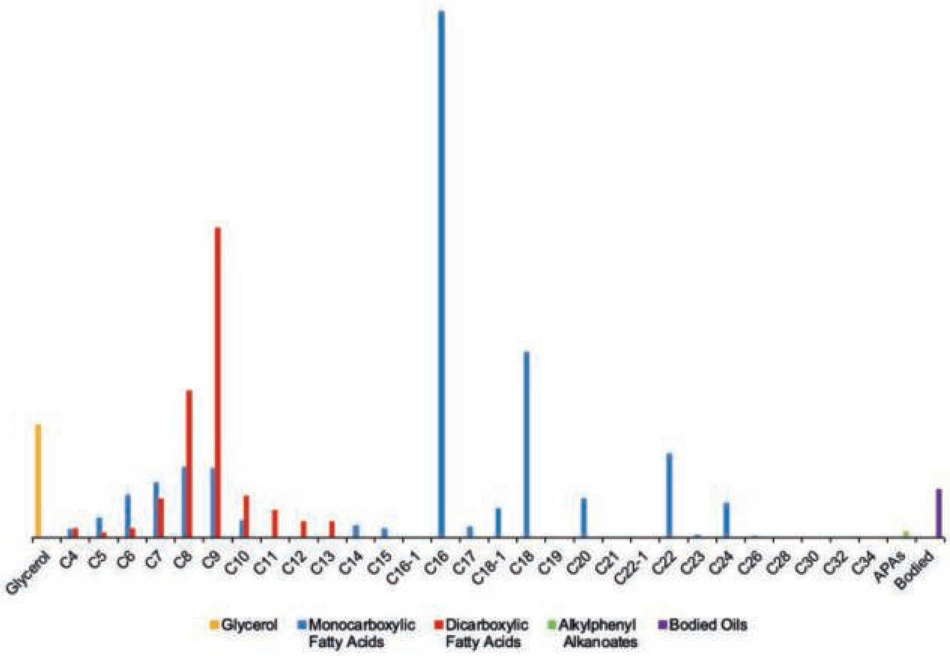

Figure 6. *Fatty acid and glycerol results for the Dubois corner cupboard layer I. Note unusually high levels of* C_{20}*,* C_{22}*, and* C_{24} *monocarboxylic fatty acids that are absent in figure 4.*

GCI of a wide range of Chinese lacquer objects: a Han dynasty ear cup from Mawangdui, an imperial Ming dynasty plate bearing the Jiajing reign mark (1522–66), an eighteenth-century carved lacquer bowl likely from Yunnan, and virtually all the pieces of late seventeenth- and eighteenth-century export lacquer that we have studied, including black, red, and Coromandel lacquer. They were also identified in several of the lacquer layers of the Van Risenburgh commode and the Dubois corner cupboards.

The presence of cedrol and *beta*-cedrene suggests the intentional addition of some form of cedar oil to the lacquer. Cedar oil is a poorly defined term that covers a wide range of oily and/or resinous materials extracted from the heartwood of trees in the family Cupressaceae (Langenheim 2003), such as the Chinese cypress (*Cupressus funebris*). A considerable amount of work has been done to determine the composition of both steam-distilled and pyrolytic cedar oil from a variety of species by chromatographic methods (Duquesnoy et al. 2006; Adams and Li 2008; Zhu 2002). A number of additional sesquiterpene compounds have been identified in these products, and some (mayurone and cuparene) appear in the lower lacquer layer of the Van Risenburgh commode. That unsaturated compounds such as *beta*-cedrene are not permanent markers in natural aging processes perhaps explains why cedrol is always the more abundant compound in lacquered objects. Cedar oil markers can be quite persistent even in archaeological objects, as they have been identified in oil residues from a lamp from the Tang dynasty (618–907) (Wei et al. 2015) and an ink stick from the Eastern Jin dynasty (317–420 CE) (Wei et al. 2012).

In the Chinese and Western literature that we have surveyed, there is no mention of cedar oil being used in lacquer, paints, or varnishes, so we can only speculate as to why it might have been added to lacquer formulations. In our lacquered replica panels that contained cedar oil, we observed changes in gloss and flexibility, so perhaps these properties were desired by the makers of the objects. Further research is needed to help clarify the sources of cedar oil in Chinese lacquer, better understand its function, and assess its effect on lacquer degradation.

Protein

Protein is an important class of natural products in Asian lacquer foundations (Chang and Schilling 2016; Schellmann 2012). The materials most commonly used are blood, glue, egg, and tofu (Webb 2000), but in Chinese foundations blood is by far the most common. In the Chinese literature, pig's blood is mentioned as an ingredient in foundation layers in records dating back to the Yuan dynasty (1279–1368) (Chang and Schilling 2016). In lacquer, pig's blood has been used as a primary binder or as a coating over the ground layer, especially in Chinese or Ryukyuan objects (Körber et al. 2016). In the course of our analytical investigations of a variety of Chinese lacquer objects, we have confirmed blood to be a common ingredient in Chinese ground layers, usually without the addition of Anacard lacquer. This finding accords well with descriptions given in a sixteenth-century Chinese text, preserved in Japan, known as *Kyushoku-roku* in Japanese and *Xiushi lu* in Chinese (Wang 1983), and *On Lacquering* in English.

With recent advances in proteomics, many excellent analytical tools are capable of providing incredibly detailed information about the sources and precise compositions of proteins used in lacquers (Miklin-Kniefacz et al. 2014), yet they have limited application to the other classes of

Table 2. *Protein marker compounds for the ground layer of the Dubois secrétaire.*

Protein Marker Compound	Dubois Secrétaire Ground	Blood	Glue
Tofu and blood: protein 1	23	21	7.3
1H-indole, 1,3-dimethyl-	10	4.3	0
1H-pyrrole, 1-methyl-	3.9	3.2	25
Blood unverified 5	30	26	1.6
Blood unverified 6	23	24	1.9
Blood unverified 7	9.3	5.6	0.2
Blood unverified 9	0	3.9	0.3
Blood and glue: protein 3	0	1.9	32
Casein and egg white (131/160)	0	5.7	0
Egg yolk	0	0	0
Fish glue (126/158)	0	0.9	1.4
Fish glue (126/158-2)	0	0.2	1
Glue unverified 3	0	1.3	21
Hydroxyproline	0	0.5	5.7
Methyl-d-proline, N-methoxycarbonyl	0	1.2	2.7
Correlation coefficient		0.96	–0.2

Note: Numbers are normalized peak area percentages with reference data for blood and glue compiled by Chang (2020).

materials. As one of the guiding principles in the Getty lacquer project was to learn as much as possible from each test result, quite some time was spent searching the THM-Py-GCMS test results for protein marker compounds. This part of the project turned out to be more difficult than anticipated because Py-GCMS results for polymeric nitrogenous materials such as proteins are quite dependent upon the analytical protocol, especially the pyrolysis temperature and derivatization conditions. High pyrolysis temperatures, such as the one used in our analytical protocol, lead to complex pyrolyzate compounds with little obvious resemblance to the original amino acid structures (Zang et al. 2001).

A set of lacquer samples compiled by Julie Chang, who studied Coromandel and carved Chinese lacquered objects for her PhD dissertation (Chang 2020), proved to be of great help in identifying protein marker compounds in the analytical results. The set consisted of foundation samples and Coromandel paints that, according to historic records, would have contained blood and glue, respectively. Reference standards of blood, glue, egg, casein, and tofu were included with the historic samples. AMDIS was used on the THM-Py-GCMS data files to find component mass spectra that displayed rough correspondence to nitrogenous compounds in the NIST library, and the result of this effort was a set of fifty-seven compounds suspected of originating from proteins. Application of principal component analysis to the sample data set resulted in a subset of fifteen marker compounds that reliably differentiated blood and glue both in the Chang data set and in the blood and glue reference standards. Most of the fifteen are pyrolysis products with chemical structures yet to be determined (Schilling et al. 2016), and so they are designated by the words "unverified" or "protein" in their names.

Pearson's correlation coefficients were employed to compare the protein marker compound distribution for each ground sample to reference data for blood and glue in order to identify proteins in lacquer samples. In this method, a correlation of 1.0 indicates a perfect match between sample and reference test results, whereas values of zero or less indicate no correlation exists. The example in table 2 shows the results for the ground layer of the Dubois secrétaire, which were similar to the results for the ground layer of the Van Risenburgh commode. The correlation coefficient of 0.96 between the sample and blood indicates that blood is present in the ground layer.

Further research on a wider range of reference samples made from egg and tofu in typical foundation and lacquer formulations would likely lead to a somewhat broader set of marker compounds. Until that time, the present set of fifteen marker compounds appears adequate for differentiating blood and glue in foundations and Coromandel paints.

Conclusions

By all measures, we are living in the golden age of Asian lacquer research. Fundamental scientific research on Anacard lacquer conducted over the past one hundred years formed a solid foundation for understanding the composition and behavior of this versatile artist's material. In-depth scholarly research of a diverse range of literature is revealing an enormous diversity of lacquer recipes, specialty applications, and their history and regions of usage, plus the limitations imposed when dealing with terminology that may have changed numerous times throughout history. With the advent of highly sensitive analytical tools like Py-GCMS and their adoption in cultural heritage laboratories, it became possible to conduct technical studies of lacquered objects that led to the verification of historic lacquer recipes and to the discovery of materials with no prior association with lacquer in their formulations. As our understanding increases of the chemical changes that lacquered objects undergo when exposed to light, safer and more effective conservation treatments that take this complex surface chemistry into consideration may be developed. Workshops on lacquer craft techniques, conservation, and analysis are helping to raise standards and introduce more professionals to the lacquer community. Based on these trends, the future of lacquer looks bright indeed!

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Appendix 1. Sampling Protocol

Physical sampling of the lacquer for analysis is preceded by careful examination to ensure that the sample site is well preserved and representative of the object as a whole. Promising sample sites are identified during examination under a stereomicroscope. Next, these areas are examined under ultraviolet (UV) light and imaged by x-ray radiography to reveal modifications and restorations that are not otherwise detectable. After identifying well-preserved and representative sample sites, samples are taken for visible and UV cross-section microscopy. These yield a clear understanding of the layer structure at the sample site, including the number, appearance, and thickness of original and restoration layers present. Ideally, sampling for organic analysis is done *in situ*, directly adjacent to the cross-section sample site.

Sampling for analysis by THM-Py-GCMS is done by scraping with a scalpel or a custom-made microchisel. In general, an area approximately 2 × 2 mm is selected for sampling and excavated layer-by-layer, collecting the scrapings from each stratum separately. This area yields sufficient sample material for analysis on individual layers as thin as 20 µm, but the area can be reduced proportionately for thicker layers. The work of excavation is conducted at moderate- to high-magnification under a stereomicroscope using both visible and UV illumination. The use of a high-intensity UV spotlight is extremely useful in differentiating the layers as they are sampled. The previously prepared cross-section photomicrographs are regularly consulted as sampling progresses to aid in the identification of each layer. Before sampling any given layer, all overlying material is removed with the excavating tool. Then scrapings of the target layer are carefully extracted and placed in the well of a single-depression microscope slide. Collection of sample material is halted when the next, underlying layer begins to be exposed, because it poses a risk of interlayer contamination. All remnants of the sampled layer are then scraped away and discarded so that sampling of the next layer can begin. Layers greater than 20 µm in thickness can usually be sampled discretely with little or no contamination from adjacent layers. For sample locations beneath gilded mounts, microcracking of the lacquer and subsequent contamination by restoration coatings are generally not encountered because the areas sampled are well protected from light. Finally, for layers less than 20 µm in thickness, adjacent layers may prove to be inseparable even with the help of UV light. In these cases, multiple layers are sometimes knowingly sampled together.

Appendix 2. Analytical Protocol

Samples were tested by pyrolysis–gas chromatography mass spectrometry using thermally assisted hydrolysis and methylation (THM-Py-GCMS). Tetramethylammonium hydroxide (TMAH) was added to the samples prior to analysis to convert labile compounds to more volatile products. Each sample was placed into a 50 µl stainless steel Eco-cup, and 3 µl of a 25% methanolic solution of TMAH was introduced for derivatization. After 3 minutes, the cup was fitted with an Eco-stick, then placed into the pyrolyzer, where it was purged with helium for 3 minutes. A Frontier Lab PY-2020D double-shot pyrolyzer system was used for pyrolysis, with the interface maintained at 320°C. The pyrolyzer was attached to an Agilent Technologies 5975C inert MSD/7890A gas chromatograph mass spectrometer. The split injector was set to 290°C with a split ratio of 20:1 and no solvent delay. An Agilent J and W Ultra-inert DB-5MS capillary column was used for the separation (20 M × 0.18 mm × 0.18 µm). Helium carrier gas was set to 0.9 ml/minute. The GC oven temperature program was 35°C for 1.5 minutes; 60°C/minute to 100°C; 14°C/minute to 250°C; 6°C/minute to 315°C; 1.5 minute isothermal. The MS transfer line was at 250°C, the source at 220°C, and the MS quad at 150°C. The mass spectrometer was scanned from 30 to 600 amu (although 12–600 amu is preferable for improved AMDIS library matches). For some samples, a second set of GCMS conditions was used: A J and W DB-5MS-UI capillary column (30 m × 0.25 mm × 0.25 µm) attached to a Frontier Vent-Free adaptor was used (40 m effective column length), with the helium flow set to 1 ml per minute. The split injector was set to 320°C with a split ratio of 20:1. The oven of the GC was held at 40 °C for 2 minutes, then ramped to 320°C at 6°C per minute, followed by a 9-minute isothermal hold.

References

Adams, R. P., and S. Li. 2008. The botanical source of Chinese cedarwood oil: Cupressus funebris or Cupressaceae species? *Journal of Essential Oil Research* 20(3): 235–42.

Chang, J. 2020. A cross-disciplinary approach to Chinese lacquer technology. PhD diss., University College London.

Chang, J., and M. R. Schilling. 2016. Reconstructing lacquer technology through Chinese classical texts. *Studies in Conservation* 61(3): 38–44.

Chen, Y., A. Zlatkis, B. S. Middleditch, J. Cowles, and W. Scheld. 1987. Lipids of contemporary stillingia oil. *Chromatographia* 23(4): 240–42.

Cheng Dachang and Haipeng Zhang 程大昌，張海鵬. 1991. *Yan fan lu* 演繁露續集 [Evolving luxuriant dew]. Beijing: Zhonghua Book Company

Chiavari, G., and R. Mazzeo. 1999. Characterisation of paint layers in Chinese archaeological relics by pyrolysis-GC-MS. *Chromatographia* 49(5–6): 268–72.

Coueignoux, C., and S. Rivers. 2015. Conservation of photodegraded Asian lacquer surfaces: Four case studies. *Journal of the American Institute for Conservation* 54(1): 14–28.

Duquesnoy, E., N. H. Dinh, V. Castola, and J. Casanova. 2006. Composition of a pyrolytic oil from Cupressus funebris Endl. of Vietnamese origin. *Flavour and Fragrance Journal* 21(3): 453–57.

eFloras. 2022. *Carthamus tinctorius*. In *Flora of China* 20–21:190–91, http://efloras.org/florataxon.aspx?flora_id=2andtaxon_id=200023631 (accessed 23 July 2021).

Evershed, R. P., M. S. Copley, L. Dickson, and F. A. Hansel. 2008. Experimental evidence for the processing of marine animal products and other commodities containing polyunsaturated fatty acids in pottery vessels. *Archaeometry* 50(1): 101–13.

Frade, J. C., M. I. Ribeiro, J. Graca, and J. Rodrigues. 2009. Applying pyrolysis-gas chromatography/mass spectrometry to the identification of oriental lacquers: Study of two lacquered shields. *Analytical and Bioanalytical Chemistry* 395(7): 2167–74.

Hagelskamp, Christina, Arlen Heginbotham, and Paul van Duin. 2016. Bending Asian lacquer in eighteenth-century Paris: New discoveries. *Studies in Conservation* 61(sup3): 91–96, https://doi.org/10.1080/00393630.2016.1227054.

Heginbotham, A., J. Chang, H. Khanjian, and M. R. Schilling. 2016. Some observations on the composition of Chinese lacquer. *Studies in Conservation* 61(3): 28–37.

Heginbotham, A., H. Khanjian, R. Rivenc, and M. Schilling. 2008. A procedure for the efficient and simultaneous analysis of Asian and European lacquers in furniture of mixed origin. In *ICOM Committee for Conservation 15th Triennial Meeting, New Delhi, preprints*, ed. J. Bridgland, 2: 608–16. New Delhi: Allied Publishers.

Heginbotham, A., and M. Schilling. 2011. New evidence for the use of Southeast Asian raw materials in seventeenth-century Japanese export lacquer. In *East Asian lacquer: Material culture, science and conservation,* ed. S. Rivers, R. Faulkner, and B. Pretzel, 92–106. London: Archetype.

Keneghan, B. 2011. Developing a methodology for the artificial ageing of urushi and a preliminary examination of urushi-based conservation options. In *East Asian lacquer: Material culture, science and conservation,* ed. S. Rivers, R. Faulkner, and B. Pretzel, 51–59. London: Archetype.

Koller, J., and U. Baumer. 1997. Baroque and Rococo transparent gloss lacquers, pt. 2, Scientific study of lacquer systems. In *Lacke des barock und rokoko / Baroque and rococo lacquers*, ed. K. Walch and J. Koller, 52–85. Munich: Bayerisches Landesamt für Denkmalpflege.

Körber, U. 2018. The journey of artifacts: The study and characterization of a nucleus of lacquered Luso-Asian objects from the 16th and 17th centuries. PhD diss., University of Évora.

Körber, U., M. R. Schilling, C. Barrocas Dias, and L. Dias. 2016. Simplified Chinese lacquer techniques and Nanban style decoration on Luso-Asian objects from the early seventeenth century. *Studies in Conservation* 61(3): 68–84.

Kumanotani, J. 1995. *Urushi* (oriental lacquer): A natural aesthetic durable and future-promising coating. *Progress in Organic Coatings* 26: 163–95.

La Nasa, J., J. Mazurek, I. Degano, and C. E. Rogge. 2021. The detection of fish oils in 20th century paints and paintings. *Journal of Cultural Heritage* 50: 49–60.

Lake, S. 2010. *Willem de Kooning: The artist's materials*. Los Angeles: Getty Conservation Institute.

Langenheim, J. H. 2003. *Plant resins: Chemistry, evolution, ecology, and ethnobotany*. Portland, Ore.: Timber Press.

Le Hô, A. S., M. Regert, O. Marescot, C. Duhamel, J. Langlois, T. Miyakoshi, C. Genty, and M. Sablier. 2012. Molecular criteria for discriminating museum Asian lacquerware from different vegetal origins by pyrolysis gas chromatography/mass spectrometry. *Analytica Chimica Acta* 710: 9–16.

Li, S., and X. Luo. 2003. *Compendium of Materia Medica: Bencao Gangmu*. Beijing: Foreign Languages Press.

Lu, R., and T. Miyakoshi. 2015. *Lacquer chemistry and applications.* Amsterdam: Elsevier.

Lu, R., T. Yoshida, and T. Miyakoshi. 2013. Oriental lacquer: A natural polymer. *Polymer Reviews* 53(2): 153–91.

Matsen, C., M. J. Petisca, and S. Auffret. 2017. When science reveals craft practices: Recent findings in the pyGC/MS analysis of Chinese export lacquer. In *ICOM-CC 18th Triennial Conference preprints*, *Copenhagen, 4–8 September 2017*, ed. J. Bridgland, art. 2102. Paris: International Council of Museums.

Miklin-Kniefacz, S., M. Griesser, W. Parson, V. Pitthard, and S. Stanek. 2016. Searching for blood in Chinese lacquerware: zhū xiě huī. *Studies in Conservation* 61(sup. 3): 45–51.

Mills, J. S. 1966. The gas chromatographic examination of paint media, pt. 1, Fatty acid composition and identification of dried oil films. *Studies in Conservation* 11: 92–107.

Mogensen, J. B., L. S. Eriksen, B. Höök, H. Khanjian, M. N. Mortensen, M. Schilling, and M. Taube. 2017. Two mid-19th-century Chinese lacquered folding screens still in use: Research and conservation. In *ICOM-CC 18th Triennial Conference preprints, Copenhagen, 4–8 September 2017*, ed. J. Bridgland, art. 2103. Paris: International Council of Museums.

Niimura, N., T. Miyakoshi, J. Onodera, and T. Higuchi. 1999. Identification of ancient lacquer film using two-stage pyrolysis-gas chromatography/mass spectrometry. *Archaeometry* 41(1): 137–49.

Oelke, E. A., E. S. Oplinger, T. M. Teynor, D. H. Putnam, J. D. Doll, K. A. Kelling, B. R. Durgan, and D. M. Noetzel. 1990. Safflower. In *Alternative field crops manual.* University of Wisconsin—Extension, Cooperative Extension, https://hort.purdue.edu/newcrop/afcm/safflower.html (accessed 5 January 2022).

Petisca, M. J. 2019. Investigations into Chinese export lacquerware: Black and gold, 1700–1850. PhD diss., University of Delaware.

Petisca, M. J., J. C. Frade, M. Cavaco, I. Ribeiro, A. Candeias, J. Graça, and J. C. Rodrigues. 2011. Chinese export lacquerware: Characterization of a group of Canton lacquer pieces from the 18th and 19th centuries. In *ICOM Committee for Conservation 16th Triennial Meeting, Lisbon, preprints,* ed. J. Bridgland, 1–10. Almada: Critério.

Robb, E. W., and J. J. Westbrook. 1963. Preparation of methyl esters for gas liquid chromatography of acids by pyrolysis of tetramethylammonium salts. *Analytical Chemistry* 35: 1644–47.

Saverwyns, S., M. Vermeulen, and E. van Binnebeke. 2014. Investigation of lacquers by TMAH-Py-GC/MS. *e-Preservation Science* 11: 64–75.

Sawaguchi, Goichi. 1966. *Nihon shikko no kenkyu* [A study of Japanese lacquerwork]. Tokyo: Bijutsu Shuppansha.

Schellmann, N. C. 2012. Consolidation of stressed and lifting decorative coatings on wood. PhD diss., Dresden: Hochschule für Bildende Künste.

Schellmann, N., and S. Rivers. 2005. Aqueous cleaning of photo-degraded East Asian lacquer: A preliminary investigation of the effect of pH and ionic concentration on gloss and colour. *Zeitschrift für Kunsttechnologie und Konservierung* 19(2): 369–76.

Schilling, M. R., A. Heginbotham, H. van Keulen, and M. Szelewski. 2016. Beyond the basics: A systematic approach for comprehensive analysis of organic materials in Asian lacquers. *Studies in Conservation* 61(3): 3–27.

Song Yingxing. (1637) 1966. *Tiangong kaiwu; Chinese technology in the seventeenth century*, trans. E-tu Zen Sun and Shiou-chuan Sun. University Park: Pennsylvania State University.

Stein, S. E. 1999. An integrated method for spectrum extraction and compound identification from GC-MS data. *Journal of the American Society of Mass Spectrometry* 10: 770–81.

Tamburini, D., P. Gennaro, M. P. Colombini, and I. Bonaduce. 2017. The degradation of Burmese lacquer (*thitsi*) as observed in samples from two cultural artefacts. *Journal of Analytical and Applied Pyrolysis* 124: 51–62.

Tarján, G., S. Nyiredy, M. Györ, E. Lombosi, T. Lombosi, M. Budahegyi, S. Mészáros, and J. Takács. 1989. Thirtieth anniversary of the retention index according to Kováts in gas-liquid chromatography. *Journal of Chromatography A* 472: 1–92.

Van Keulen, H. 2014a. The analysis and identification of transparent finishes using thermally assisted hydrolysis and methylation pyrolysis gas chromatography mass spectrometry. In *12th International Symposium on Wood and Furniture Conservation, 14–15 November 2014*, 134–41. Amsterdam: Ebenist.

Van Keulen, H. 2014b. Slow-drying oil additives in modern oil paints and their application in conservation treatments: An analytical study in technical historical perspective. In *ICOM Committee for Conservation 17th Triennial Meeting, Melbourne, preprints*, ed. J. Bridgland, [1–8]. Paris: International Council of Museums.

Van Keulen, H., and M. Schilling. 2019. AMDIS and EXCEL: A powerful combination for evaluating THM-Py-GC/MS results from European lacquers. *Studies in Conservation* 64(1): 74–80.

Wan, Y., R. Lu, Y. Du, T. Honda, and T. Miyakoshi. 2007. Does Donglan lacquer tree belong to Rhus vernicifera species? *International Journal of Biological Macromolecules* 41(5): 497–503.

Wang, Shixiang 王世襄. 1983. *Xiushi lu jie shuo* 髹飾錄解說 [*On lacquering* comments]. Beijing: Wen wu chu.

Webb, M. 2000. *Lacquer: Technology and conservation*. Oxford: Butterworth-Heinemann.

Webb, M. 2011. The autofluorescence of Asian lacquer. In *East Asian lacquer: Material culture, science and conservation,* ed. S. Rivers, R. Faulkner, and B. Pretzel, 148–58. London: Archetype.

Webb, M., M. R. Schilling, and J. Chang. 2016. The reproduction of realistic samples of Chinese export lacquer for research. *Studies in Conservation* 61(3): 155–65.

Wei, S., X. Fang, J. Yang, X. Cao, V. Pintus, M. Schreiner, and G. Song. 2012. Identification of the materials used in an Eastern Jin Chinese ink stick. *Journal of Cultural Heritage* 13: 448–52.

Wei, S., Y. Lia, Q. Ma, S. Lou, and M. Schreiner. 2015. Characterization of Tang dynasty lamp oil remains by using pyrolysis gas chromatography and mass spectrometry. *Journal of Analytical and Applied Pyrolysis* 116: 237–42.

Wilson, G., and A. Heginbotham. 2021. *French rococo ébénisterie in the J. Paul Getty Museum*. Los Angeles: Getty Publications.

Yamashita, Y., and S. Rivers. 2011. Light-induced deterioration of *urushi*, *maki-e* and *nashiji* decoration. In *East Asian lacquer: Material culture, science and conservation*, ed. S. Rivers, R. Faulkner, and B. Pretzel, 208–16. London: Archetype.

Zang, X., J. C. Brown, J.D.H. van Heemst, A. Palumbo, and P. G. Hatcher. 2001. Characterization of amino acids and proteinaceous materials using online tetramethylammonium hydroxide (TMAH) thermochemolysis and gas chromatography–mass spectrometry technique. *Journal of Analytical and Applied Pyrolysis* 61: 181–93.

Zhang Yan 張燕. 1992. *Yangzhou qiqi de zhiqi, zhitai he xiutu* 揚州漆器的製漆、製胎和髹塗 [The manufacturing of lacquer, substrate and decoration of Yangzhou lacquer]. *Journal of Chinese Lacquer* 11(4): 36–42.

Zhu Fengjie 祝鳳喈. 2002. *Yu gu zhai qin pu* 與古齋琴譜 [Abiding with antiquity]. Shanghai: Shanghai Rarebooks Publishing House.

Chinese Texts on the Fabrication of *Jiazhu* Sculpture

Julie Chang

ABSTRACT "Dry lacquer" is the literal English translation of the Japanese term *kanshitsu* 乾漆. It is a lacquer technique that requires the application of multiple layers of textile and lacquer. In Chinese the technique is commonly known as *jiazhu* 夾紵, which literally means "binding layers of hemp." The technique is described in inscriptions on archaeological objects and in numerous historical texts. This information not only supports our understanding of the fabrication of surviving lacquer pieces but also enriches their historical, cultural, and religious background. This article aims to outlines some of the highlights of these documents.

Introduction

Asian lacquer is a natural sap that is collected by tapping trees in the Anacardiaceae family. It is a material with great compatibilities and has a wide range of usages, including protective coatings, decorative surfacing, adhesives, and painting media. According to early historical writings, lacquer was appreciated by the ancient Chinese for its protective and decorative characteristics. For example, the Legalist classic *Master Han Fei* (Han feizi 韓非子), written in the third century BCE, mentions that King Shun's wooden tablewares were painted with black lacquer and King Yu's sacrificial vessels were decorated black on the outside and painted red inside (Chang and Schilling 2016, 3), and the earliest Chinese technology text in existence, *Book of Diverse Crafts* (Kaogong ji 考工記) compiled sometime between the fifth and third centuries BCE, stated in the chapter titled "Bowmakers" (*gongren* 弓人) that "the lacquer protects the bow from frost and dew" (Wenren 2017, 110).

As time moved on, more complicated and decorative manufacturing techniques were invented. Out of more than one hundred lacquer technologies, the technique known as *jiazhu* 夾紵is unique. Whether simple or complex, most lacquer technologies are identified based on their decorative characteristics, the areas that are visible to the eye, such as carved lacquer (*diaoqi* 雕漆), gold engraving (*qiang jin* 戧金) (also known as *chinkin* in Japanese), and inlaid shell (*luodian* 螺鈿) (also known as *raden* in Japanese). *Jiazhu*, however, is characterized by the "invisible" substrate that results from the manufacturing process. It is not listed as one of the techniques among the fourteen major categories of lacquer in the sixteenth-century lacquer treatise *On Lacquering* (Xiushi lu 髹飾錄). However, Yang Ming's 揚明 seventeenth-century annotation to a section on substrates in that treatise mentions the technique of using a "layered cloth substrate" (*chongbu tai* 重布胎), with no further explanation (Chang Bei 2007, 219).

Unlike most lacquer types, which are frequently applied as a protective or decorative layer on a wooden, metal, ceramic, or basketry substrate, the flexibility of the *jiazhu* technique allows the formation of unlimited shapes and sizes. Due to these characteristics, *jiazhu* is recorded in various historical texts, accompanied by stories associated with the statues on which it has been used. These are the subject of this article.

Terminology in Different Historical Periods

Depending on the time period and the location, *jiazhu* can be referred to using various names. It is known as "model exchange" (*tuanhuan* 摶換) or "shelling work" (*tuohuo* 脫活) in *Respite from Plowing in the Southern Village* (Nancun chuo geng lu 南村輟耕錄) (Tao 1959), a text from the late Yuan (1279–1368) to early Ming dynasty (1368–1644), and as "cloth shell" (*tuosha* 脫紗) in *Current Regulations and Precedents Concerning the Buddhist Atelier at the Yuanming Garden* (Yuanmingyuan nei gong fu zuo xian xing ze li 圓明園內工佛作現行則例), a court document from the Qing dynasty (1644–1912) (Tang and Shen 2004, 719).

Based on the archaeological discoveries, the earliest known usage of the term *jiazhu* can be traced back to the Han dynasty (206 BCE–220 CE). Among the burial goods discovered in the tomb of Wang Xu 王盱 located in Lelang 樂浪, four pieces of lacquered tableware have inscriptions that mention the term *jiazhu* (Zheng 2012, 189). Inscriptions on lacquerwares recorded manufacturing details, such as dates of creation, capacities of the vessel, and the names of the workers and their supervisors. One of the dated lacquer vessels in Wang Xu's tomb is an ear cup manufactured in the twenty-eighth year of Jianwu 建武 (the name of the first era of Emperor Guangwu of Han, which is equivalent to 52 CE)

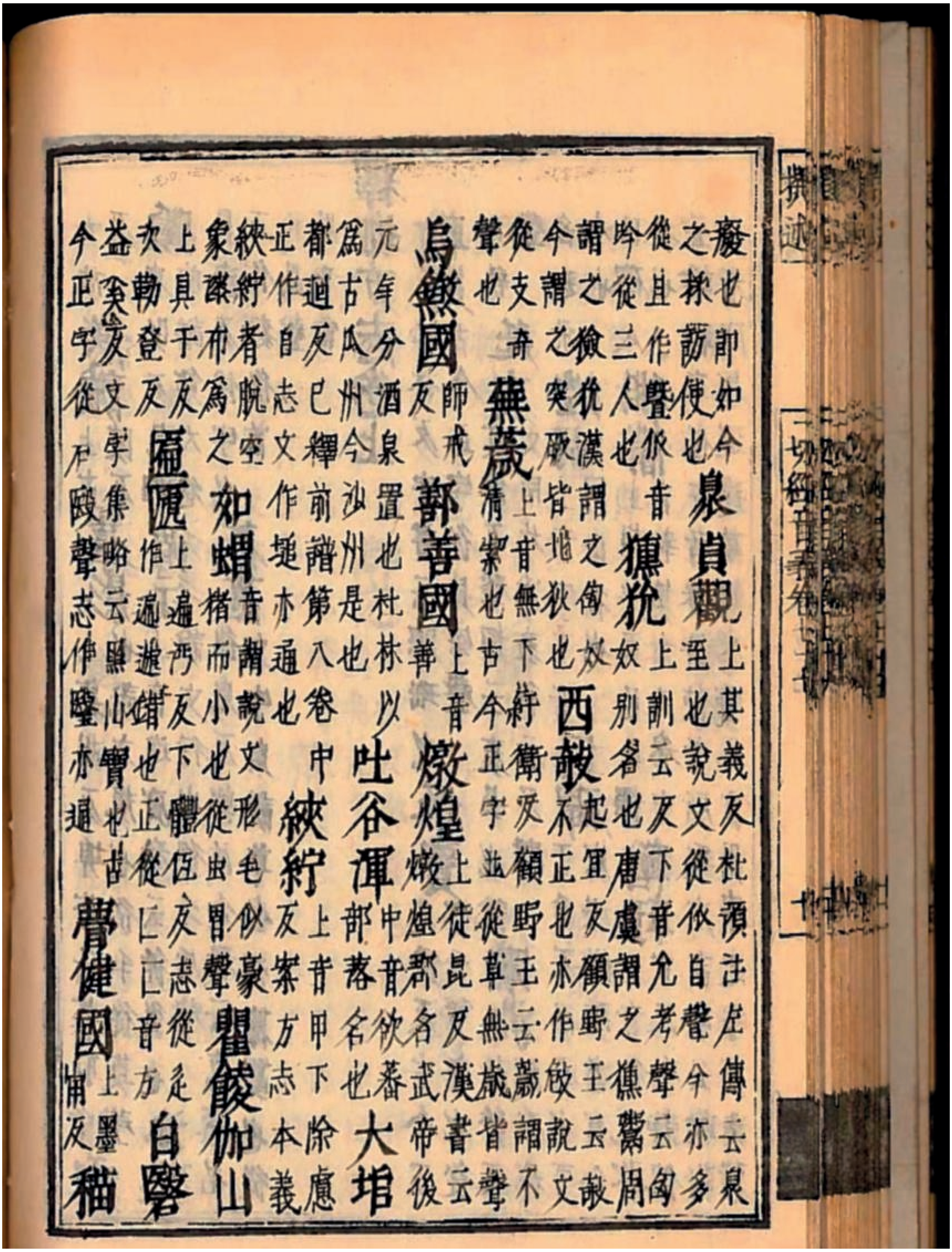


Figure 1. *Huilin and Silin (Xilin),* Pronunciation and Meaning in the Complete Buddhist Canon *(Yi qie jing yin yi), 1738. Freer Gallery of Art and Arthur M. Sackler Gallery Library, Smithsonian Libraries, 230.H89. The manuscript was compiled by the Tang dynasty monk Huilin and the Liao dynasty monk Xilin. The current edition is a 1738 reprint. The text defines* jiazhu *as a technique that uses lacquered textile to create hollow-core statues.*

Table 1. *List of historical documents referencing* jiazhu.

Time Period	Chinese Name	Transliteration	English Translation
Liang dynasty 502–57	為人造丈八夾紵金薄像	*Wei renzao zhangba jiazhu jindang xiang*	The Construction of a 1.8 Zhang Gilded *Jiazhu* Statue
Eastern Wei dynasty 534–50	洛陽伽藍記	*Luoyang qielan ji*	A Record of Buddhist Monasteries in Luoyang
Tang dynasty 618–906	辯正論	*Bianzheng lun*	Essays of Disputation and Correction
Tang dynasty 618–906	一切經音義	*Yi qie jing yin yi*	Pronunciation and Meaning in the Complete Buddhist Canon
Tang dynasty 618–906	大唐西域記	*Datang xiyu ji*	Great Tang Records on the Western Regions
Tang dynasty 618–906	朝野僉載	*Chaoye qian zai*	The Anecdotes of the Emperors, Ministers, and Common Men
Tang dynasty 618–906	續高僧傳	*Xu gao seng chuan*	Supplement to the Biographies of Eminent Monks
Tang dynasty 618–906	法苑珠林	*Fa yuan zhu lin*	Pearl Garden of the Dharma Forest
Later Jin dynasty 936–946	舊唐書	*Jiu Tang shu*	Old Book of the Tang
Northern Song dynasty 960–1127	資治通鑒	*Zizhi tongjian*	Comprehensive Mirror to Aid in Government
Northern Song dynasty 960–1127	太平廣記	*Taiping guang ji*	Extensive Records of the Taiping Era
Northern Song dynasty 960–1127	大宋僧史略	*Dasong seng shi lue*	Topical Compendium of the Buddhist Clergy Compiled in the Great Song Dynasty
Yuan dynasty 1279–1368	道園學古錄	*Dao yuan xue gu lu*	Collected Works of Yu Ji
Yuan dynasty 1279–1368	劉正奉塑記	*Liu zhengfeng su ji*	A Sculptural Record of Liu Zheng Feng
Ming dynasty 1368–1644	南村輟耕錄	*Nancun chuo geng lu*	Respite from Plowing in the Southern Village
Ming dynasty 1368–1644	元史	*Yuan shi*	History of Yuan
Qing dynasty 1644–1912	揚州畫舫錄	*Yangzhou huafang lu*	A Record of Yangzhou Gaily Painted Pleasure Boats
Qing dynasty 1644–1912	圓明園內工佛作現行則例	*Yuanmingyuan nei gong fu zuo xian xing ze li*	Current Regulations and Precedents Concerning the Buddhist Atelier at the Yuanming Garden

(Uchida 2014, 77). The characters on the ear cup are written as 俠紵, whose pronunciation in modern Mandarin is *xiazhu*. By comparing the characters and their pronunciations, one can observe the clear similarities to the term *jiazhu* 夾紵. The two terms are therefore believed to be the equivalent of each other by scholars (Fan 2020, 299). In addition, another lacquered dish from the same burial, manufactured sixteen years later, in the twelfth year of Yongping 永平 (the twelfth year in the reign of the of Emperor Ming of Han, which is equivalent to 68 CE), contains the inscription 綊紵, which is also pronounced as *jiazhu* (Uchida 2014, 78) and parallel in meaning.

So, what is *jiazhu*? An early description can be found in the eighth-century document *Pronunciation and Meaning in the Complete Buddhist Canon* (Yi qie jing yin yi 一切經音義), composed by the Tang dynasty monk Huilin 慧琳 (737–820 CE) (fig. 1). The text states that "*jiazhu* refers to a hollowed statue, which is created by lacquered textile" (Huilin and Silin 1738, 77: 10, my translation). Based on this description, one can deduce that *jiazhu* is a technique used to create hollow-core statues using lacquer and textile. As *Pronunciation and Meaning in the Complete Buddhist Canon* is a Chinese dictionary of Buddhist terminologies, it provides general information but not detailed technical descriptions. A more comprehensive explanation of *jiazhu* can be found in a later document, *History of Yuan* (Yuan shi 元史), compiled by the Ming dynasty court, which states that "*tuanhuan* [another name for *jiazhu*] is created by wrapping clay figurines with textiles and covering them with lacquer applications. Afterward, the clay is removed from its center and the statue is then completed" (Chan 1997, 110, my translation).

Both of these historical texts share three key features in their descriptions of *jiazhu*: lacquer, textile, and coreless. From later studies on inscribed archaeological objects and those treasured and preserved through inheritance from one generation to the next, however, we see that not everything identified as *jiazhu* (or its equivalent terms) is coreless. The technique can be differentiated based on the presence or absence of a core and divided into two main categories: wood-core *jiazhu* and hollow-core *jiazhu* (Zheng 2012, 189). This understanding is supported by recent studies by the Freer Gallery of Art and Arthur M. Sackler Gallery. Of the five *jiazhu* sculptures examined for the project, the buddha from the Walters Art Museum (pl. 1, p. 12) has a wood core, and the other four are coreless (pls. 2–5, pp. 13–16) (Strahan and McCarthy 2018; also Leidy, Strahan, and McCarthy, in this volume). The complexity of the historical terms and the detailed study required for clear identification make it difficult to distinguish one from the other through pure historical text investigation. For these reasons, this article does not attempt to differentiate the two techniques but discusses *jiazhu* using its more general definition as a technique that requires the application of multiple layers of textile and lacquer.

Early *Jiazhu* Sculptures Recorded in Historical Texts

According to the current understanding, the technique of *jiazhu* in China originated around the time of the Warring States period (475–221 BCE), was popularized during the Han dynasty, and had its mature phase during the overlapping periods of the Wei, Jin, Southern and Northern dynasties (220–589 CE) (Zhou 2009, 162–63). We will probably never discover when the technique of *jiazhu* was first applied to sculpture, but we do know that the rise and spread of Buddhism during these years inspired the development of *jiazhu* statues. The unique characteristics of the technique allowed the creation of large and lightweight Buddhist sculptures that could be carried around the cities during Buddhist ceremonies (Zhou 2009, 163). Although there are earlier archaeological inscriptions containing the term *jiazhu*, it is during this time that the term begins to appear in historical documents (table 1). One early mention is in the manuscript *The Construction of a 1.8 Zhang Gilded Jiazhu Statue* (Wei renzao zhangba jiazhu jindang xiang 為人造丈八夾紵金蕩像) composed by Emperor Jianwen of Liang (503–51 CE): "I have long vowed to construct a 1.8 *zhang* [a unit of measure approx. 5.6 m, using Tang dynasty standard measurements] *jiazhu* buddha statue for the six paths of existence and four modes of birth" (Zhou 2009, 163, my translation).

According to this document, the *jiazhu* technique was not only present during the Liang dynasty (502–57 CE) but was also used in combination with gold leaf decoration. In addition, the early catalog of Buddhist texts translated into Chinese, the *Collected Records concerning the Tripitaka* (Chu sanzang ji ji 出三藏記集) composed by Sengyou (445–518 CE) from the Liang dynasty mentions in its documentation "A Record of the Construction of *Jiazhu* Statue by the Two *Dai*s of Qiao Kingdom" (Sengyou 445–518, juan 12). This document not only indicates the presence of *jiazhu* statues but also states their creators and origin. The Qiao Kingdom 譙國 is located in today's Anhui province and the two "*Dais*" refer to the famous sculptors: Dai Kui 戴逵 (326–396 CE) and his son Dai Yong 戴颙 (377–441 CE) (Zhang 2006, 14). Dai Kui was so well known for his talents and his skills that another document, the *Essays of Disputation and Correction* (Bianzheng lun 辯正論), composed by Tang dynasty monk Falin 法琳 (572–640 CE), also mentions that he created five *jiazhu* buddha statues with his own hands and states they are incomparable in beauty (Falin 2008, 3: 11).

Jiazhu Buddist Sculptures in the Eastern Wei and Tang Dynasties

In addition to early mentions of *jiazhu* sculptures in standard historical documents, other texts actually document the technique. For example, *A Record of Buddhist Monasteries in Luoyang* (Luoyang qielan ji 洛陽伽藍記), composed by Yang Xuanzhi 楊衒之 in 547 CE, states that at the Yongming 永明 Temple in the western suburbs of the city Luoyang, a man named Meng Zhonghui 孟仲暉

> had a life-size dry-lacquered statue [buddha] made, whose marks and signs were so sumptuous as to be a rarity in the contemporary world. It was placed on the Sumeru Shrine in [Yuan Ching-] hao's anterior hall. In the second year of the Yung-an period [529 CE], every night the image would walk around its base, leaving sunken footprints on the ground. Thereupon the dignitaries and commoners, thinking it curious, come here for a view. As a result, countless numbers of them wanted to become Buddhist devotees. In the third year of the Yung-hsi period [534 CE], it suddenly disappeared by itself, and nobody ever knew of its whereabouts (Yang and Wang 1984, 208).

A Record of Buddhist Monasteries in Luoyang was composed during the Eastern Wei dynasty (534–50 CE), and, according to the text, the author personally experienced the flourishing glory of the city Luoyang when it was the capital of the Northern Wei dynasty (386–534 CE). Five to six years after Yang Xuanzhi's visit, the dynasty came to an end and the city of Luoyang was destroyed (Yang and Wang 1984). To commemorate the past, the author collected stories and legends regarding the ruined temples in the city and from that information created a book. Although this book contains valuable information regarding the culture, legends, literature, religion, and geography of the time period, it is a literary piece that was meant to reflect the author's emotions and sorrow. The text was not intended to be a work of truth and facts; therefore it contains many unusual stories, including the one mentioned above. Although the text cannot be taken literally, it still reflects the religious importance and the appreciation of *jiazhu* Buddhist sculptures during this time period.

Another unusual story related to a *jiazhu* statue took place in the Tang dynasty (618–907 CE), also in the city of Luoyang. According to the famous Chinese historiography text *Comprehensive Mirror to Aid in Government* (Zizhi tongjian 資治通鑒) composed by Sima Guang 司馬光 in 1084:

> Empress Wu Zetian [624–705 CE] ordered Monk Huanyi [662–695 CE] to construct a large *jiazhu* statue. The statue was so large that its little finger could hold more than ten people. Heavenly Hall (Tiantang) was constructed north of Bright Hall (Mingtang) to house this statue. The hall was destroyed by a storm when it was first built. It was then rebuilt using 10,000 laborers daily and wood from Jiangling [the region beyond the Jiangnan Mountains, where the specific mountain is not known]. Within a few years, trillions in expenditures were spent on the project, which exhausted the government savings (Sima 1787, 205: 24, my translation).

Some argue that this document was written during the Northern Song dynasty (960–1127 CE), around three hundred years after the supposed construction of the sculpture, and therefore its accuracy should be reevaluated. However, this enormous *jiazhu* statue was also recorded in another document, *The Anecdotes of the Emperors, Ministers, and Common Men* (Chaoye qian zai 朝野僉載) by Zhang Zhuo 張鷟, composed in the seventh to eighth century. According to the text the *jiazhu* statue was constructed for the Heavenly Hall:

> In the first year of Zhengsheng [695 CE] in the Wu Zhou dynasty, Xue Huaiyi constructed a 1000 *chi* [Chinese foot, approx. 32 cm] Merit Hall (Gongdetang) located north of Bright Hall (Mingtang). There was a 900 c*hi* [approx. 280 m, using Tang dynasty standard measurement] statue in it, whose nose is the size of a 1000 *hu* [Chinese unit of capacity and volume] ship and whose little finger can hold ten men sitting side by side. The statue was fabricated by binding layers of hemp coated with lacquer (Zhang 1787, 11–12, my translation).

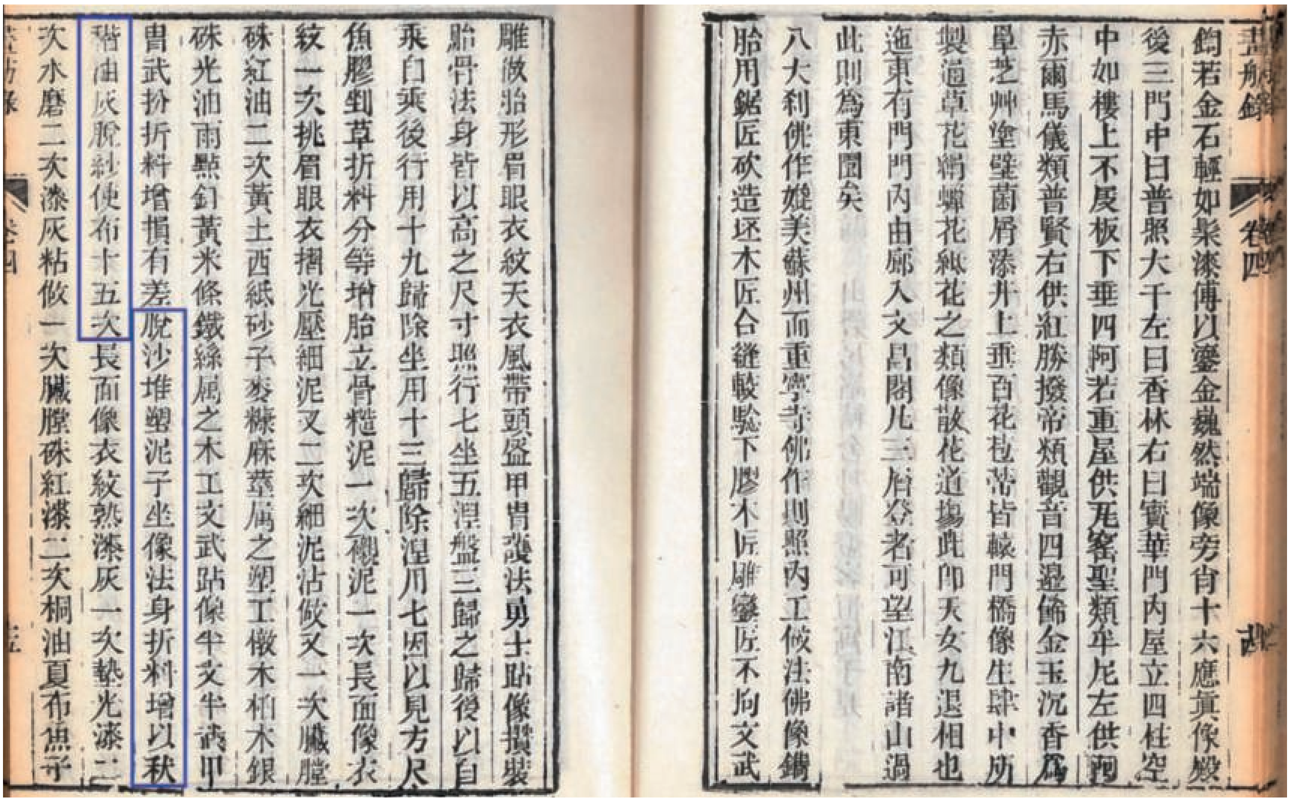
Although this document does not contain as much detailed information as the earlier text, it was composed around the same time as the reign of Empress Wu Zetian and that increases its importance. From the text alone we cannot know if the enormous *jiazhu* statue ever was completed, but we do know that even if it was constructed it did not last long. According to the *Old Book of the Tang* (Jiu Tang shu 舊唐書), the Bright Hall caught fire on the night of 16 January (in the traditional Chinese calendar) 695. The fire extended to the Heavenly Hall, and both structures were burned to ash by dawn (Liu 1784, 27).

Even though we may never be sure if the above documents exaggerate reality or if they are purely folk tales, there are a few things of which we can be certain. First, based on surviving historical records and existing examples we know that *jiazhu* statues were not only created but also highly prized during the Tang dynasty. Second, creating large buddha statues was a fashion of the Tang dynasty. Supporting evidence includes the 35.5 meter high Northern Giant Buddha in Cave 96, Dunhuang, China (Dunhuang Academy 2014). The buddha statue was created in the late seventh century during the reign of Empress Wu Zetian using clay stucco with a sandstone foundation (Dunhuang Academy 2014). Third, archaeological excavations discovered the architectural foundations for both the Bright Hall and the Heavenly Hall (Shi et al. 2011). The archaeological evidence that proves the existence of the two halls helps to substantiate the accounts in the historical texts.

Fabrication Details on *Jiazhu* Lacquer from the Qing Dynasty

In addition to the early mentions of *jiazhu* lacquer and stories associated with it, there are also practical details about the fabrication of the *jiazhu* lacquer in several Qing dynasty documents. Along with invaluable information on life in the city of Yangzhou, the collection of brush notes *A Record of Yangzhou Gaily Painted Pleasure Boats* (Yangzhou huafang lu 揚州畫舫錄) published by the Qing dynasty scholar Li Dou 李斗 in 1795, contains details on the fabrication of Buddhist statues (fig. 2). For example, it states that the creation of a seated *tuosha* (another name for *jiazhu*) figure requires fifteen cloth applications (Li [1795] 1872, 15). Other Qing dynasty court documents contain step-by-step descriptions for making *jiazhu* sculptures and the materials required for the process. For example, the eighteenth-century court document *Current Regulations and Precedents concerning the Buddhist Atelier at the Yuanming Garden* (Yuanmingyuan nei gong fu zuo xian xing ze li 圓明園內工佛作現行則例) states:

> A *tuosha* lacquer [statue] is created with twelve applications of cloth layers, twelve applications of lacquer paste to fill the cloth's weaves. . . . one application of lacquer foundations layer, three applications of *dianguang* lacquer 墊光漆 [a type of intermediate lacquer], polishing the surface three times with water, one application of lacquer paste [this is probably for surface decoration] and two applications of red lacquer.
>
> [Materials required for the above procedures]: every *chi* [of the statue] uses
>
> - 12 taels [≈ 447.6 g] and 6 maces [≈ 22.2 g] of *yan sheng qi* 嚴生漆 [raw lacquer from Yanzhou, Zhejiang province],
> - 1 *zhang* [≈ 320 cm], 4 *chi* [≈ 128 cm], *4 cun* [≈ 12.8 cm] of hemp cloth,
> - 3 *catties* [≈ 1790.4 g], 15 *taels* [≈ 559.5 g], 2 *maces* [≈ 7.4 g] of pyrolusite power,
> - 6 *maces* [≈ 22.2 g] of *long zhao qi* 籠罩漆 [a type of coating lacquer with high percentage of tung oil]



飾若金石輕如髹漆傅以鎏金巍然端像旁肖十六應眞像殿
後三門中曰普照大千左曰香林右曰寶華門內屋立四柱空
中如樓上不度板下垂四阿若重屋供[illegible]聖類牟尼左供[illegible]
赤爾馬儀類普賢右供紅勝撥帝類觀音四壁飾金玉沉香爲
阜芝艸塗壁菌屑漆井上垂百花苞蒂皆藤門橋像生肆中所
製道草花蝴蝶花絨花之類像散花道場此即天女九退相也
迤東有門門內由廊入文昌閣凡三層登者可望江南諸山過
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Figure 2. *Li Dou,* A Record of Yangzhou Gaily Painted Pleasure Boats *(Yangzhou huafang lu), 1872. Freer Gallery of Art and Arthur M. Sackler Gallery Library, Smithsonian Libraries, 900.L5. The manuscript was first published by the Qing dynasty scholar Li Dou in 1795. The current edition is an 1872 reprint by Zi Ran An* 自然盦. *The text contains details on the fabrication of Buddhist statues in Zhongningsi* 重寧寺 *(Double Peace) Monastery, which includes a description of the* jiazhu *technique using its other name tuosha (literally, "cloth shell").*

- 1 *taels* [≈ 37.3 g], 2 *maces* [≈ 7.4 g] of *qi zhu* 漆硃 [a type of red lacquer?]
- 1 *catty* [≈ 596.8 g], 15 *taels* [≈ 559.5 g], 6 *maces* [≈ 22.2 g] of *tui guang qi* 退光漆 [a type of processed lacquer used to create the final surface]
- 2.4 labor credits of *tuo sha* lacquer craftsman

(Tang and Shen 2004, 719, my translation)

Note: the sign ≈ means "approximately equal to"

This account is a representative example of the kind of thorough information available in court documents. The detailed description of the manufacturing procedures, material requirements, and even the labor obligations on every *chi* of work allows us to understand not only the process of the *jiazhu* technique but also the development, organization, and standardization in the Qing dynasty workshop system.

Conclusions

Those studying Chinese civilization are extremely fortunate to have a large number and a wide range of historical records still in existence today. Although few documents contain in-depth manufacturing details and the content of the available information is quite limited, careful study of the texts produces many interesting anecdotes and references regarding the past. While some documents may be more reliable than others, they are all valuable sources of information. In recent years, there has been an increase in cross-disciplinary research on different types of lacquer. The information provided by these in-depth studies advances the understanding of lacquer's complexity. The study of *jiazhu* lacquer and its challenges is just a small window into the larger study of lacquer.

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References

Chan Hok-Iam 陳學霖. 1997. *Mingdai renwu yu chuanshuo* 明代人物與傳說 [Ming dynasty characters and legends]. Hong Kong: Chinese University Press.

Chang Bei 長北. 2007. *Xiushi lu tushuo* 髹飾錄圖說 [*On lacquering* illustrated]. Jinan: Shandong Pictorial Publishing House

Chang, Julie, and Michael Schilling. 2016. Reconstructing lacquer technology through Chinese classical texts. *Studies in Conservation* 61(3): 38–44.

Dunhuang Academy. 2014. Mogao Cave 96 (Early Tang 618–705 A.D.), http://public.dha.ac.cn/content.aspx?id=177263794633 (accessed 26 February 2018).

Falin 法琳. 2008. *Bianzheng lun* 辯正論 [Essays of disputation and correction]. Chinese Text Project (CTP), https://ctext.org/library.pl?if=gb&res=80676 (accessed 10 December 2017).

Fan Changxi 范常喜. 2020. *Hai hun hou Liuhe mu chutu qishu "dan yu" "chou bu" kao* 海昏侯劉賀墓出土漆書“丹臾”“醜布”考 [A study on the lacquerware inscriptions "dan yu" and "chou bu" unearthed in the tomb of Marquis Liu He]. *Linguistic Sciences* 19(3): 296–304.

Huilin and Silin 慧琳 , 希麟. 1738. *Yi qie jing yin yi* 一切經音義 [Pronunciation and meaning in the complete Buddhist canon]. Kyoto: Nichirensha.

Li Dou (1795) 1872. *Yangzhou huafang lu* 揚州畫舫錄 [A record of Yangzhou gaily painted pleasure boats]. Zi ran an cang ban.

Liu Xu 劉昫. Yangzhou 1784. *Jiu Tang shu* 舊唐書 [Old book of the Tang]. Chinese Text Project (CTP), https://ctext.org/library.pl?if=gb&res=5983 (accessed 10 December 2017).

Sengyou 僧祐. 445–518. *Chu sanzang ji ji* 出三藏記集 [Collected records concerning the Tripitaka]. Chinese Buddhist Electronic Text Association (CBETA), http://tripitaka.cbeta.org/en/T55n2145_012 (accessed 26 February 2018).

Shi Zishe, Yuesen Cao, Jianhua Han, Li Zhou, and Ruyi Zhang 石自社，曹岳森，韓建華，周立，張如意. 2011. *Henan Luoyang sui tang chengmingtang he tiantang yi zhi de fajue* 河南洛陽隋唐城明堂和天堂遺址的發掘 [The excavation of Mingtang and Tiantang located in the Luoyang ruins of Sui and Tang dynasty, Henan province]. *China's Cultural Relics* 4: n.p.

Sima Guang 司馬光. 1787. *Zizhi tongjian* 資治通鑑 [Comprehensive mirror to aid in government]. In *Sika quanshu*, Internet Archive, https://archive.org/details/06057164.cn (accessed 10 December 2017).

Strahan, Donna, and Blythe McCarthy. 2018. Construction from the inside out: Early Chinese lacquer Buddha fabrication, National Museum of Asian Art website, https://www.asia.si.edu/essays/construction-from-the-inside-out-early-chinese-lacquer-buddha-fabrication/ (accessed 26 February 2018).

Tang Dai and Yuan Shen 唐岱，沈源. 2004. *Yuanmingyuan dang an shiliao cong bian* 圓明園檔案史料叢編 [The archival sources concerning the Yuanming Yuan in Qing dynasty archives]. Beijing: China National Microfilming Center for Library Resources.

Tao Zongyi 陶宗儀. 1959. *Nancun chuo geng lu* 南村輟耕錄 [Respite from plowing in the Southern Village]. Beijing: Zhonghua Book Company.

Uchida, Hiromi 内田宏美. 2014. *Zhongguo Handai jinian ming qiqi chutu yilan* 中国漢代紀年銘漆器出土一覧 [Lacquered ware with the date of production in the Han dynasty]. *Japan-Sea Rim Studies Annual Report* 21: 71–80.

Wenren Jun 聞人軍, trans. 2017. *Kaogong ji yizhu* 考工記譯註 [Ancient Chinese encyclopedia of technology: Translation and annotation of *Kaogong ji*]. London: Garland Science.

Yang Hsuan-Chih and Yi-Tung Wang 1984. *A record of Buddhist monasteries in Lo-yang*. Princeton: Princeton University Press.

Zhang Feilong 張飛龍. 2006. *Zhongguo qi wenhua lishi yuanyuan yanjiu* 中國漆文化歷史淵源研究 [The studies of the history and origin of Chinese lacquer]. *Journal of Chinese Lacquer* 25(1): 6–20.

Zhang Zhuo 張鷟. 1787. *Chaoye qian zai* 朝野僉載 [The anecdotes of the emperors, ministers, and common men]. In *Sika quanshu*, Internet Archive, https://archive.org/details/06047373.cn (accessed 10 December 2017).

Zheng Xin 鄭鑫. 2012. *Lun chuantong qi yi de lixing chuancheng yu fazhan* 論傳統漆藝的理性傳承與發展 [The inheritance and development of traditional lacquer art]. *Southeast Academic Research* 5: 188–94.

Zhou Ya-dong 周亞東. 2009. *Jia zhu gongyi yu fojiao zaoxiang* 夾紵工藝與佛教造像 [*Jiazhu* technique and buddha modeling]. *Hundred Schools in Arts* 8(111): 162–95.

Note: Dates for manuscripts are often uncertain or contested. In such cases the authors in this volume may have used life dates as the date of the manuscript.

Sculptures by Anige and Liu Yuan at the Yuan Court

Anning Jing

ABSTRACT The thirteenth-century lacquer bodhisattva in the Freer Gallery of Art collection could have been produced only in the Supervisorate-in-Chief of All Artisans (Zhuse renjiang zongguanfu 諸色人匠總管府) at the Yuan court headed by Anige 阿尼哥 and Liu Yuan 劉元. In China, figural sculpture in the form of hollow-core lacquer (*jiazhu* 夾紵) appeared at the end of the fourth century, reached its peak during the Tang dynasty, and was revitalized during the Yuan dynasty by the Nepali artist Anige's Chinese student Liu Yuan. This article briefly discusses some important literary records of pre-Yuan lacquer sculptures to establish a historical perspective, then focuses on sculptures by Anige and Liu Yuan, two of the best and highest-ranking artists at the Yuan court. This focus leads to the main argument: the lacquer bodhisattva in the Freer Gallery of Art's collection could be produced only in their institution.

Early Historical Records

A survey of important literary records of pre-Yuan dynasty (1279–1368) lacquer sculptures can help to establish a historical perspective (Pelliot 1923; Pelliot 1924). The earliest artists who have left a historical record of making lacquer statues were the famous Eastern Jin (317–420 CE) scholar and sculptor Dai Kui 戴逵 (326–396 CE), living in Shanxian 剡縣, and Kuaiji 會稽, and his son Dai Yong 戴顒 (377–441 CE). The Liang dynasty (502–57 CE) Buddhist monk Sengyou 僧祐 (445–518 CE) recorded lacquer statues made by them in *Collected Records Concerning the Tripitaka* (Chu sanzang ji ji 出三藏記集, *juan* 12 in T. 55, 2145: 92).

According to the early Tang dynasty (618–907) Buddhist monk Falin 法琳 (572–640 CE), Dai Kui "was excellent in the study of arts and built the Monastery of Calling for Reclusion. He personally made five lacquer statues. The images were all unparalleled, and constantly luminary" (*Treatise on Determining Orthodoxy* [Bianzheng lun 辯正論], *juan* 3 in T. 52, 2110: 505). The description "constantly luminary" clearly refers to gold surface decoration on the lacquer images, most likely gold leaf. Dai Kui used gold leaf even in his painting. The Northern Song (960–1279) scholar and connoisseur Mi Fu 米芾 (1051–1107) (1993, 1: 978) wrote that he had in his collection a painting of Guanyin by Dai Kui that was decorated with pasted gold leaf. The technique was widely used in the Liang dynasty. The second Liang emperor, Jianwen Di 梁簡文帝 (503–551 CE), made a lacquer statue with gold leaf decoration that was 4.41 meters tall (Xiao Gang [503–51] 1986, 1414: 590). Judging from these sources, it seems safe to say that Dai Kui was not only the first famous artist who worked in the medium of lacquer to create statues but also the first to use gold leaf as surface decoration on a lacquer statue.

In the Chen 陳 dynasty (557–89 CE), the last emperor Chen Baoshu's (陳寶叔, r. 583–89 CE) trusted minister Yuan Xian 袁憲 (529–598 CE) had ten lacquer statues made in a Buddhist monastery at Zhongshan 鐘山 in Nanjing (Falin, in T. 52, 2110: 506). During the period of division between the South and the North, lacquer statues were made also under the Northern Wei (386–534 CE) during the early sixth century. Sometime before 529, a scholar–official named Meng Zhonghui 孟仲暉 (life dates unknown) made a medium-size human lacquer statue in the capital Luoyang. It was placed on a Mount Sumeru–style base in the front hall of the residence of a prince (see Jing Hao 景皓 in *Beiqi shu* 北齊書 [636] 1972, *juan* 41, p. 544). According to Yang Xuanzhi's 楊衒之 *A Record of Buddhist Monasteries in Luoyang* (Luoyang qielan ji洛陽伽藍記) (in T. 52, 2092: 1018; see also Fan 1958, 237) datable to 547 CE, the image was "extremely rare in the world." Yang (*Luoyang qielan ji*, in T. 51, 2092: 999) estimated that there were about one thousand Buddhist temples in and around Luoyang, and it was in that context that he stated that the lacquer statue was extremely rare. Clearly the medium was still in its infancy in the North in the early sixth century.

The tallest lacquer statue known during the Sui dynasty (581–618 CE) (Zhang [ca. 658–730] 1986, *juan* 5, pp. 10–11) was made by a prime minister of the Sui named Yu Qingze 虞慶則 (d. 597), who devotedly built the Buddhist temple Chongjue si 沖覺寺 in Xiangzhou 襄州 (around modern Xiangyang, Hubei province), in which he commissioned a massive lacquer sculpture of Vairocana Buddha. It was 35.52 meters (120 *chi*) high, reportedly wonderful in appearance and particularly efficacious (Falin, in T. 52, 2110: 519).

During the Tang dynasty it was a common practice for the rulers to make lacquer images of deities and imperial portraits at the court workshop and send them to sacred sites throughout the country. In the summer of 630, Taizong 太宗 (r. 627–49), while seeking cool air at the Southern Mountain south of Changan 長安, built the Dragon-Field Buddhist Temple (Longtian si 龍田寺) there due to the prominent and auspicious terrain of the mountain. Later he commissioned six life-size lacquer imperial portraits and sent them to the temple (Falin, in T. 52, 2110: 514).

The lacquer portraits of the Tang emperor Zhongzong 中宗 (656–710, r. 684, 705–10) and his empress, Weihou 韋后 (d. 710), were transported about 1,000 kilometers from the capital to Mount Tai in Shandong. In 709, Zhongzong instructed three Daoist priests to travel to the Daiyue Guan 岱嶽觀 Abbey at Mount Tai to conduct a grand Daoist ritual ceremony known as the Great Retreat of the Golden Register (*jinlu dazhai* 金籙大齋) on his behalf. As part of the ceremony, a set of eleven lacquer statues were installed in the abbey to bless the emperor and the empress (Gu [1613–82] 1986, 683: 661).

A lacquer portrait statue of Emperor Xuanzong 玄宗 (r. 713–55) was enshrined in the Daoist temple Xiuzhen Guan 修真觀 in Zhouzhi 盩厔, Shaanxi. It wore a red silk robe and a Tang-style cap (*fujin* 幅巾) (Li [925–96] 1986), *juan* 374, p. 7).

Sometimes only statues of the deities were sent from the court to sacred sites, without imperial portraits. For example, in the middle of the Kaiyuan era (713–41), Xuanzong dreamed of a Daoist deity wearing an elaborate crown and a red robe. He commissioned a lacquer statue of the deity and sent it from the capital to a faraway Daoist temple in Sichuan (Cao [1575–1646] 1986), *juan* 77, p. 3).

On another occasion in 742, Xuanzong dreamed that twenty-seven deities informed him that they were the Twenty-Eight Constellations, with one absentee on duty protecting the frontiers of the empire. After wakening, the emperor issued an order to search for their location throughout the country. Eventually a site in Ningzhou 寧州 (in modern Gansu) was identified, where twenty-seven jade statues of Daoist deities were found. The images were moved to the court, and the emperor personally prayed in front of them. He then ordered lacquer workers (*jiazhugong* 夾紵工) to make twenty-seven lacquer statues and send them to the original site of the Twenty-Eight Constellations (Li [925–96] 1986, *juan* 29, pp. 3–4). The event was even recorded in an official history of the Tang (*Xin tangshu* [1060] 1975, *juan* 37, p. 969).

The Tang court often made large numbers of lacquer statues. In 650 when Emperor Gaozong 高宗 (r. 650–83) ascended the throne, he commissioned more than two hundred lacquer Buddhist statues in an effort to gain good karma. The projects were supervised by the great Buddhist master Xuanzang 玄奘 (602–664) (Huili慧力 and Yancong 彥悰, 688, *Datang Da Ci'en Si Sanzang Fashi zhuan* 大唐大慈恩寺三藏法師傳, in T. 50, 2053, *juan* 7, p. 260).

Under the reign of Wu Zetian 武則天 (624–705), the most famous statue was a colossal lacquer Maitreya in the Heavenly Hall in Luoyang. A Tang dynasty source claims that the hall was 300 meters (1,000 *chi*) tall, and the great lacquer statue inside was 270 meters (900 *chi*) high (Zhang [ca. 658–730] 1986, *juan* 5, pp. 10–11). However, the numbers seem unrealistic and contradict other sources (*Jiu Tang shu* 舊唐書 [945] 1975, *juan* 22, p. 865).

During the Tang, the making of lacquer statues spread to other countries and regions. The best-known example is the portrait sculpture of Jianzhen 鑑真 (Japanese: Ganjin) (688–763), made by his disciples in Tōshōdaiji (Japanese: 唐招提寺) in Nara, Japan, who began to work on the project before the end of his life. The medium of lacquer statues also spread westward. On his way to India, Xuanzang noted a standing lacquer statue in the Dirghabhavana Monastery in the kingdom of Hotan (Hetian 和闐). It came from the kingdom of Kucha (in modern Xinjiang, China) (Xuanzang [602–64] 1985, *juan* 12, pp. 1014–15).

Under the Song dynasty (960–1279), lacquer images were made less frequently than in the Tang, a decline that may indicate that Buddhist art production in general was less flourishing, except in the area of Sichuan. A significant event occurred during the reign of Yuanfeng 元豐 (1078–85), when Emperor Shenzong 宋神宗 (1048–1085) gave lacquer Buddhist statues to Koryo (in modern Korea) as gifts. The images were sent to Kaesŏng, the capital of Koryo, about 1,770 kilometers away by land. The images were installed in a grand Buddhist temple near the capital city (Xu [1091–1153] 1986, *juan* 17, p. 5).

The Yuan Dynasty Court Artists Liu Yuan and Anige

Throughout the history of the medium of lacquer statues, only four artists' full names are known. They are the famous Eastern Jin artist Dai Kui; his son Dai Yong; the Tang artist Yuan Jiaer 元伽兒, about whom the only thing known is that he made hollow-core lacquer statues in a Buddhist temple in Lintong 臨潼 near Changan (Song [1019–79] 1986, *juan* 15, p. 13); and lastly, the Yuan artist Liu Yuan (1248–after 1318) (Yu [1272–1348] 1986, *juan* 7, "Liu Zhengfeng [Liu Yuan] suji" 劉正奉塑記, pp. 24–26).

The most important historical documentation of Liu Yuan and his works is Yu Ji's 虞集 (1272–1348) essay "Note on the Sculptures by Liu Zhengfeng" (Liu Zhengfeng suji 劉正奉塑記) (in Yu [1272–1348] 1986, *juan* 7, pp. 24–26, the basis for accounts in Tao [ca. 1322–1403], 1986, *juan* 24, p. 11; *Yuan shi* [1370] 1976), *juan* 203, pp. 4546–47). It was written in 1317 or slightly later, when Liu Yuan was 70 years old and still active artistically.

Liu Yuan 劉元 was a native of Baodi 寶坻 in Ji 薊 (modern northern Tianjin). At first Liu Yuan studied under a Daoist teacher in Qingzhou 青州 (in modern Shandong) and learned his skills. In 1270 Khubilai Khan (1215–1294, r. 1260–94) began to build his Buddhist temple of the state, the Great Temple of Benevolent King Who Safeguards the State (Da huguo renwang si 大護國仁王寺) at Gaoliànghe 高良河 west of the city of Dadu 大都 (the Great Capital, modern Beijing), and outstanding artists throughout the country were sought after for the project (Yu [1272–1348] 1986, *juan* 7, p. 24). At that time the Nepali artist Anige 阿尼哥 (1245–1306) was in charge not only of the construction but also to a large degree of project personnel. For example, in the summer of 1270, Anige recommended to Khubilai's wife, Empress Chabi 察必 (1225–1281), that she appoint a capable warehouse manager named Wu Cheng 吳誠 from Taiyuan, Shanxi, to be director of warehouses (zhu wuku tingling 諸物庫提領) in order to manage materials needed for the construction. Later Wu Cheng was further promoted, and his contribution to the construction was officially recognized (Cheng [1249–1318] 1986, *juan* 21, pp. 5–6).

When Liu Yuan was hired for the project, he was still a Daoist priest. Previously Liu studied with his Daoist teacher in Qingzhou, which was a stronghold of the Quanzhen 全真 school of Daoism. It is certain that Liu Yuan was a Quanzhen Daoist. During the Mongol invasion of northern China, Quanzhen Daoism developed rapidly and by the late 1220s had become the dominant religion in northern China. Since then, Quanzhen Daoists had taken over about five hundred Buddhist monasteries and properties, many of them vacant due to war, to accommodate the dramatically growing number of Quanzhen followers, and the Buddhist statues and murals in them were often damaged and replaced by Daoist images. By 1250, the Mongol rulers were alarmed by the growing power of Quanzhen, and Khubilai formed an alliance with the Buddhist clergy to suppress Quanzhen school. The Mongol government ordered Quanzhen Daoists to return 237 Buddhist temples and properties to Buddhist clergy and repair and restore damaged Buddhist images in them (Jing 2012). It must have been in this process that Liu Yuan, although a Daoist priest, ironically became an expert in the making of Buddhist statues. As an extraordinary artist, he was hired for the construction of the state Buddhist temple. One of the reasons for his employment was no doubt his Daoist expertise, which was needed since Anige was often asked to make and repair Daoist images, on one occasion as many as nearly two hundred large statues (*Yuandai huasu ji* [1331] 1983). Liu Yuan's age then was 23, while Anige was 25.

The construction of the temple began in the twelfth month of 1270 and ended in the third month of 1274. By that time Liu Yuan learned Himalayan Buddhist imagery from Anige as well as the process of casting metal images. He soon excelled in Buddhist statues of clay, metal, and lacquer. In return, he no doubt also taught Anige traditional Chinese art style. Later Liu Yuan made statues also in other famous temples in the two capitals, Dadu and Shangdu 上都 (in modern Inner Mongolia).

According to Yu Ji, statues made by Liu Yuan were unmatched by all others. For this reason, Khubilai married two court ladies to him and appointed him a head of his institution. For more than forty years, wherever the emperors went on tours of inspection, Liu Yuan was always included in the entourages. Emperor Renzong 仁宗 (Ayurbarwada, r. 1311–20), who particularly emphasized the importance of education by imagery (*xiangjiao*象教), even issued a decree forbidding him to make images of deities privately for others (Yu [1272–1348] 1986, "Liu Zhengfeng suji," p. 24).

Liu Yuan had worked continuously for the court for nearly half a century, since 1270. Yet in 1317, when he was 70 years old, Emperor Renzong still assigned him to make images (*Yuandai huasu ji* [1331] 1983, 17–20). But by 1320, court documents of imperial projects recorded his disciple Supervisor Zhang as a leading sculptor, while Liu Yuan is no longer mentioned (*Yuandai huasu ji* [1331] 1983, 21), suggesting that Liu Yuan was no longer active.

The main institutional base where Anige and Liu Yuan carried out various imperial projects was the rank 3a Supervisorate-in-Chief of All Artisans (Zhuse renjiang zongguanfu 諸色人匠總管府). Its actual main function was to make imperial and religious images ordered by the Yuan emperors and empresses. One of its eleven departments was the Lacquer Department, which specialized in lacquer images (*xiuqi* 髹漆) (*Yuan shi* [1370] 1976, *juan* 85, p. 2145). It was established in 1275, two years after Anige was appointed supervisor-in-chief of all artisans and five years after Liu Yuan was hired by Anige. The establishment and operation of the Lacquer Department would be impossible without the expertise of Chinese court artists such as Liu Yuan, since the medium of lacquer had been unknown in Himalayan or Indian artistic traditions, in which Anige was trained. Anige was the first supervisor-in-chief of this institution. In 1279 a position of *daruhachi*, the highest position in an institution, was set up in the Supervisorate-in-Chief. Anige held this position until he passed away in 1306; the position was usually hereditary, and Anige's son Ashula inherited it. Because Anige was simultaneously head of the Imperial Manufactories Commission appointed in 1278 (*Yuan shi* [1370] 1976, *juan* 10, p. 198), he had the official rank of 2a.

After Anige became *daruhachi* in 1279, the vacant position of the supervisor-in-chief must have been filled by Liu Yuan, since Khubilai appointed him a head of his institution. This appointment would make him a rank 3a official, equal in rank to a minister of the Yuan central government. He was still active in that position in 1318 (*Yuandai huasu ji* [1331] 1983, 20). Sometime slightly before or in 1317 he was promoted to rank 2a. He was also given the honorary titles of Grand Academician of Brilliant Literary Hall (Zhaowen guan da xueshi 昭文館大學士), Grand Master for Proper Service (Zhengfeng dafu 正奉大夫), and Director of the Palace Library (Mishujian qing 秘書監卿).

Anige and Liu Yuan were the top two leading artists at the Yuan court; among thousands of craftsmen working for the court, only they enjoyed the high official rank of 2a, lavish titles, and official biographies in the biographical section for artists in the official history of the Yuan dynasty (*Yuan shi* [1370] 1976, *juan* 203, pp. 4545–46 [Anige], pp. 4546–67 [Liu Yuan]).

Liu Yuan's Buddhist sculptures, although the best, were little known to the public since they were mostly Tantric images in royal temples and not easily accessible even to scholar-officials like Yu Ji (Yu [1272–1348] 1986, "Liu Zhengfeng suji," p. 26). It was his creation of Daoist images in the Temple of the Eastern Peak (Dongyue Miao 東嶽廟) in the Great Capital (Goodrich and TenBroeck 1964), which was open to the public (Yu [1272–1348], 1986, *Daoyuan xuegu lu*, *juan* 23, "Stele Inscription for the Temple of the Eastern Peak" [Dongyue Rensheng Gong bei東嶽仁聖宮碑], p. 8.), that gained him popular recognition in his own time and lasting reputation in history. From the context of

Yu Ji's essay, it is clear that at least some of Liu Yuan's images in the temple were lacquer statues. The temple still exists today, but none of the original buildings or statues have survived, although many original stone stelae with inscriptions have been preserved.

This Daoist temple was first planned by Feng Daoyi 馮道頤 (life dates unknown), abbot of the Changchun Palace 長春宮, the national headquarters of the Quanzhen in the capital. The abbot told his disciples: "If we fail to acquire the famed artist Liu Zhengfeng [Liu Yuan], no one else is worthy of our temple. Besides, Zhengfeng was once a disciple of our religion, so he shouldn't be reluctant" (quoted in Yu [1272–1348] 1986, "Liu Zhengfeng suji," p. 24). The abbot's statement confirms that Liu Yuan was a Quanzhen Daoist priest-turned-artist. The abbot went to see Liu Yuan and invited him to work on the project. Although the abbot of the Changchun Palace was one of the most prominent and respected figures in Quanzhen Daoism, Liu Yuan could not accept the invitation due to the imperial decree forbidding him to make images for others. His declination, however, agonized him so severely that he fell ill and lost consciousness for three days. This reaction is understandable: after all, he was once a Quanzhen Daoist and now he had to reject a most respected master's invitation to make images of his own faith. After he came to, he asked his disciples, sons, and grandsons to drive him on a horse-drawn cart to the temple. As soon as he arrived, he felt better, and he prayed for the opportunity to make the image of the Emperor of the Eastern Peak (Rensheng Di 仁聖帝), the main deity of the temple. Soon afterward, he recovered fully from illness. He was authorized to make the images due to the abbot's appeal to the emperor for permission, and his official rank was promoted from 3a to 2a. He personally created twenty-five statues in three groups: in the central hall was the Emperor of the Eastern Peak, flanked by two female attendants, two male attendants, four ministers, and two warriors; to the west was the Duke Bingling 炳靈公 with two female attendants and two officials; and to the east was the Lord of Fate (Siming Jun 司命君), accompanied by two Daoist priests, two Daoist officials, two warriors, and two generals. Yu Ji himself visited the temple to see these statues with his own eyes in the spring of 1317. The following was his critique after seeing the images:

> The much-praised images in the galleries are all based on real scenes from mundane life, and they are very appealing to the viewers. But the grand manner of the royalty overwhelms the visitor who pays homage to the Emperor of the Eastern Peak. The other characters are most appropriate for their names. I particularly love those well-dressed and graceful standing attendances who are absorbed in profound contemplation. I sighed to myself: how can one integrate idea and form into such a single identity? Mr. Tian 田 told me that at first when Zhengfeng was planning an image of an attending official, he pondered over it for a long time without taking action. One day while

Figure 1. *Attendant bodhisattva, mid- to late thirteenth century, hollow-core lacquer, cloth, traces of blue, gold, and green paint, and gold leaf, 58.5 × 43.3 × 29.5 cm. Freer Gallery of Art, Smithsonian Institution, Washington, D.C., Purchase—Charles Lang Freer Endowment, F1945.4. Side view.*

Figure 2. *Detail of figure 1.*

Figure 3. *Buddha, India, Uttar Pradesh, Gupta period, fifth century, sandstone, 155 × 87 × 27 cm. Museum of Archaeology, Sarnath, 340.*

Figure 4. *Buddha, north India, early seventh century, copper alloy, h. 87.6 cm, including base 97.8 × 34 × 24.1 cm, Metropolitan Museum of Art, New York, lent by a private collection, L.2015.76a–e.*

> viewing pictures in the Palace Library, he saw a portrait of the Tang [official] Wei Zheng魏徵 [580–643]. Greatly surprised, he said: "I got it! Otherwise, how can this be called an official?" He immediately rushed to the temple to work on the image and completed it on the same day. How extraordinary it was! [His work] is not straightforward craftsmanship (Yu [1272–1348] 1986, "Liu Zhengfeng suji," p. 25).

In his discussion of the lacquer medium, Yu Ji emphasized Liu Yuan's contribution and historical role: "Hollow lacquer statue [*tuanhuan* 摶換] is to spread fabrics on clay images, then lacquer the fabrics. Afterwards remove the clay, and the lacquered fabrics remain as the images. People in the past made such images, but by the time of Zhengfeng [Liu Yuan], he was particularly devoted to it" (Yu [1272–1348] 1986, *Daoyuan xuegu lu, juan* 7, "Liu Zhengfeng suji," pp. 24–26).

Indeed, Liu Yuan's lacquer statues impressed the Mongol emperors so much that they became fond of the medium and often commissioned lacquer images, especially by Liu Yuan. For example, on 16 September 1317 (Yanyou 4.8.11), a commissioner of household service for the empress (Zhongzheng yuan shi 中政院使) named Kuo Kuo Dai 闊闊觧 (life dates unknown) reported to the throne that in the gate of the Blue Stupa Temple (Qingta Si 青塔寺), statues of the Four Heavenly Kings had not been started. The commissioner said that now would be a good time to start since the weather had cooled down in the fall, but it was not clear which artists should work on the images. An imperial order was issued, instructing that Grand Academician Liu (Liu Yuan) should model the images, and other painters and sculptors should be assigned by Asengge (*Yuandai huasu ji* [1331] 1983, 17),[1] Anige's eldest son (*Yuandai huasu ji* [1331] 1983, 17).

Another imperial order followed on 3 March 1318 (Yanyou 5.1.30), giving instructions on what images should be made in the Main Hall and who should make them, and giving further instructions on images in the temple gate: "Inside the Gate construct Heavenly Kings. For the materials needed, send requests to the ministries and departments" (*Yuandai huasu ji* [1331] 1983, 17). To implement the imperial orders, Liu Yuan made four statues of the Four Heavenly Kings in lacquer (*tuanhuan* 團換) (*Yuandai huasu ji* [1331], 1983, 17).

After 1318, Liu Yuan was probably retired, but lacquer statues were continuously made in the Supervisorate-in-Chief. By 1320, the supervisor-in-chief was a man named Duoerzhi 朵兒只, which is apparently a transliteration of the Tibetan name rDo rje. On 6 January 1322 (Zhizhi 1.12.18), an imperial order to rDo rje and others in the

Figure 5. *Avalokiteshvara in the form of Khasarpana Lokeshvara, India, Bihar or Bengal, Pala period, late eleventh–early twelfth century, schist, 95.3 × 47 × 17.2 cm. Asian Society, New York, Mr. and Mrs. John D. Rockefeller 3rd Collection, 1979.40.*

Figure 6. *Bodhisattva Simhanada Lokeshvara. India, Bihar, Pala period, about eleventh century, basalt, 114 × 53.9 × 18.1 cm. Art Institute of Chicago, 2019.729.*

Supervisorate-in-Chief requested that two lacquer images be made:

> Images can be placed by the sides of the jade stupa in the Stupa Hall behind the Main Hall. Copper platforms and golden flames should be added to the stupa. It should have inlays of artificial Seven Treasures. A statue of Bodhisattva Mañjuśrī should be placed to the west (of the stupa), and a statue of Maitreya Buddha should be placed to the east. Both statues should be covered with fabrics and lacquered. Flaming mandorlas, bases, and copper platforms should all be gilded. Below, make lacquer purification platforms. Acquire all necessary materials from the Secretariat (Zhongshu 中書) (*Yuandai huasu ji* [1331] 1983, 33).

Of all the lacquer statues made by the Supervisorate-in-Chief, the only survivor seems to be the bodhisattva in the Freer collection (figs. 1 and 2; see also pl. 5, p. 16). Its radiocarbon age is mid- to late thirteenth century (Jett 1995; Jett 1997; Donna Strahan and Denise Leidy, personal communication, 24 July 2017), but one must consider that carbon dating is really about the materials, and later artists could use earlier materials that had been in storage. The dates fall into time frames of Xixia (982–1227), Jin (1115–1234), Southern Song (1127–1279), and Yuan (1279–1368). The time frames of the Southern Song and Jin can be safely excluded on the basis of style alone. Besides, there is no surviving record of any lacquer statue under the Southern Song, Jin, or Xixia. Xixia can also be excluded, on both stylistic and technical basis. The body of this image, particularly the upper torso, is triangular in shape, tight and lean, a little geometric. This style is rooted in a long tradition starting from the Gupta at Sarnath in northern India (fig. 3), characteristic of the Nalanda school (fig. 4), crystalized under the Pāla (figs. 5 and 6), and slightly softened in Nepal (fig. 7); it shows a long tradition of real appreciation of the beauty of the body itself. But we do not see this kind of understanding of the body and the technical perfection to achieve it in Xixia tradition. Compared with this type of neat and crisp form, Xixia images are slightly puffy and rounded (Xie 2002). The face is more characteristic of Nepali tradition (fig. 8), youthful with high and long, arched eyebrows, straight but thin nose, dimples at the corners of the mouth, and squarish chin. The proportion is perfect.

Anige did learn how to make lacquer statues in China, although before his arrival in China he did not know the medium. Following his guru 'Phags pa bLo gros rgyal

Figure 7. *Bodhisattva Maitreya, Nepal, Kathmandu Valley, Thakuri period, eleventh century, copper alloy with gilding and color, 66 × 20.9 cm. Metropolitan Museum of Art, New York, Rogers Fund, 1982, 1982.220.12.*

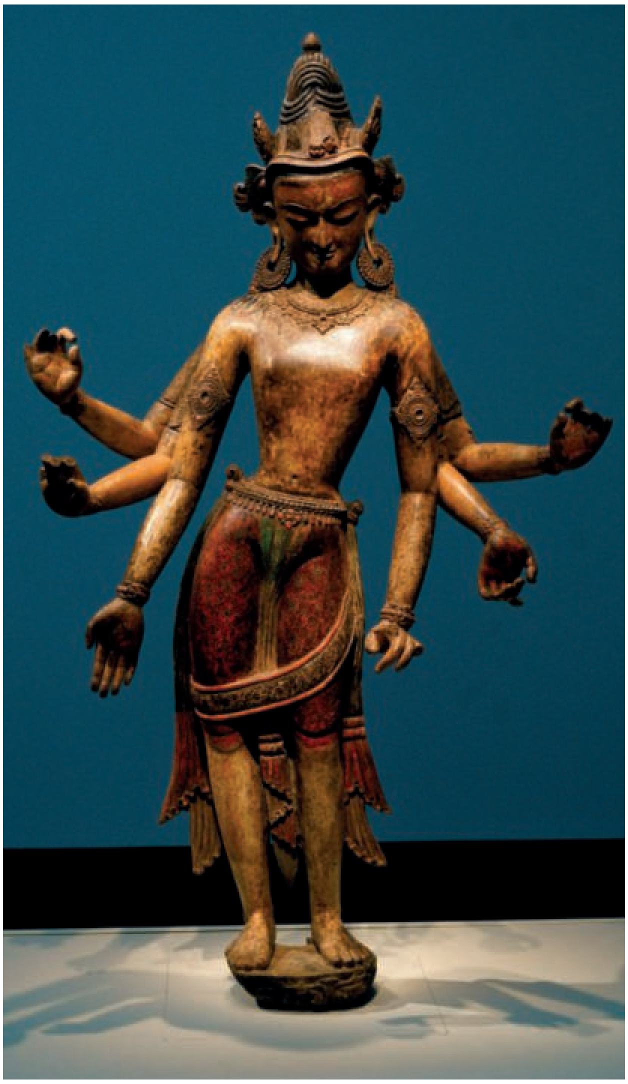

Figure 8. *Avalokiteshvara, Nepal, early Malla dynasty, fourteenth century, polychromed wood, 162.5 × 96 × 37 cm. Freer Gallery of Art, Purchase—funds provided by the Friends of the Freer and Sackler Galleries and Sigrid and Vinton Cerf in honor of Dr. Mary Shepherd Slusser, F2000.5.*

mtshan (1235–1280), he arrived at Khubilai Khan's court around the end of 1262. The khan inquired about his specialty when he was introduced. Anige replied that he roughly knew painting, casting, and carving. Understandably at that time his self-acknowledged specialty did not include the medium of lacquer sculpture since it was unknown in Indian and Himalayan sculptural traditions. But later in China he acquired new skills of weaving images in silk and making images in lacquer, both traditional luxury media in Chinese art. Therefore, the scholar-official Cheng Jufu 程鉅夫 (1249–1318), writing Anige's official posthumous biography according to an imperial order in 1316, praised his busy and tireless work in various artistic media, notably including lacquer statue: "weaving, casting with mold, lacquering (*tuanzhi* 摶埴, namely *tuanhuan* 摶換, lacquer sculpture),[2] and painting" (Cheng [1249–1318] 1986, *juan* 7, p. 16). Anige must have learned the technique of lacquer sculpture from Liu Yuan, since the two worked together and the latter was particularly famous for the medium.

The function of the image was probably to serve as a model for approval by the emperor, and, once approved, it served as a model for full-size images. It would be one of many images in a complete iconographical program. Finished full-size images were usually quite large, for example, following an imperial edict of 28 November 1318 (Yanyou 5.10.25), Liu Yuan made a group of the Four Heavenly Kings at Xiangshan 香山 and other images. Among them were a statue of Mañjuśrī and a statue of Samantabhadra, both measuring 2.8 meters (9 *chi*), together with two mandolas bearing flame patterns and measuring 4.68 (1 *zhang* 5 *chi*) meters high and 2.34 (7 *chi* 5 *cun*) meters wide (*Yuandai huasu ji* [1331] 1983, 20). Judging from the materials used for the two images, they were clay sculptures with armatures made of iron bars whose surfaces had patterns of large, medium, or small dots, and thin iron wire to support wet clay. They were gilded with red gold leaf and colorfully painted.

Conclusions

Hollow-core lacquer statues are a relatively rare medium except during Tang times. Due to its Nepali style and iconography as well as its traditional Chinese lacquer medium, the Freer bodhisattva could have been made only in the Supervisorate-in-Chief. Compared with fourteenth-century Yuan Buddhist imagery, the figure shows more Himalayan characteristics and therefore most likely dates to the late thirteenth century. The perfect proportion, the tight body, and the subtle beauty of the face all indicate that the image was made by great masters at the Supervisorate-in-Chief. Such a great work could only be the result of collaboration between a master of Himalayan tradition active in the late thirteenth century whose main contribution was style and iconography, and a Chinese artist particularly adept at the medium. Who else could they be except Anige and Liu Yuan?

Acknowledgments

I would like to thank Donna Strahan for giving me the opportunity to see the Freer lacquer bodhisattva. I am also grateful to Chino Franco Roncoroni for sharing his great knowledge of Himalayan art and his friendship and support.

Notes

1. In the text Asengge 阿僧哥 is incorrectly written as Age 阿哥.
2. In Chinese, *tuanzhi* 摶埴 can mean "unfired pottery," but that definition is not applicable in the context of Anige's work. Here *tuan* 摶 is a short form for *tuanhuan* 摶換 (lacquer replacement), while *zhi* 埴 means "clay." So *tuanzhi* refers to the replacement of clay by lacquer, describing the creative process of lacquer sculpture.

References

Beiqi shu 北齊書[History of the Northern Qi]. (636) 1972. Reprint, Beijing: Zhonghua shuju.

Cao Xuequan 曹學佺. (1575–1646) 1986. *Shuzhong guangji* 蜀中廣記 [Extensive records in Shu]. In *Siku quanshu*, Wenyuan ge edition. Reprint, Taibei: Shangwu yinshu guan.

Cheng Jufu 程鉅夫. (1249–1318) 1986. *Xuelou ji*雪樓集 [Collection at the Snow Tower]. In *Siku quanshu,* Wenyuan ge edition. Reprint, Taibei: Shangwu yinshu guan.

Falin 法琳 (572–640). 626. *Bianzheng lun* 辯正論. In T. 52, 2110.

Fan Xiangyong 范祥雍. 1958. *Luoyang qielan ji jiaozhu* 洛陽伽藍記校注 [Buddhist temples in Luoyang with annotations]. Shanghai: Shanghai guji chubanshe上海古籍出版社.

Goodrich, A. S., and J. R. TenBroeck. 1964. *The Peking Temple of the Eastern Peak: The Tung-yueh miao in Peking and its lore*. Nagoya: Monumenta Serica.

Gu Yanwu 顧炎武. (1613–82) 1986. *Qiugu lu* 求古錄 [A record of the search for antiquity]. In *Siku quanshu*, Wenyuan ge edition. Reprint, Taibei: Shangwu yinshu guan.

Huili 慧力 and Yancong 彥悰. (688–) *Datang Da Ci'en Si Sanzang Fashi zhuan* 大唐大慈恩寺三藏法師傳 [Biography of Xuanzang of the Great Temple of Cien of the Great Tang]. In T. 50, 2053.

Jett, P. 1995. The study and treatment of Chinese dry lacquer sculpture. In *The Seventeenth International Symposium on the Conservation and Restoration of Cultural Property: Conservation of Urushi Objects, Tokyo*, 167–86. Tokyo: National Research Institute of Cultural Properties.

Jett, P. 1997. A note concerning the radiocarbon dating of a Chinese dry lacquer figure in the collection of the Freer Gallery of Art. *Orientations* 28 (November): 66–67.

Jing Anning 景安寧. 2012. *Daojiao Quanzhen pai gongguan, zaoxiang yu zushi* 道教全真派宮觀、造像與祖師 [Temples, images and patriarchs of the Quanzhen school of Daoism]. Beijing: Zhonghua shuju.

Jiu Tang shu 舊唐書 [The original version of the history of the Tang]. (945) 1975. Reprint, Beijing: Zhonghua shuju.

Li Fang 李昉. (925–96) 1986. *Taiping guangji* 太平廣記 [Records of the Taiping]. In *Siku quanshu*, Wenyuan ge edition. Reprint, Taibei: Shangwu yinshu guan.

Mi Fu 米芾. (1051–1107). 1993. *Hua shi* 畫史 [A painting history, ca. 1101]. Reprinted in *Zhongguo shuhua quanshu*, vol. 1. Shanghai: Shanghai Shuhua chubanshe.

Pelliot, P. 1923. Les statues en "laque sèche"' dans l'ancien art chinois. *Journal Asiatique* 202 (April–June): 181–207.

Pelliot P. 1924. Deux termes techniques de l'art chinois 脫沙 t'o-cha et 隱起 yin-k'i. *T'oung Pao*, ser. 2, 23(4) (October): 260–66.

Sengyou 僧祐. 445–518. *Chu sanzang ji ji* 出三藏記集 [Collected records concerning the Tripitaka]. In T. 55, 2145.

Song Minqiu 宋敏求. (1019–79) 1986. *Chang'a-n zhi*長安志 [Gazetteer of Changan]. In *Siku quanshu*, Wenyuan ge edition. Reprint, Taibei: Shangwu yinshu guan.

T. = Takakusu Junjirō 高楠順 次郎 and Watanabe Kaigyoku 渡邊海旭, eds. 1924–34. *Taishō shinshū Daizōkyō* 大正新修大蔵経 [Taishō Revised Tripitaka]. Tokyo: Taishō Issaikyō Kankōkai 大正一切経刊行会.

Tao Zongyi 陶宗仪. (ca. 1322–1403) 1986. *Chuogeng lu* 輟耕錄 [Records after ploughing]. In *Siku quanshu*, Wenyuan ge edition. Reprint, Taibei, Shangwu yinshu guan.

Xiao Gang 蕭綱 [Liang Jianwen Di]. (503–51) 1986. *Wei ren zao zhangba jiazhu jinba xiang shu* 為人造丈八夾紵金薄像疏 [Letter concerning creation of a lacquer image of gold foil measuring one zhang and eight chi [4.41 meters]. In *Liang Jianwen di ji* 梁簡文帝集 [Collected works of Jianwen Di of the Liang Dynasty], in *Han Wei Liuchao bai san jia ji* 漢魏六朝百三家集 [Writings of 103 authors of the Han, Wei and the Six Dynasties Period], ed. Zhang Pu 張溥, *juan 82 xia, ye 65–66*. In *Siku Quanshu*, Wenyuan ge edition. Reprint, Taibei: Shangwu yinshu guan.

Xie Jisheng 謝繼勝. 2002. *Xixia zangchuan huihua* 西夏藏傳繪畫 [Tibetan style of Xixia painting]. Shijiazhuang: Hebei jiaoyu chubanshe.

Xin tangshu 新唐書 [A new history of the Tang]. (1060) 1975. Reprint, Beijing: Zhonghua shuju.

Xu Jing 徐兢. (1091–1153) 1986. *Xuanhe fengshi Gaoli tujing* 宣和奉使高麗圖經 [Illustrated records of the envoy to Korea during the Xuanhe reign]. In *Siku quanshu*, Wenyuan ge edition. Reprint, Taibei: Shangwu yinshu guan.

Xuanzang 玄奘. (602–64) 1985. *Da Tang xiyu ji jiaozhu*大唐西域記校注 [Great Tang records of the West]. Annotations by Ji Xianlin 季羡林. Beijing: Zhonghua shuju.

Yang Xuanzhi 楊衒之. 547. *Luoyang qielan ji*洛陽伽藍記 [A record of Buddhist monasteries in Luoyang]. In T. 51, 2092.

Yu Ji 虞集. (1272–1348) 1986. *Daoyuan xuegu lu* 道園學古錄 [Daoyuan's record of study of antiquity]. In *Siku quanshu*, Wenyuan ge edition. Reprint, Taibei: Shangwu yinshu guan.

Yuandai huasu ji 元代畫塑記 [A record of sculptures and paintings in the Yuan dynasty]. (1331) 1983. Reprint, Beijing: Renmin meishu chubanshe.

Yuan shi 元史. [History of the Yuan dynasty]. (1370) 1976. Reprint, Beijing: Zhonghua shuju.

Zhang Wu 张鷟. (ca. 658–730) 1986. *Chaoye qianzai* 朝野僉載 [Stories in and out of the court]. In *Siku quanshu*, Wenyuan ge edition. Reprint, Taibei: Shangwu yinshu guan.

Note: Dates for manuscripts are often uncertain or contested. In such cases the authors in this volume may have used life dates as the date of the manuscript.

Please note that the following article includes images of human remains.

Lacquered Bodies: Whole-Body *Śarīra* as Relic and Image

Justin R. Ritzinger

ABSTRACT Mummification of prominent monks is a practice with a long history in Chinese Buddhism. Covered in lacquer and enshrined, mummies represent a confluence of the cults of relics and images. After tracing the development of this phenomenon, this article draws out the unique features of these "flesh icons" through juxtaposition with their sacred cousins, the relic and the image.

Introduction

To people, mummification would appear to be an odd practice for Chinese Buddhists to engage in. It seems out of sync with popular images of the tradition as rational and deritualized as well as with canonical pronouncements of impermanence and injunctions to detachment. Even the great chronicler of modern Chinese Buddhism, Holmes Welch, wrote of the practice with undisguised disgust, rendering one term for mummified monks, *roushen* 肉身, as "meat bodies," because he thought "it suit[ed] the repellant nature of the object," even though he confessed "a more sympathetic rendering would be 'person in the flesh'" (Welch 1967, 511n60), and he declared it "the antithesis of the doctrine of impermanence" (Welch 1967, 345). Yet the practice is much more consonant with tradition than Welch imagined. It is, in fact, a novel combination of the cults of relics (Sanskrit: *śarīra*) and images, both of which originated in Indian Buddhism before being introduced to China. Over time they were called by several terms: "whole-body relics" (*quanshen shelì* 全身舍利), "true bodies" (*zhenshen* 真身), "bodhisattvas in the flesh" (*roushen pusa* 肉身菩薩), and even, tellingly, "flesh icons" (*roushen xiang* 肉身像).[1] Here, I will sketch the origins and evolution of the cult and then bring the unique character of whole-body relics into focus through a comparison with their sacred cousins, the *śarīra* and the image. We shall see that whole-body relics display characteristics of both while remaining distinct from either and enjoying, as a result, a doubled charisma.

Evolution of the Cult

The earliest recorded Chinese Buddhist mummies were fourth- and fifth-century mountain ascetics, whose mummifications appear to have been either accidental or natural.[2] The first, Heluojie 何羅竭 (d. 298 CE), was a monk of unclear origins known for his wonder-working. When his cremation failed, his body was placed in cave, where it was seen "sitting solemnly" by an Indian visitor thirty years later (T. 50, 2059: 389a3–16). Zhu Tanyou 竺曇猷 (d. 390s) and Bo Sengguang 帛僧光 (d. 385 CE), in contrast, were spontaneously preserved. Zhu died in his cave on Chicheng shan 赤城山 near Tiantai shan 天台山. His body turned black but remained seated and intact until the end of the Yixi 義熙 period (405–19 CE), when it was seen by another mountain recluse. Later visitors who sought a glimpse failed to locate the remains (T. 50, 2059: 395c26–396b16). Bo remained so lifelike after his passing that it took a week for his followers to realize he was dead and not merely meditating. He, too, was placed in a cave, but when a visitor tapped the remains with his *ruyi* 如意 scepter seventy years later, they crumbled but for the bones. The cave was then sealed and a portrait painted (T. 50, 2059: 395c5–25). Among the four, Shan Daokai 單道開 (d. ca. 360 CE), a disciple of Fotudeng 佛圖澄 (232–348 CE), has attracted scholarly attention for dietary practices reminiscent of Daoism: "cutting off grains" and subsisting instead on cypress seeds, pine resin, and eventually just pebbles. After his death on Luofu Shan 羅浮山, he, too, was entombed in a cave. Perhaps three years later, the prefect of Nanhai visited the cave and compared the body to a "cicada husk" (*chantui* 蟬蛻) (T. 50, 2059: 387b1–c14).

Although these mountain ascetics are often discussed in the literature as the origins of the cult of mummified monks, they are notably different from those of later eras. First of all, their biographies note the remarkable preservation of their remains without actually offering much remark on it. We find no theorizing of what this bodily preservation indicates about their spiritual attainments. Some scholars have seen the reference to a "cicada husk" in the case of Shan Daokai as an indication that the mummies were conceived of as having attained "corpse deliverance" (*shijie* 尸解) in the manner of Daoist transcendents (*xian* 仙) who slipped the bonds of mortality leaving a substitute body in their place.[3] Yet we do not find any stories of postmortem sightings as we would expect of a transcendent. Rather, it seems likely that the term is simply a poetic description of the darkened and desiccated remains (Ritzinger and Bingenheimer 2006, 58). We also find little evidence of cultic activity. Foulk and Sharf (1993, 166) have seen the portrait painted of Bo Sengguang as an early case of an image standing in for a failed mummy in a tomb cult, but we must point out that tapping remains with a scepter hardly seems a reverential gesture. Combined with the lack of theorization, the references to later visitors simply seeing the corpse preserved is more suggestive of a fascination with the strange than worship. Finally, we may note the absence of wonders attributed to the monks beyond the sheer fact of their preservation. Rather than the origins of the cult, we might better see these monks as precursors.

The cult proper begins not with obscure mountain ascetics of the fourth- and fifth-century dynasties but with the most prominent thinker of the sixth century: Zhìyi 智顗 (538–597), the founder of Tiantaí 天台 school. When Zhìyi passed away, his body was placed in a coffin and taken to a spot he had chosen on the southwest peak of Mount Tiantai, where the body was entombed and two white stupas were erected. Subsequently a tomb cult formed, and miracle tales began to circulate. Four years after the master's interment, the crown prince—the future emperor Sui Mingdi 隋明帝 (569–618)—discussed these wonders with Zhiyi's successor Guanding 灌頂 (561–632) and asked if there was scriptural support for opening the tomb. Guanding replied that "*Śākyamuni Tathāgatha* with his right hand opened the stupa of *Prabhūtaratna* and the eight kinds of beings [in the assembly] saw his whole body (*quanshen* 全身)" (T. 46, 1934: 816a17–18). This passage of course alludes to the chapter of the *Lotus Sutra* in which a stupa appears containing the ancient, extinct Buddha *Prabhūtaratna*. When *Śākyamuni* opens it, he finds *Tathāgatha* "seated . . . his body whole and undecayed as if in meditative absorption" (*quanshen busan ru ru chanding* 全身不散如入禪定) (T. 9, 262: 813b29). The crown prince subsequently echoed this connection when he referred to the remains as a "whole-body relic" (*quanshen sheli* 全身舍利) and described Zhiyi as "appearing after all these years as if in meditation" (*yujin shuzai yanran ruosi* 于今數載儼然若思). This phenomenon, he proclaimed, was the result of attaining advanced stages of the bodhisattva path (T. 46, 1934: 811c29–813c23). Rather suddenly with Zhiyi, then, we find many of the elements that would characterize the subsequent cult of mummified masters. The mummification was quite likely intentional. At the very least the way the opening of the tomb was framed suggests that Zhiyi was already known to be preserved. The preservation was interpreted in terms derived from the sutras, particularly the *Lotus*, as a "whole-body relic" indicative of high spiritual attainment. Finally, there is clear indication of cultic activity and reports of wondrous responses.

The key piece still missing, of course, is lacquer, the application of which allowed a whole-body relic to be preserved indefinitely. The first monk whose mummified remains were thus treated was the ascetic Daoxiu 道修 (d. 627), who lived in northeastern Shaanxi. After his uncorrupted remains were discovered in his hut by local villagers, a mausoleum was built and the body covered with lacquer-soaked cloth (*yu qishang jia qíbu* 於其上加漆布) (T. 50, 2060: 684b18), much as the wood or clay core of a typical lacquer sculpture would be. The result might be termed, at the risk of a gruesome turn of phrase, a "flesh core" sculpture. That such an expensive process was employed to preserve the whole-body relic of an otherwise rather obscure monk suggests that in the wake of Zhiyi's mummification incorruptibility had taken on new prestige. A more influential example was that of Daoxin 道信 (d. 651), the fourth Chan patriarch. At the end of his life, the monk ordered that a stupa be built to inter his remains. A year after his death, his successor Hongren 弘忍 (601–674) and the other disciples opened the stupa to find the master "sitting upright as of old" (T. 50, 2060: 606b20–28), in a scene recalling both Zhiyi's example and the scriptural prototype. We might conclude that Hongren hoped to make both a claim for his master's attainments and also his own, by assuming the role of *Śākyamuni* to Daoxin's *Prabhūtaratna*.

Lacquering whole-body relics in this way had important effects. The process ensured that the remains would endure indefinitely[4] and could be publicly displayed.[5] As a result, they became more useful as proofs of holiness and tokens of legitimacy. The transformation into a kind of icon also allowed mummified remains that had been kept in stupa-mausoleums to begin to be enshrined within monasteries in "memorial halls" (*chongtang* 崇堂) or "portrait halls" (*zhentang* 真堂). There the whole-body relic could serve as the seat of the departed master's spirit and receive offerings appropriate to his status as a monastic ancestor (Sharf 1992, 21–22).[6]

By the mid-Tang dynasty (618–907), the cult of mummified masters had become an important part of the Buddhist landscape. A number of luminaries, including Hongren, Huineng慧能 (638–713),[7] and Yunmen 雲門 (862/864–949) from the Chan tradition as well as the Faxiang 法相 exegete Kuiji 窺基 (632–682) and the Tantric master *Subhakarasiṃha* (Shanwuweì 善無畏) (637–735), were all mummified, as were scores of lesser figures. The increasing frequency of mummification as well as the statistically unlikely number of prominent figures included in the ranks of the incorruptible indicates that techniques were being developed to increase the likelihood of preservation. Textual sources are largely silent on these matters, but biographies do typically state that the bodies were entombed in a stupa, encoffined in a niche (*kan* 龕), or, a bit later, sealed between two large earthenware jugs (*gang* 缸) typically for a period of three years. We know that in later periods the bodies were packed with desiccating agents such as charcoal or salt and that at least some masters fasted before their death or ingested purgative agents to encourage preservation. In some cases, the viscera were apparently removed. While scholars have found in some biographies suggestions of failed mummifications, whatever the precise process may have been it appears to have been at least somewhat reliable (Ritzinger and Bingenheimer 2006, 69–70, 83–84). Nevertheless, the risk of failure meant that success could still be cast as wondrous proof of holiness (Sharf 1992, 23).

Mummy as Relic and Image

In their mature period, beginning in the mid-Tang, mummies had come to combine relic and image, sharing attributes of both yet remaining distinct from either. In this section, I will

Figure 1. A portrait of the monk Cihang 慈航 *(1893–1954) in the manner of Budai* 布袋*. Credit: Central News Agency (Taiwan) (zhongyang tongxun she* 中央通訊社*).*

Figure 2. Cihang in 1959 after his mummification. Credit: Central News Agency.

highlight the unique character of these whole-body relics through juxtaposition with two closely related objects of veneration: the crystalline or sometimes pearl-like *śarīra* relics classically produced by cremation, and the icon of a buddha, bodhisattva, or other holy figure.

We have already seen that from the time of Zhiyi the mummified remains of eminent monks were conceptualized as relics. The Tiantai master was declared to be a "whole-body relic" and compared with the extinct Buddha *Prabhūtaratna* entombed within a stupa, the classic Buddhist reliquary structure. Later, Zanning 贊寧 (919–1001), the compiler of the *Song Biographies of Eminent Monks* (Song gaoseng zhuan 宋高僧傳) would ascribe the incorruptibility of *Śūbhakarasiṃha* to his body being "imbued with concentration and insight" (*ding hui suo xun* 定慧所熏) (T. 50, 2061: 716a08). The idea that relics are produced by thus imbuing the body with discipline, concentration, and insight through a lifetime of self-cultivation can already be found in Indian Buddhism (Sharf 1992, 8; see also Schopen 1997, 127).[8] Moreover, as Sharf (1992, 4, 22) points out, both crystalline *śarīra* and mummies are bodies transfigured, "distanced from the corpse through a process of transformation and purification" in which "the impure corpse, prone to putrefaction," becomes "a pure, immortalized body."

Yet whole-body, or integral, relics are also quite different from their disintegral counterparts. *Śarīra* are more often than not impersonal tokens of spiritual power in Chinese Buddhism. Bones and teeth of the Buddha aside, very little attention is paid to the provenance of *śarīra*. Frequently they lack any connection to a body at all as they emerge not from a cremation pyre but from thin air. Kang Senghui 康僧會 (d. 280 CE) is said to have prayed for the appearance of relics to demonstrate the efficacy of Buddhism to a skeptical Sun Quan 孫權 (182–252 CE) in 248 CE. In response, relics (not stated to be of anyone in particular) did appear in a bottle, emanating a miraculous light. According to another account, when Kuiji raised his brush to compose one of his commentaries "fourteen kernels of *śarīra* fell from its tip" (Kieschnick 2003, 50). Even when relics do have a clear provenance, they may still retain an impersonal quality. Kieschnick (2003, 32, 49–50) notes that the eminent scholar-monk Xuanzang's 玄奘 (602–664) discussions of relics of the Buddha dwell more on the appearance than their connection to the *Tathāgatha*. Another example is the relic enshrined in Ayuwang Monastery 阿育王寺. It is, according to legend, a relic of the Buddha placed in China by King Ashoka (ca. 304–232 BCE) that was miraculously revealed in 282 CE. It became famous, however, more for its ability to change size and color in response to the sincere devotion of worshippers than for its connection to the Buddha. When I had the opportunity to see it in the summer of 2015 with a group of nuns, all subsequent conversation centered on the appearance manifested to each. The word "buddha" was mentioned not once.[9] Yet these disintegral relics' most obvious difference from their integral cousins is visual. Taken in isolation, *śarīra* are often indistinguishable from bits of quartz or even pebbles, which archaeologists have discovered that in some cases they in fact are (Kieschnick 2003, 38). As Sharf (1999, 81) notes, *śarīra* are "devoid of representational qualities." It is the framing of the

Figure 3. *The sculptor Liu Shi* 劉獅 *filling in the face with plaster. Credit: Qin Bingyan*秦炳炎*, Central News Agency.*

reliquary that defines ambiguous objects as *śarīra* for the viewer more than anything about the objects themselves.

In this respect, whole-body relics are more closely related to images. The whole-body relic is unambiguously a human figure. Moreover, lacquered and enshrined, it looks much like other icons. Indeed, we find that connection drawn in interesting ways in Kuiji's commentary *The Sutra on the Visualization of Maitreya Bodhisattva's Ascent to Tuṣita Heaven* (Guan mile pusa shangsheng doushuaì tian jing 觀彌勒菩薩上生兜率天經). There, when Maitreya dies and is reborn in Tuṣita for his penultimate life, he is described as leaving "a bodily *śarīra* like a cast gold image" (*qi shen sheli ru zhujin xiang* 其身舍利如鑄金像), which Kuiji sees as a reference to a whole-body relic (T. 38, 1772: 292a26–b01).

Figure 4. *The "bodhisattva in the flesh," lacquered and gilded, receiving veneration. Credit: Chen Yongkuí* 陳永魁*, Central News Agency.*

Appearances notwithstanding, as a relic the flesh icon is nevertheless also distinct from the image. A conventional image of a buddha or bodhisattva may look like the figure represented. Yet at least from a doctrinal "high-church" perspective, something else is necessary to close the gap between signifier and signified and endow the image with the figure's real presence. Most commonly this is ritual consecration, but sometimes relics or symbolic relics are enshrined within (Kieschnick 2003 59–62; Strahan 2010, 40–41).[10] The whole-body relic, in contrast, is more than representational. There is no gap between signifier and signified because it is the figure himself. As such, no rite of consecration is required. At the same time, as an image, it, like the crystalline *śarīra*, is "framed." Covered in lacquer and gold, not infrequently after being filled out with clay, the mummified body, which might easily be an object of horror, is aestheticized. Enshrined in the monastery among statues of buddhas and bodhisattvas and portraits of departed abbots, it is constituted as an icon to be venerated (figs. 1–4).[11]

As both relic and icon, whole-body relics figure in miracle tales in ways that recall both. Miracles associated with relics are impersonal and reactive in character. As we have already seen, the production of relics, whether by cremation or manifestation, is considered the miraculous result of an impersonal process: the perfuming of the body through spiritual cultivation. Subsequent miracles associated with relics are likewise impersonal in character but are typically evoked as a response to a devotee through the principle of sympathetic resonance (*ganying* 感應), as in the case of the Buddha relic at Ayuwang. Emitting light or multiplying, in particular, was common (Kieschnick 2003, 31–36).[12] Whole-body relics, like *śarīra*, were miraculous by their very existence, and, like *śarīra*, they were sometimes said to emit light in response to devotion. The doors of Zhiyi's tomb, according to one tale, opened of themselves and poured forth light when the monk Jiaosheng 皎生 (life dates unknown) performed repentance before it (T. 46, 1934: 812c25–813a15; T. 50, 2050: 197a29–b04). Light was also said to have shone from Sengqie's 僧伽 (d. 710) stupa during the reign of Song Taìzong 宋太宗 (960–76), inspiring thousands to burn off fingers, light incense on their heads, and cut off arms in a display of reverence (Yü 2000, 215) that recalls the Tang dynasty furor for the Buddha's finger bone that so disgusted Han Yu.

The miracles associated with images in such stories are quite different in character. Where *śarīra* are impersonal and reactive, images are personal and proactive, the protagonists of their own stories. One image in a Tang dynasty tale sweats with fear when soldiers loot the monastery, while another "[complains] in a devotee's dream that its fingers are in need of repair" (Kieschnick 2003, 64, 68; see also Dudbridge 1998). Once lacquering becomes common and mummies begin to function as images, personal agency begins to figure more prominently in their stories as well. Like the Tang image with unfinished fingers, mummified monks sometimes sent dreams to alert patrons of problems with their craftsmanship. In the early Song (960–1279), Xingxiu 行修 (d. 950) sent a dream to the local prefect to tell him that "the area beneath me is not finished" (T. 50, 2061: 899a2–6), while his contemporary Wang Luohan 王羅漢 (d. 968) appeared in dreams to alert others to a problem with his mummification (T. 50, 2061: 852b4–8) (Sharf 1992, 155). Finally, Sengqie "raised a stink" when he was enshrined in a location that did not agree with him, emitting a foul odor that alluded to his status as a corpse. Once relocated to a more pleasing locale, he emitted a sweet fragrance befitting his miraculous preservation (T. 49, 2035: 372c16–18; T. 51, 2076: 433a18–20; Faure 1991, 153; Yü 2000, 213).[13] In the modern period, Huineng is said to have appeared to Xuyun 虛雲 (attributed life dates 1840–1959) in dreams and meditation to commission him to begin the restoration of Nanhua Monastery 南華寺 (Faure [1992] 1994, 173).

At once relic and image, whole-body relics would have enjoyed a special charisma. Sharf (1999, 82, 90) has argued that relics hold an allure as "the distilled essence of human corporeality." They evoke a visceral fascination because they "confront us in the starkest possible way with our irreducible 'thingness'" and at the same time with "the puzzle of life itself." Once alive but no longer yet perhaps somehow imbued with the stuff of life still, relics can provide "intimacy . . . with an otherwise remote figure." Kieschnick (2003, 48) has qualified this observation in the case of crystalline *śarīra* on the grounds that they are very often viewed in quite impersonal terms in China, as we have seen. As an intact human body, however, whole-body relics were inescapably personal. Thus they retained their ambiguity and intimacy. Images, too, were objects of fascination in medieval China. Whereas the modern period is saturated with images, they were then still a comparative rarity, encountered primarily in monasteries and other sacred precincts. To medieval visitors to a Buddhist site, holy icons, lifelike but not alive, left a deep impression and were often taken to be endowed with power and agency simply by their own uncanny nature (Kieschnick 2003, 65; see also Dudbridge 1998; Brown 1998). Flesh icons shared images' uncanny visual properties but often added a palpable individuality. Partaking of both relic and image, the flesh icon would have been alluring indeed.

This allure was one reason that whole-body relics, like a famous relic or a numinous image,[14] were an important asset for the institutions that enshrined them. Faure ([1992] 1994) has argued that the mummifications of Huineng and Hanshan Deqing 憨山德清 (1546–1623) played key roles in the fortunes of Nanhua Monastery. Likewise, I have noted elsewhere (Ritzinger and Bingenheimer 2006, 80) that the mummification of the Korean monk Jin Dizang 金地藏 (696–794) played a key role in establishing Jiuhua shan 九華山 as one of China's four great Buddhist mountains and that the mummification of Wuxia 無瑕 (attributed life dates 1513–1623) centuries later transformed his modest temple into Baisui gong 百歲宮, one of Jiuhua's most important monasteries. Sharf (1992, 25–26) sees mummified abbots as stockpiles of charisma that could lend stability to the fortunes of its institution by continuing to attract worshippers and patronage through moments of transition and disruption. We might also view these icons/relics as tokens that achieve effects of distinction identified by Bourdieu (1984). The mummification of a monk and his subsequent lacquering involved considerable time, expense, and expertise. The resultant relic-image was thus testament not only to the monk's holiness but also to the clout and prestige of the institution that undertook it. Small wonder that these valuable assets were often subject to contestation and even theft.[15]

Conclusions

In subsequent centuries, the mummification of monks and their worship as whole-body relics continued to be a significant, though far from universal, practice. The sacred mountain Jiuhua shan 九華山 became an important center, enshrining eight mummies at its height, and as late as the seventeenth century we find three of the four "great master of the late Ming" being mummified (Ritzinger and Bingenheimer 2006, 79–81). Yet by the Qing dynasty

(1644–1912), a saturation point may have been reached.[16] While the Qing court bestowed an elegant posthumous title on one flesh icon, "the Buddha who gazes upon the river" (*wangjiang fo* 望江佛), another received the dismissive "Yet another buddha" (*you shi fo* 又是佛) (Yetts 1911, 716), suggesting that the distinction conferred by a whole-body relic had diminished. No eminent monk of the Republic of China (1912–1949) was mummified, and over the course of the Cultural Revolution most flesh icons met the same fate as their metal and wood compatriots.[17] The practice continues in Taiwan today but is rather marginal (Gildow and Bingenheimer 2005) and has been revived in the People's Republic but likewise seems to be the preserve of relatively unknown figures (see figs. 1–4).

Yet these flesh icons—blurring the gap between life and death, between sign and signifier—nevertheless remain objects of fascination. As the minor 2015 stir caused by the flesh icon exhibited and subjected to a CT scan in the Netherlands demonstrates,[18] we today no less than Chinese Buddhists a millennium ago are subject to the allure of this compelling combination of relic and image.

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Notes

1. This term can be found online in contemporary usage and also appears in the sixteenth-century travel account included in the Ming dynasty *Gazetteer of Mount Tiantaí's Otherworldly Precincts* (Tiantaí shan fangwaì zhì 天台山方外志) in reference to the mummy of a certain Master Rong 榮師. Du 1980–94, BETA GA90, 89: 771a8.
2. Much of this section has been discussed at greater length in Ritzinger and Bingenheimer 2006.
3. First posited by Andō 1961, 162–67. See also Sharf 1992, 7–8.
4. Or at least appear to. While the lacquered remains of Huineng are enshrined to this day, they are said to have turned to dust within his lacquer shell, necessitating repair and reinforcement. Xu 1987, 50–51.
5. The remains of Daoxìn purportedly survived all the way down to the early twentieth century when the reformist master Taixu (2006, 2:158) claimed to have seen them, though he reports that they were subsequently destroyed by the Communists.
6. Foulk and Sharf (1993, 168) have speculated that lacquer images emerged as a substitute for failed mummies. Yet Strahan (1993, 107) states that buddha images were being produced with lacquer as early as the end of the Han dynasty (206 BCE–220 CE), well before the seventh-century lacquering of Daoxiu and Daoxin's mummies. Nevertheless, Foulk and Sharf are certainly correct that there was a long-standing connection between portraits and tomb cults. This connection perhaps did make the lacquering and enshrinement of whole-body relics a more natural step.
7. As Sharf (1992, 10) points out, given that the biography of Huineng is a later construction, the mummy may well not be that of Huineng himself. Nevertheless, it was produced or procured to play that role.
8. The attentive reader will notice that Zanning only mentions two of the three. It seems likely that discipline was left implicit for the sake of a euphonious four-character phase: *dìng huì suǒ xún* 定慧所熏.
9. Xuyun famously became enamored of this relic and its transformations, though its status as a relic of the Buddha did hold importance for him as well. Luk 1988, 41–44.
10. Additionally, in the case of a Chan abbot's portrait, a self-eulogy was inscribed in his own hand in order to enliven the image. Foulk and Sharf 1993, 200.
11. Faure (1991, 159) makes a similar point about the "iconization" of mummies but does not stress their aesthetic qualities.
12. In the contemporary period, the relics of Taìxu are said to have multiplied. Ritzinger 2017, 274n24.
13. Elsewhere I mistakenly stated that Sengqie was not lacquered. Ritzinger and Bingenheimer 2006, 74.
14. The "naturally formed" image of the white-robed Guanyin once enshrined at Upper Tianzhu Monastery and the "Guanyin who refused to leave" (*bù kěn qù Guānyīn* 不肯去觀音) on Putuo shan are good examples of the latter. Yü (1992) 1994.
15. Contestation surrounded the enshrinement of Sengqie and Wuliao (Faure 1991, 161) as well as Huineng and Hanshan (Faure [1992] 1994, 175–76). Theft of crystalline *śarīra*, in contrast, seems to have been rare. Given their visually ambiguous presentation and imputed powers of multiplication, theft was likely unnecessary.
16. In a much-quoted passage, Prip-Møller (1967, 179) wrote in the early twentieth century that whole-body relics were "found frequently in Central China and could almost be said to abound in Sichuan."
17. When visiting Fenghua 奉化 in 2015, for example, I was told that the whole-body relic of Budaì 布袋, which had been enshrined in Zhongta Chan Monastery 中塔禪,寺, had been destroyed by Red Guards.
18. It is rare, after all, for Buddhist images to receive coverage in the *Washington Post* (Winter 2015) and on CNN (Ng 2015). Subsequently, it emerged that the mummy had been stolen from its village temple in Fujian before being sold to the Dutch collector. Liu 2017.

References

Andō Kōsei. 1961. *Nihon no miira* [Japanese mummies]. Tokyo: Asahi Shinbunsha.

Bourdieu, P. 1984. *Distinction: A social critique of the judgment of taste*. Cambridge, Mass.: Harvard University Press.

Brown, R. L. 1998. Expected miracles: The unsurprisingly miraculous nature of Buddhist images and relics. In *Images, miracles, and authority in Asian religious traditions*, ed. R. H. Davis, 23–36. Boulder, Colo., and Oxford: Westview Press.

Du Jiexiang, ed. 1980–94. *Zhongguo fo si shi zhi huikan*. Taipei: Mingwen shuju. Abbreviated GA.

Dudbridge, G. 1998. Buddhist images in action: Five stories from the Tang. *Cahiers d'Extrême-Asie* 10: 377–91.

Faure, B. 1991. *The rhetoric of immediacy: A cultural critique of Chan/Zen Buddhism*. Princeton: Princeton University Press.

Faure, B. (1992) 1994. Relics and flesh bodies: The creation of Ch'an pilgrimage sites. In *Pilgrims and sacred sites in China*, ed. S. Naquin and C. Yü, 150–89. Taipei: Southern Materials Publishing.

Foulk, G., and R. H. Sharf. 1993. On the ritual use of Ch'an portraiture in medieval China. *Cahiers d'Extrême-Asie* 7: 149–219.

Gildow, D., and M. Bingenheimer. 2005. Buddhist mummification in Taiwan: Two case studies. *Asia Major*, 3rd ser., 15 (pt. 2): 87–127.

Kieschnick, J. 2003. *The impact of Buddhism on Chinese material culture*. Princeton: Princeton University Press.

Liu, Z. 2017. Will the god win? The case of the Buddhist mummy. *International Journal of Cultural Property* 24: 221–38.

Luk, C., trans. 1988. *Empty cloud: The autobiography of the Chinese Zen master Xu Yun*. Shaftesbury, England: Element Books.

Ng, N. 2015. Scan reveals 1,000-year-old mummified monk hidden in statue. Aired 27 February on CNN. https://www.cnn.com/2015/02/27/asia/mummified-monk-statue/index.html.

Prip-Møller, J. 1967. *Chinese Buddhist monasteries: Their plan and function as a setting for Buddhist monastic life*. 2nd ed. Hong Kong: Hong Kong University Press.

Ritzinger, J. R. 2017. *Anarchy in the pure land: Reinventing the cult of Maitreya in modern Chinese Buddhism*. New York and Oxford: Oxford University Press.

Ritzinger, J., and M. Bingenheimer. 2006. Whole–body relics in Chinese Buddhism: Previous research and historical overview. *Indian International Journal of Buddhist Studies* 7: 37–94.

Schopen, Gregory. 1997. *Bones, stones, and Buddhist monks: Collected papers on the archaeology, epigraphy, and texts of monastic Buddhism in India*. Honolulu: University of Hawai'i Press.

Sharf, R. 1992. The idolization of enlightenment. *History of religions* 32(1): 1–31.

Sharf, R. 1999. On the allure of Buddhist relics. *Representations*, no. 66: 75–99.

Strahan, D. K. 1993. The Walters Chinese wood-and-lacquer Buddha: A technical study. *Journal of the Walters Art Gallery* 51: 105–20.

Strahan, D. K. 2010. Creating sacred images of the Buddha: A technical perspective. In D. P. Leidy and D. Strahan, *Wisdom embodied: Chinese Buddhist and Daoist sculpture in the Metropolitan Museum of Art*, 27–46. New York: Metropolitan Museum of Art.

T. = Takakusu Junjirō and Watanabe Kaigyoku, eds. 1924–34. *Taishō shinshū Daizōkyō* [Taishō Revised Tripitaka]. 100 vols. Tokyo: Taishō Issaikyō Kankōkai. All citations to the Buddhist canon refer to the Chinese Buddhist Electronic Text Association (CBETA) edition, www.cbeta.org.

Taixu. 2006. *Taixu dashi quanshu* [Collected works of Master Taixu], ed. Yinshun 印順. In *Yinshun fashi foxue zhuzuo ji* [Master Yinshun Corpus]. CD-ROM, version 4.0. Taipei: Yinshun wenjiao jijinhui.

Welch, H. 1967. *The practice of Chinese Buddhism, 1900–1950*. Cambridge, Mass.: Harvard University Press.

Winter, M. 2015. Buddha statue reveals remains of mummified monk inside. *Washington Post*, 24 February.

Xu Hengbing. 1987. Nanhuasi liuzu Huineng zhenshen kao. [A study of the true body of the sixth patriarch Huineng in Nanhua Monastery]. *Journal of the Institute of Chinese Studies of the Chinese University of Hong Kong* 18:47–68.

Yetts, W. P. 1911. Notes on the disposal of Buddhist dead in China. *Journal of the Royal Asiatic Society of Great Britain and Ireland* 43(3): 699–725.

Yü, C. (1992) 1994. P'u-t'o shan: Pilgrimage and the creation of the Chinese Potalaka. In *Pilgrims and sacred sites in China*, ed. S. Naquin and C. Yü, 190–245. Taipei: Southern Materials Publishing.

Yü, C. 2000. *Kuan-yin: The Chinese transformation of Avalokiteśvara*. New York: Columbia University Press.

Body Relics in Tibetan and Mongolian Traditions

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ABSTRACT In Tibet, the range of practices for disposing of the deceased has included sky, earth, water, and stupa burial, as well as cremation and very limited mummification. Earth burial, cremation, and placing mummified bodies within a stupa are all reported for Mongolia, with mummification again rare. In both regions, mummification was practiced only for very high-ranking incarnate religious persons. Some instances of body preservation in Tibet (for infants) and Mongolia (for elite burials) without religious connotation are also found but not considered to create body relics. In addition to whole-body relics, relics of association or contact (such as clothing or any objects used by or associated with a monk or teacher), or the bone fragments and ashes resulting from cremation, can be incorporated into religious objects as part of a consecration ceremony. Ethnographic research is the best vehicle for fully understanding the variation in local burial traditions, consecration practices, and the context of relics.

Context of Body Relics within the Burial Traditions of Tibet and Mongolia

Before looking at the appearance and use of body relics, it is useful to examine their overall context within the burial traditions of Tibet and Mongolia. In Tibet, when a person dies, the first and most important step is to bring in one or more religious teachers or monks to assist the person in peacefully leaving the corpse and finding the way toward a good rebirth or reincarnation. Tibet is most famous for its unusual practice of sky, or celestial, burial. This involves disposing of a corpse, with elaborate preparation and procedures and in a special area, to be consumed by vultures or other carrion (Ronge 2004). It is perhaps the most widely accepted and commonly practiced method of disposing of the dead, especially in pastoral areas. Various explanations for this practice include the ideas that feeding corpses to birds provides an opportunity for good deeds, that it is environmentally beneficial, and that it does not require digging into the earth or taking land out of cultivation (Blo rtan rdo rje 2008). It has also been noted that in many places in Tibet wood is scarce, so cremation could be difficult, and the same problem is often encountered with a lack of available land suitable for burial (Horne 1872–73). The origin of sky burial is sometimes attributed to the last wish of an eleventh-century tantric master in Lhasa (Blo rtan rdo rje 2008). However, the history of this practice is unclear, and it seems to occur according to local customs and preferences rather than to any actual environmental factors (Martin 1996). Often after the flesh has been consumed, the bones are pulverized (or sometimes burned), then mixed with barley flour and yak butter, made into balls or other shapes, and left to be consumed by birds (Rockhill 1891; Losel 1991; Martin 1996). Should vultures not appear at all—a bad omen—the remains of the corpse are returned to the village for cremation (Blo rtan rdo rje 2008).

However, other modes of burial are also practiced, and there is great variation depending on region and local customs. The most common of these varying practices include earth burial (interment in the ground), water burial (placing the body in a river or stream), cremation, and whole-body preservation. Cremated remains and a preserved or desiccated body may sometimes be placed inside a large *mchod rten*, a reliquary structure serving as a Buddhist shrine or monument (stupa) (Wylie 1964–65; Gelek 2002; Li and Jiang 2003) (fig. 1).

Earth burial is thought to be the earliest funeral practice in Tibet, pre-dating the introduction of Buddhism, based on findings from Neolithic archaeological excavations; the burial mounds of the early kings of Tibet are also well known (Tucci 1950; Kvaerne 1985; Snellgrove and Richardson 1989; Cutler 1991; Wang et al. 2005). Earth burial is still practiced in some Tibetan regions, with much variation. Sometimes a body is buried or placed under a pile of stones, with no coffin, in an isolated place. Losel (1991) describes a wide range of earth burial practices. These include the use of a wooden coffin or a basket as coffin; interment in a family burial ground or a local cemetery; graves with or without a mound of earth built up over them; various mechanisms for marking the location of the grave; and graves built as a cave into the side of a hill with the opening closed by stones and mud and marked with decoration.

Water burial has been said to be a simple method for the poor to dispose of a body, by placing it in a river or stream (Rockhill 1891). It is also a practice in areas lacking access to vultures or other carrion. While there are religious rituals associated with water burial, these tend not to be as

Figure 1. *Tibetan Buddhist* mchod rten*, Aba Tibetan and Qiang autonomous prefecture, Sichuan province, China.*

Figure 2. Tsha tshas *in the form of miniature mchod rten (from various time periods) left along a ledge in the earliest shrine room of Kangwu Monastery, Muli Tibetan autonomous county, Sichuan province, China.*

extensive as with sky burial. As with earth burial, there is much local variation in the practices associated with water burial. For example, the body may be placed into the river while in a basket; the basket used to carry the body to the river may be thrown in separately, after the body; the body may be dismembered before being placed into the river; or it may be buried in a hole in the river bottom and covered by stones (Losel 1991). In some villages, if a child under age seven dies, no religious activities are conducted, and the body is wrapped with a new thin white cloth to be placed by male relatives into a river as a food offering to water creatures (Blo rtan rdo rje 2008).

Cremation is another funeral practice seen in Tibetan areas where wood is more abundant or where the practice is simply preferred over sky burial. The cremation itself is usually accompanied by a complex religious ritual (Kvaerne 1985). Depending on local custom, the ashes might be left in place, spread over a mountain summit or a river, or buried in the earth or under a rock. For important religious teachers, the bodies are rubbed with butter before cremation (Blo rtan rdo rje 2008). The ashes of the cremated body (or the cremated remains of the body that has first been preserved for a few months) may be placed directly in a *mchod rten* (Losel 1991). Sometimes the ashes and bone remnants are mixed with clay and made into *tsha tsha*s, small votive clay objects that usually depict deities or miniature *mchod rten*. Depending on who the deceased person was, the *tsha tsha*s are deposited into a larger *mchod rten* or a small building constructed for that purpose, or they may be placed in rivers or on mountain ledges, in caves, on ledges in temples or shrine rooms, or around prayer wheels (fig. 2). Preservation of an intact desiccated body is reserved only for certain high-ranking individuals. It involves mummification or preservation of the body, which is then placed inside of an elaborate *mchod rten* to be honored (Wylie 1964–65; Gelek 2002; Li and Jiang 2003).

As Losel (1991) emphasizes, there is great variability in burial practices in Tibetan areas. The type of burial and the associated funeral practices depend on local customs, ideas, beliefs, and environmental conditions. Sometimes multiple burial types are practiced in sequence: burial in the ground, followed by disinterment at a later date for cremation; cremation followed by placing the ashes in the ground, or in a river, or by mixing them with barley flour and leaving them for birds to consume; or sky burial followed by burning the bones and burying the ashes. Variation in single locations may be due to differing practices depending on the age of the deceased, or the best burial form for a particular individual may be selected through some form of cosmological calculation.

In Mongolia, earth burial and cremation are the most common funeral practices. However, mummification for placement of the body within a stupa is also known for the highest-ranking religious teachers.

Whole-Body Mummified Relics in Tibetan Buddhism

Whole-body relics are uncommon but do appear as a Buddhist practice in Tibet and Mongolia, specifically for the purpose of relic worship. The main purpose of relics is to aid practitioners in their devotion and spiritual growth (Ritzinger and Bingenheimer 2006; Loseries-Leick 2008). The presence of a preserved body would be an expression of compassion, to provide a very revered object that can help practitioners earn merit through offerings or through contemplating the enlightened qualities of the teacher and trying to emulate them (Gouin 2010).

Mummification in Tibet, with a preserved body placed in an elaborately decorated *mchod rten*, was reserved for certain high-ranking religious figures, primarily the Dalai Lamas and the Panchen Lamas. There were several different ways in which the body could be prepared for placement in the *mchod rten* (Wylie 1964–65; Li and Jiang 2003; Loseries-Leick 2008). For example, the body may first be cleaned and perfumed and then placed in a container filled with salt. After three to four months, the corpse is desiccated. Afterward, the used salt lumps were highly valued and considered able to expel disease and bad luck. An alternative method of preserving a body was to bury it in very dry sand for about three years, so that the sand can pull out all body fluids. Yet another method was to slowly bake the body in a room with a stove under a specially prepared floor. However the body was dehydrated, it was then covered with perfumed oil and thin sheets of gold. It has been reported (Li and Jiang 2003) that upon the death of the Tenth Panchen Lama in 1989, 500 kilograms comprising 108 species of rare medicinal herbs (saffron, borneol, etc.) were used in preparation of the body. The final step was to dress the body and move it into a *mchod rten* made of precious metals such as gold and silver and covered with jewels and other ornaments, for long-term preservation and worship within a monastery or temple. Sometimes after desiccation of the body was complete, artists would reconstruct the outer appearance of the deceased teacher, using clay and paint, leaving a sculpture-like mummy that greatly resembles the former living person, and this was placed into a *mchod rten*.

A short Tibetan treatise on how to prepare the corpse, written at the time of the death of the Thirteenth Dalai Lama (1933), gives some details on one variation of the process that was used in Tibet (Uebach and Vogliotti 2005). The corpse was first dried by placing it into a container and completely covering it with salt for about one year, with the salt renewed regularly. The interior of the body was cleansed with mercury as a purgative. A large quantity of mercury was poured into the mouth until milk flowed through the body unaltered. The prepared corpse was wrapped in silk and then covered with a thin layer of lime mixed with ground precious stones and herbs. The face, hands, and feet were then covered with liquid gold over the lime crust. The last step was to paint the eyes, as part of the "opening of the eyes" consecration ceremony.

The desiccated remains of the Fifth and Seventh through Thirteenth Dalai Lamas are housed in *mchod rten* in the Potala Palace in Lhasa. The Potala itself is an architectural masterpiece (fig. 3) that was built during the reign of the Fifth Dalai Lama (1642–82), to serve as his main residence and administrative headquarters, to house his personal monastery, and to serve as the place of burial of Dalai Lamas (Larsen and Sinding-Larsen 2001). The *mchod rten* housing the Great Fifth is 60 feet high, with a framework said to be made of solid silver, covered with plates of gold that are studded with diamonds, sapphires, and other precious stones, giving it the name "Ornament of the World." All subsequent Dalai Lamas (except for the Sixth, who died in eastern Tibet) are also housed in the Potala, although their *mchod rten* were generally built on a smaller scale (Wylie 1962). Nonetheless, the funerary *mchod rten* of the Thirteenth Dalai Lama, the last one made (in 1934), is still 46 feet tall and coated with 590 kilograms of gold and with the precious stone inlays worth ten times the value of the gold that was used (Ma 2003). Raised ornamented golden roof covers mark from above the locations of the Dalai Lama funerary chapels inside the building below (fig. 4).

The mummified remains of former Panchen Lamas were installed at Tashilunpo Monastery (Hedin 1910). These are also in the form of tall *mchod rten* made of gilded copper ornamented with turquoise and coral, each housed in a dedicated chapel. Each is topped by a statue of the deceased Panchen Lama and surrounded by wall paintings and by *thangka*s representing scenes from the lives of members of the lineage. Offerings from visitors are placed near the front.

Two mummifications with *mchod rten* burial have been reported at Sakya (Sa skya) Monastery, where their remains were housed in *mchod rten* within temples there (Wylie 1964–65). One is for the founder of the monastery, Dkon mchog rgyal po, who died in 1102, and the other is for a member of the lineage who died in the early seventeenth century, 'Khon 'Jam dbyangs bsod nams dbang po (1559–1621). All other members of the 'Khon-rig lineage of the Sakya ruling family were cremated (Wylie 1964–65). After cremation, the bones were pulverized and mixed with medicinal substances (most important, myrobalan, a fruit-bearing plant). The resulting particles, as well as

Figure 3. *The Potala in Lhasa houses the funerary* mchod rten *of the Fifth and Seventh through Thirteenth Dalai Lamas.*

Figure 4. *Raised ornamented golden roof covers on the Potala mark from above the locations of the Dalai Lama funerary chapels inside the building below.*

the remainder of body ashes, were then mixed with clay and made into thousands of *tsha tsha*s. These were then placed into a large (typically 10 feet in height) *mchod rten* of gilded copper within a temple at Sakya Monastery. For lesser-ranked members of the ruling family of Sakya, the *tsha tsha*s might be placed in the river or in the mountains surrounding the monastery.

Bell (1928) reported seeing, at a monastery north of Lhasa, the mummified body (not housed in a *mchod rten*) of an Indian teacher who had traveled to Tibet to help spread Buddhist teachings. A wooden frame covered the lower part of the body, and the upper body was wrapped in cloth. Bell also reported that at another monastery, a *mchod rten* housed the mummified body of the mother of the man who had rebuilt Talung Monastery after its destruction by fire.

It has been proposed that one of the earliest places for the practice of preserving whole-body relics in Buddhism was Mongolia and other parts of Central Asia, where the very

Figure 5. *Flat* tsha tshas *featuring deity images, made in the workshop of Tsukpo Tsephel, Dharamsala, India.*

dry climate could create the conditions for natural mummification (Ritzinger and Bingenheimer 2006). Indeed, funerary stupas enshrining the mummies of great lamas and reincarnations were considered in Mongolia to be precious relics that turned a monastery into a local pilgrimage center. For example, a dozen monasteries linked to Öndör Gegeen Zanabazar, the supreme spiritual authority of the Gelugpa lineage of Tibetan Buddhism in Mongolia (who lived from 1635 to 1723 and was a renowned sculptor and bronze caster), are said to enshrine some of his relics and those of his reincarnations (Charleux 2015). Hence they attracted pilgrims from all over Mongolia. He died while on a visit to Beijing at age 88 and was embalmed there. The body was returned to Mongolia to complete the mummification process.

It was also said that the Sixth Dalai Lama, who died outside of Central Tibet, was mummified and enshrined in the Baruun Kheid Monastery of Inner Mongolia (Charleux 2015), which was built by one of his disciples. It has not been confirmed, however, that this was actually the mummy of the Sixth Dalai Lama, and the mummy is said to have been destroyed during the Cultural Revolution. Earth burial and cremation were the primary means of disposing of a corpse in Mongolia; the cremated remains of incarnate lamas were usually buried in a stupa. However, the most high-ranking lamas were sometimes mummified.

Pozdneyev (1978) discusses in detail the burial of reincarnated lamas in Mongolian Buddhism. Some were cremated in an elaborate procedure. The ashes were then mixed with clay and used to make small statues that were placed in a specially built chapel at the burial site. Sometimes it was considered important to preserve the body in the form of a mummy. In those cases, after initially rubbing the body with perfumed liquids, salt was piled over the entire body. After about two months the body would be completely dry. It was then clothed, the face gilded, and the eyebrows, mustache, and lips ornamented with designs, while the eyes were left shut. This body relic was then placed in a shrine and became an object for honor and worship.

There also seems to be a tradition in Mongolia of body preservation in burial for the elite. For example, Zhukovskaya (1991) discusses some tombs of Mongolia prior to the 1921 revolution. These range in date from the late eighteenth to the early twentieth century and are associated with evidence that Tibetan Buddhism was practiced in this location. The bodies were placed on top of aromatic juniper branches in wooden sarcophagi within huts constructed on stone foundations. The bottom of the sarcophagus was covered with juniper, and the remainder of the space within it was filled with rock salt. Salt was known to be a good preserver, and it is speculated that the goal was to preserve the corpse in an intact state, so this was not mummification to create a body relic.

An interesting exception to reserving desiccation for certain very high-ranking incarnate religious teachers is also seen in a few places in Tibet (Wylie 1964–65). In the past in Lhasa, if an infant died in the first year, the body was sometimes desiccated, but in a manner different from that used for mummification of religious persons. The corpse was placed in a clay pot and suspended from the ceiling of the ground floor of its parents' home. Desiccation occurred over about eight to nine months through contact with the dry air. The mummified body was then cremated, and the ashes were used in the making of clay *tsha tsha*s, which were then left on mountain ledges near Lhasa. The clay pot was disposed of and not used again. A similar practice occurred at Sakya, but only for the first-born child of a ruling house who died in infancy. The corpse was placed in a silver urn and covered with salt. The urn was then covered with a lid and left in a ground floor storeroom indefinitely. This procedure was thought to ensure that the mother could bear more children and hence ensure continuation of the ruling lineage.

Figure 6. *A small* mchod rten-*shaped* tsha tsha *is made in Dharamsala by pressing wet clay into a metal mold that was first rubbed with vegetable oil to serve as a release agent. The finished object will be dried in the sun rather than fired.*

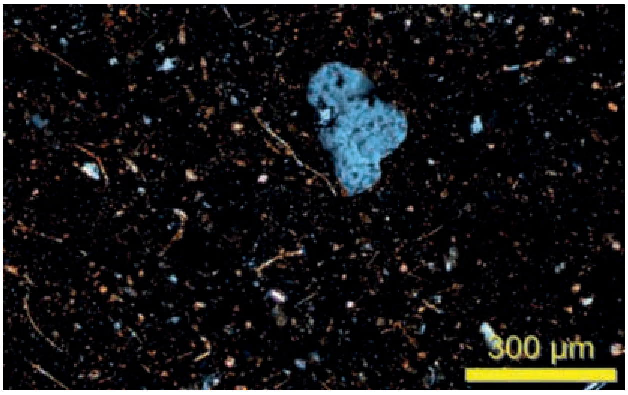

Figure 7. *The sandy clay of this porous, unfired* tsha tsha *contains many small, elongated fibers that can be seen with optical microscopy (crossed polarized light image of a thin section; the large gray grain in the center is quartz).*

Salt was also sometimes used simply for temporary preservation of a corpse in Tibet (Rockhill 1891). Temporary preservation might be necessary if death occurred at a time when it was inconvenient or impossible to perform either cremation or sky burial rites, for example, near to the time when crops had to be harvested. In these cases, the corpse might be placed in a basket and covered with salt until it was possible to perform the funeral rites.

Uses of Body Relics

Tsha Tshas

As previously mentioned, ashes or bone fragments of important teachers were sometimes mixed with clay and used in the production of flat *tsha tsha*s with deity images (fig. 5) or miniature clay *mchod rten* (see fig. 2). Relics are defined as any piece of the material body (a tooth, bone, dried flesh, or crystalline remnant of cremation) or material items associated with the venerated person (such as clothing or other possessions). Germano and Trainor (2004) note that in the Tibetan Tantric tradition of the Great Perfection, body relics of a saint are associated with the presence of Buddha-nature within all living beings and thus need to be seen within the broader context of a contemplative practice. Strong (2004) also emphasizes that the purpose of bones and other relics is not just to memorialize the dead teacher but to provide continuing opportunities for enlightenment: contemplating various stages of decomposition of the corpse helps one to understand the impermanence of a person's physical form.

*Tsha tsha*s are small (usually less than 25 cm) clay objects that are made by stamping wet clay or by pressing it into wooden or metal molds (fig. 6). The objects are usually sun dried rather than fired. Many have images in relief that may include one or more deities, religious teachers, or shrine depictions; sometimes they take the form of small, three-dimensional *mchod rten* images. They often include Sanskrit or Tibetan inscriptions, sacred syllables, or mantras. Decorative paint is sometimes applied to the surfaces. *Tsha tsha*s can have a variety of functions including symbolizing the body, mind, or essence of the Buddha; serving as consecrated relics to increase the holiness of a sculpture or building within which they are sealed during a consecration ceremony; creating an inexpensive way to develop a pantheon (set of standards showing how to correctly depict or identify the many deities of Tibetan Buddhism); providing an inexpensive religious image affordable by ordinary people; serving as portable images for nomadic herders or traveling merchants; providing souvenirs of visits to pilgrimage sites; and functioning as a memorial for a deceased teacher (Tucci 1988; Li 1995; Reedy 2006). In addition, the creation of *tsha tsha*s can itself be performed as a meditation practice, and good karma is considered to accrue to anyone who commissions the making of *tsha tsha*s.

It is often reported that the sandy clay used to make *tsha tsha*s can incorporate the ashes or bits of bone from a deceased holy person, although such *tsha tsha*s would usually be placed in a *mchod rten* or other holy place in contrast to the more widely available ordinary *tsha tsha*s. However, materials such as fibers have been found in some analyzed *tsha tsha*s (fig. 7); it is possible that these items had some significance to a particular teacher, but that can only be speculation.

Figure 8. *Tsukpo Tsephel makes* mchod rten*-shaped tsha tshas at his workshop in Dharamsala. Cut-up animal fur can be seen in the bowl in front of his work station.*

However, without direct ethnographic knowledge, the association of a particular material found inside a *tsha tsha* cannot be related to a specific holy person. For example, cut-up animal fur was added to a group of *tsha tsha*s recently made in Dharamsala (fig. 8). If encountered in later material analysis of the *tsha tsha*s, the fur would be a puzzling find. The head craftsman in this workshop, Tsukpo Tsephel, said that on this occasion he was making 1,008 *mchod rten*-shaped *tsha tsha*s for the Tibetan government-in-exile. To make them especially sacred, he chose to incorporate cut-up animal fur, placing it in a hollow he formed in the bottom center of each small *mchod rten* (fig. 9). He considered this animal fur material to be sacred because of the reason it was collected. Recently, the Dalai Lama asked nomadic Tibetans to stop wearing fur, for the sake of compassion for the endangered wild animals of Tibet. Fur clothing had become fashionable in Tibet, much more than in the past, some say because of Chinese and Western influences. Yet the greater modern availability of clothing made from synthetic materials means that the wearing of animal fur is no longer necessary. Cutting up the fur garments and sending them to the Dalai Lama was therefore one way of quietly

Figure 9. *A hollow is formed in the bottom center of each clay* mchod rten*, and pieces of animal fur are stuffed inside. These are considered to be relics associated with the current Dalai Lama and carrying great spiritual power because they are from old fur garments cut up by nomads and sent to Dharamsala in response to the Dalai Lama's call to cease wearing fur for the sake of compassion for the endangered wild animals of Tibet.*

Figure 10. *A wide range of body relics and relics of contact have been found inside consecrated statues opened in museums or by collectors, but these objects can rarely be interpreted well enough to provide additional information about the statue, and since opening the statue desecrates it, opening is extremely ill advised.* **a.** *Walnuts wrapped in burlap were removed from a bronze portrait of Lama Lodrö Wangchuk.* **b.** *Paper scrolls filled with mantras were stuffed inside this statue of Padmasambhava.* **c.** Tsha tshas *in the shape of* mchod rten *that were wrapped in burlap were removed from a statue of Nairātmyā.*

expressing devotion and the idea of compassion that is so central to Tibetan Buddhism. Thus these fur remnants are seen by Tsukpo Tsephel as carrying great spiritual power, and they are also strongly associated with the current Dalai Lama.

Ashes and Bones as Consecrated Relics

Ashes and bone fragments are not only used to make *tsha tsha*s; they are also inserted into copper alloy statues or small metal *mchod rten* during a consecration ceremony (Reedy 1991). Before a sculpture can be used, a consecration ceremony first purifies it and makes it suitable for habitation by the Buddha or a deity, who is then invited to enter the object. Materials of a wide variety may be inserted during this ceremony—whatever is deemed suitable for the particular situation—to increase the holiness of the statue. When those objects are sealed into the statue by a baseplate, the deity itself is also sealed inside, making the statue a living representative of the Buddha and now a holy object that must be treated with great respect. Only relics from a high-ranking teacher or monk would receive this treatment (Bentor 1995), and these may include not only body relics but also "relics of contact"—objects associated with the individual and that he or she once used (Bentor 2003).

Because of this wide range of body relics and relics of contact that might be chosen for insertion into statues, *mchod rten*, or shrines, Western collectors or museum staff who have opened consecrated objects have not been able to fully interpret the findings. The result is a desecration of the sculpture, and opening it is quite ill advised. In the words of one Tibetan teacher, opening a statue for the sake of art-historical or scientific study is like "tearing out the guts of a living being" (quoted in Reedy 1991, 32). Imaging techniques may help to clarify some of the contents without disturbing them. However, fully interpreting the wide range of body relics that might be found is difficult, and that task is even more complicated for relics of contact. For example, pieces of bone, charcoal (which may be from a cremation), bone powder, ashes, skull fragments, teeth, and hair have all been found inside Tibetan sculptures that were opened in museums, along with *tsha tsha*s and a wide range of small objects such as burlap-wrapped walnuts and pieces of cloth that may be relics of contact or simply items associated with a particular teacher (Reedy 1991) (fig. 10). Few of these objects provided information that could help to date the statue or pinpoint a place of production more precisely than stylistic methods could, or even identify who was intended to be honored. Bentor (2003) has rightly argued that the best way to gain more information about consecration ceremonies and objects inserted in statues is through ethnographic study, where one can observe the entire process as it occurs and ask questions.

In Mongolia, too, body relics of a holy lama were used as objects of worship, to make that sacred person more present. Humphrey and Ujeed (2013) describe the effort to bring the cremated remains of the Eighth Mergen Gegen into his monastery, the Mergen Monastery in Inner Mongolia. Through a ritual, the ashes changed from being a human relic into a god, as prayers were chanted to animate the ashes and they were placed in a small brass stupa and ultimately into the Temple of Relics in the monastery. The woman who had been caring for the Gegen when he died retained a tooth, and this and other objects that had been in contact with him were placed into a second small brass stupa for worshipping at a shrine she set up in her home.

Conclusions

While mummification was sometimes practiced in Tibet and Mongolia, the practice was rare, and mainly reserved for a few categories of individuals. Preserved body relics of high-ranking incarnate Buddhist teachers were placed in *mchod rten* made of precious metals and ornamented with precious and semiprecious stones. These *mchod rten* were in turn placed as a shrine within a temple. More common was cremation of a revered monk or teacher. The resulting ashes and bone fragments were often mixed with clay and made into *tsha tsha*s that were usually placed inside a small *mchod rten* and housed in a shrine or distributed to sacred places. Occasionally, remnants of a cremation were placed directly in small *mchod rten* or metal statues. These were likely originally placed on an altar or in a monastery shrine room. Some of these sacred relics have been disturbed or disappeared over time due to political events and modern collecting practices. While some written texts provide contextual information, the best way to understand current (and past) practices regarding consecrated relics is ethnographic observation when possible. There is much more we can learn about both Tibetan and Mongolian body relic ideas and practices.

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References

Bell, C. 1928. *The people of Tibet*. Oxford: Clarendon Press.

Bentor, Y. 1995. On the Indian origins of the Tibetan practice of depositing relics and dhâraṇîs in stûpas and images. *Journal of the American Oriental Society* 115(2): 248–61.

Bentor, Y. 2003. The content of stūpas and images and the Indo-Tibetan concept of relics. *Tibet Journal* 28(1–2): 31–48.

Blo rtan rdo rje, with C. K. Stuart. 2008. *Life and marriage in Skya rgya, a Tibetan village*. New York: RBK Publishers.

Charleux, I. 2015. *Nomads on pilgrimage: Mongols on Wutaishan (China), 1800–1940*. Boston and Leiden: Brill.

Cutler, N. S. 1991. The early rulers of Tibet: Their lineage and burial rites. *Tibet Journal* 16(3): 28–51.

Gelek, L. 2002. A general introduction to Tibetan culture and religion. *Chinese Sociology and Anthropology* 34(4): 15–31.

Germano, D., and K. Trainor, eds. 2004. *Embodying the dharma: Buddhist relic veneration in Asia*. Albany: State University of New York Press.

Gouin, M. 2010. *Tibetan rituals of death: Buddhist funerary practices*. London and New York: Routledge.

Hedin, S. 1910. *Trans-Himalaya: Discoveries and adventures in Tibet*. Vol. 1. London: Macmillan and Company.

Horne, C. 1872–73. On the methods of disposing of the dead at Llassa, Thibet, etc. *Journal of the Royal Asiatic Society* 6: 28–35.

Humphrey, C., and H. Ujeed. 2013. *A monastery in time: The making of Mongolian Buddhism*. Chicago and London: University of Chicago Press.

Kvaerne, P. 1985. *Tibet Bon religion: A death ritual of the Tibetan Bonpos.* Leiden: E. J. Brill.

Larsen, K., and A. Sinding-Larsen. 2001. *The Lhasa atlas: Traditional Tibetan architecture and townscape*. London: Serindia Publications.

Li Juan. 1995. Images of earth and water: The *tsha-tsha* votive tablets of Tibet. Posted 11 November 1995. *Asian Arts,* http://www.asianart.com/li/tsatsa.html (accessed 9 December 2022).

Li, Tao, and Jiang Hong Ying. 2003. *Tibetan customs*. Beijing: China Intercontinental Press.

Losel, R. 1991. Burial customs in Garze. In *Theses on Tibetology in China*, comp. Hu Tan, 159–81. Beijing: China Tibetology Publishing House.

Loseries-Leick, A. 2008. *Tibetan mahayoga tantra: An ethno-historical study of skulls, bones and relics*. Delhi: B. R. Publication Corporation.

Ma Lihua 2003. *Old Lhasa: A sacred city at dusk.* Beijing: Foreign Languages Press.

Martin, D. 1996. On the cultural ecology of sky burial on the Himalayan plateau. *East and West* 46 (3–4): 353–70.

Pozdneyev, A. M. 1978. *Religion and ritual in society: Lamaist Buddhism in late 19th-century Mongolia*. Trans. Alo Raun and Linda Raun. Bloomington, Ind.: Mongolia Society.

Reedy, C. L. 1991. The opening of consecrated Tibetan bronzes with interior contents: Scholarly, conservation, and ethical considerations. *Journal of the American Institute for Conservation* 30(1): 13–34.

Reedy, C. L. 2006. Multiple functions and multiple histories of Tibetan *tsha-tsha*s (votive clay images). *Studies in Conservation* 51(S2): 144–50.

Rockhill, W. W. 1891. *The land of the lamas: Notes of a journey through China, Mongolia and Tibet*. New York: Century Company.

Ritzinger, J., and M. Bingenheimer. 2006. Whole-body relics in Chinese Buddhism: Previous research and historical overview. *Indian International Journal of Buddhist Studies* 7: 37–94.

Ronge, V. 2004. The corpse cutters of Sera. *Tibet Journal* 29(2): 3–12.

Snellgrove, D., and H. Richardson. 1989. *A cultural history of Tibet*. Boston and London: Shambala Publications.

Strong, J. 2004. *Relics of the Buddha.* Princeton: Princeton University Press.

Tucci, G. 1950. *The tombs of the Tibetan kings*. Rome: Instituto Italiano per il Medio ed Estremo Oriente.

Tucci, G. 1988. *Indo-Tibetica.* Vol. 1, *Stūpa, art, architectonics, and symbolism (mchod-rten and tsha-tsha in Indian and Western Tibet).* Trans. of 1938 Italian ed. by U. M. Vesci. New Delhi: Aditya Prakashan.

Uebach, H., and G. Vogliotti. 2005. A short treatise by Pha bong kha pa (1878–1941) about embalming. *Tibet Journal* 30(2): 3–8.

Wang Renxiang, Zhao Huimin, Liu Jianguo, and Guo Youan. 2005. Tibetan royal tombs at 'Phyongs-rgyas: Investigations and studies. *Chinese Archaeology* 5: 227–32.

Wylie, T. V. 1962. *The geography of Tibet according to the 'Dzam-gling-rgyas-bshad*. Rome: Istituto Italiano per il Medio ed Estremo Oriente.

Wylie, T. V. 1964–65. Mortuary customs at Sa-skya, Tibet. *Harvard Journal of Asiatic Studies* 25: 229–42.

Zhukovskaya, N. L. 1991. The main directions of Soviet ethnographic research in Mongolia in the 1970s and 1980s. *Journal of the Anglo-Mongolian Society* 13(1): 93–104.

Lacquer Sculptures in Japan: The Latest Scientific Report about the *Seated Senju Kannon Bosatsu* of Fujiidera

Mai Sarai

ABSTRACT Buddhism arrived in Japan in the middle of the sixth century, bringing Buddhist sculptural styles and techniques from China and Korea. Buddhist sculptures using the hollow-core lacquer technique were first produced slightly later, in the eighth century, but this technique did not continue after the eighth century. This article describes the current state of research on hollow-core lacquer sculpture in Japan through recent discoveries using large-scale vertically aligned x-ray computed tomography scanners at Japan's national museums.

Introduction

During the Asuka period (552–645), Japanese artisans began to make Buddhist sculptures in gilded bronze and wood, learning from the Buddhist sculpture styles and methods that were brought to Japan from China and the Korean Peninsula. This process began with Japan's first reception of Buddhism and lasted throughout the ancient period. Hollow-core lacquer, known in Japan as *kanshitsu*, was a sculpture style imported from China that became extremely popular in Japan during the eighth-century Nara period (710–94), which was named after the political capital of the day. Later, however, the style was almost never used in Japan.

This article introduces major examples of Japanese hollow-core lacquer and explains the stylistic connections among them. It also reports findings from recent studies using large-scale vertically aligned x-ray computed tomography (CT) scanners at Japan's national museums. The Tokyo National Museum acquired three CT scanners in 2015, and we used these vertically aligned CT scanners—which can take images of large-scale cultural properties measuring up to 2.5 meters in diameter—to examine numerous large-scale cultural properties, including Buddhist sculptures (fig. 1).

One of the masterpieces of Nara period hollow-core lacquer sculpture, the *Seated Senju Kannon*

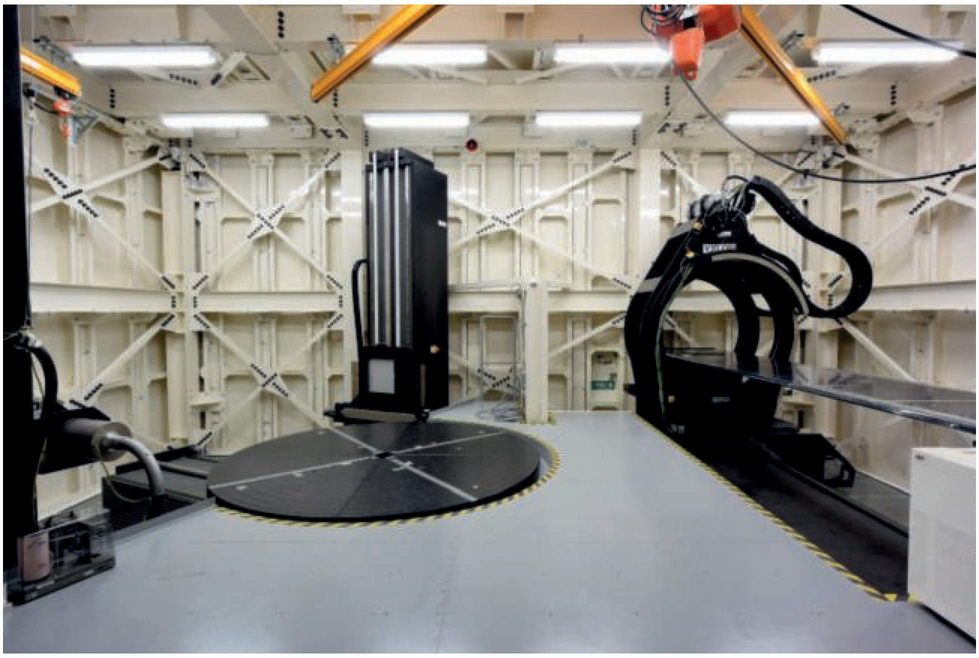

Figure 1. *The vertically aligned CT scanner used in this study.*

Figure 2. *The* Seated Senju Kannon Bosatsu *of Fujiidera Temple, Osaka prefecture.*

Bosatsu in Fujiidera Temple in Osaka (fig. 2), was displayed in the Tokyo National Museum's 2018 exhibition *Treasures from Ninnaji Temple and Omuro: Masterpieces of Tenpyō Art and Shingon Esoteric Buddhism*. This occasion allowed our researchers to take images of the sculpture using the vertically aligned CT scanner.

Hollow-Core Lacquer Sculptures Extant in Japan

Hollow-core lacquer sculptures were made in Japan during the Nara period, which overlapped with the Sui (581–618) and Tang (618–907) dynasties in China. It was a time when Japan adopted Chinese political

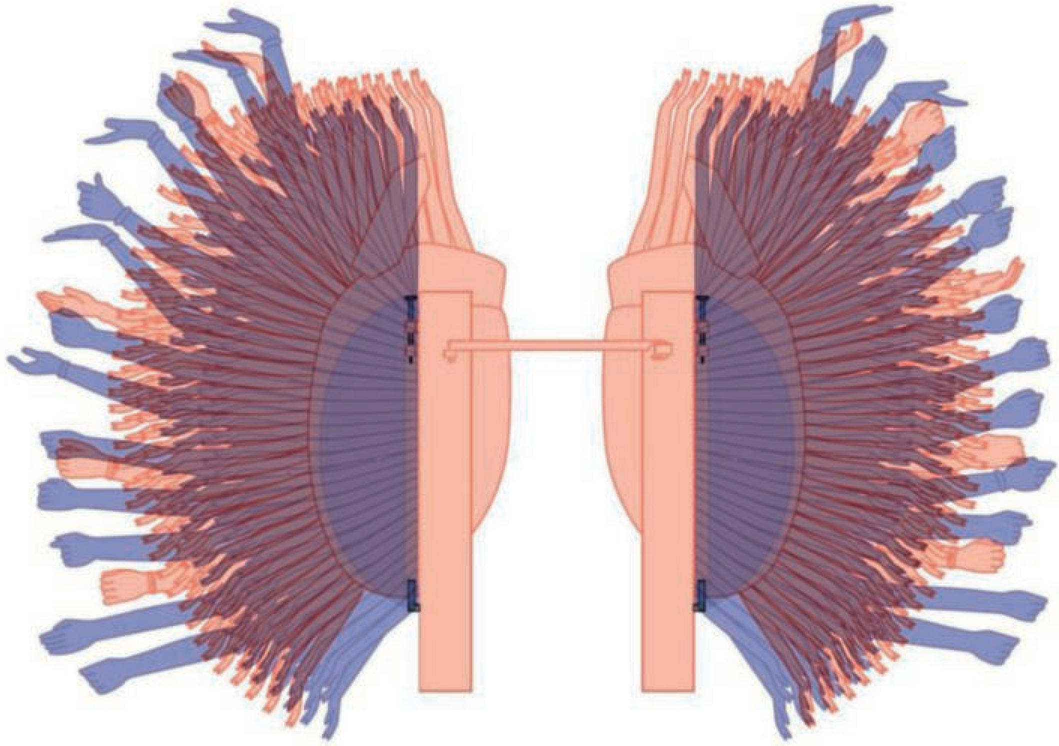

Figure 3. *Drawing showing the rear of the arms. The front arms, in red, are supported by piers that extend into the base on the right and the left side. The back arms, in blue, attach to the front arms. The right and left sets of arms are hooked together at the piers.*

culture and sought to form a nation based on a central authority.

When Buddhist sculptures were first made in Japan, during the Asuka period, gilded bronze images were prevalent. During this same period wooden images were made from camphor wood, known as *kusunoki* in Japanese. In the succeeding Nara period, gilded bronze Buddhist images were still made, while images molded from clay, hollow-core lacquer, and wood-core lacquer also began to be produced. In the latter half of the Nara period, the influence of Jianzhen (688–763), the Chinese priest who helped spread Buddhism in Japan, led to a trend for wooden sculpture. In the Heian period (794–1185), after the capital was moved from Nara to Kyoto, the majority of Buddhist sculptures were made from conifer wood, after which no more hollow-core lacquer images were made.

At present, there are thirty extant hollow-core lacquer sculptures in Japan, plus a few fragments of such sculptures. The oldest examples of Japanese hollow-core lacquer sculptures are the *Eight Legions* (Hachibushū) and the *Ten Great Disciples* (Jūdai deshi) sculptures at Kōfukuji Temple in Nara. These images are enshrined in the Western Main Hall (Saikondō) at Kōfukuji, a structure built by the Shōmu empress in 734 in memory of her mother. One of these sculptures is the deity Ashura, considered the most popular Buddhist deity image in Japan. The thin, lithe figures of these sculptures can be thought to reflect early Tang dynasty Buddhist sculptural style.

While scholars had believed that a succession of sculptures were made in the latter half of the Tenpyō era (729–49), including the Fukōkenjaku Kannon and Shitennō figures in the Lotus Hall (Hokkedō, also known as Sangatsudō) of Tōdaiji Temple, plus various images at Kōfukuji Temple, including the Hachibushū and Jūdai deshi images, recent research findings have suggested that they all were made in the first half of the Tenpyō era. The images at Tōdaiji—undated but thought to have been made around the same time as the Kōfukuji images—are stylistically different from the Kōfukuji images. The Tōdaiji sculptures were based on High Tang style. It is quite likely that the Fujiidera *Seated Senju Kannon Bosatsu* sculpture—whose construction resembles that of the images in the Lotus Hall (Hokkedō) at Tōdaiji—was made in the same period as the Lotus Hall Tōdaiji images.

The next example of a late Nara period large-scale sculpture is the Vairocana Buddha at Tōshōdaiji Temple in Nara, the temple established by the Chinese priest Jianzhen. Such images were rarely if ever made in the following Heian period.

Survey of the Fujiidera *Seated Senju Kannon Bosatsu*

Overview of the Fujiidera Sculpture

The Fujiidera *Seated Senju Kannon Bosatsu*, referred to in this article as the Fujiidera sculpture, has many points of resemblance with the Nikkō Bosatsu and Gakkō Bosatsu figures that date to earlier in the same Tenpyō period. Those two images are molded clay and are part of a group of images in the Lotus Hall (Hokkedō), Tōdaiji. The Fujiidera sculpture further shares many points of resemblance with

Figure 4. *CT image indicating that there are wooden shingles (identified by the tree growth rings) between the linen layer and the sawdust lacquer layer, and we can surmise that they were placed there to increase the thickness of the abdomen.*

the figures in the Hokkedō group that are considered representative examples of Nara period sculpture. The Fujiidera sculpture's well-proportioned, elegant facial features, including its shapely nose, the lithe, modulated musculature on its upper body, and other features can all be considered a form of human figural beauty. Indeed, this image embodies the most complete example of Nara period sculptural style.

The Fujiidera sculpture can be discussed in terms of its body, arms, and pedestal, with the arms similarly divided into four sections. The arms are attached to the back of the body on the right and left, and the front arms are supported on both the right and left by pillars (visible in profile as tall rectangles as seen in figure 3) put into the base. The back sets of arms on both the right and left sides are fitted with hooks, and thus the back group of arms are hooked to the front group of arms.

Even though the body of this image is hollow-core lacquer, the arms are wood-core lacquer, with core intact, made out of the relatively lightweight paulownia wood. The pedestal is composed of a combination of wood and wood-core lacquer. The lotus petal central section of the pedestal was carved from a single piece of paulownia wood. The flower petals and seat area are made of wood-core lacquer.

While these basic facts have been previously well known, the unprecedented opportunity for further examination occurred when the sculpture was brought to the Tokyo National Museum for display in the 2018 special exhibition and made available for us to take CT scans.

CT Survey of the Fujiidera Sculpture

In early February 2018, specialists spent one week packing up the sculpture at Fujiidera for transport to the Tokyo National Museum. In the process the wrapped parts of the sculpture were divided into two groups and transported by truck 500 kilometers from Osaka to Tokyo. As soon as the sculpture arrived at the Tokyo National Museum, it was examined via a YXLON CT scanner. The equipment for this process is part of the Conservation and Restoration Department's facilities, and two members of that staff took the images using a Y.TU600-D01 tube at 560 kV, 1.25 mA, for 700 milliseconds. Tube to object distance was 1617 millimeters.

The original form of this sculpture was made of molded clay. Two or three layers of linen cloth were pasted onto the surface of this molded clay form, and several window openings were cut into the back of the linen to extract the clay. All remaining clay was removed from the interior of the now-empty linen wrapping. A wooden framework was inserted, and the cut window areas stitched shut. The linen surface was then coated with a build-up of lacquer mixed with sawdust, until the desired form was achieved. The Fujiidera sculpture's wood-powder lacquer layer is 5 millimeters thick, which is thicker than the 2–3 millimeter layer seen on the Hachibushū images at Kōfukuji.

It was discovered in this examination that the built-up area on the abdomen consists not only of sawdust and lacquer but also includes thinly cut wooden shingle forms. At the center of the abdomen, these new x-ray images indicate that there are shingles between the linen layer and the sawdust lacquer layer, and we can surmise that they were added to increase the thickness of the abdomen (fig. 4). The validity of this hypothesis is further underscored by the other sections of the sculpture. The CT images reveal that thin wood fragments were also inserted into the thickest area of drapery folds on the legs. This method for thickening the sawdust lacquer layer has previously been noted in the Ashura sculpture (one of the Hachibushū) at Kōfukuji during a CT examination at the Kyushu National Museum (Tagawa et al. 2018).

In 2009 a special exhibition of the National Treasure-designated Ashura sculpture was held at the Tokyo National Museum and the Kyushu National Museum. In 2008 the Kyushu National Museum used its previously installed CT scanning equipment to survey the Jūdai deshi and Hachibushū sculptures. During that process researchers discovered that wood shingles were inserted into a relatively large section of the Ashura image's decorative scarves.

In the case of the Fujiidera sculpture, large numbers of wood shingles were found in the abdomen area, drapery folds, and pedestal center made of wood-core lacquer. Cross-sections of the pedestal center show that the central

Figure 5. *CT image showing copper wire that was wrapped in straw rope and built up with a lacquer containing sawdust to form the fingers.*

section is made of square-cut timber, with numerous layers of shingles added to make it into an overall cylindrical form. We can surmise that shingles were used to economize: they decreased the need for lacquer, and, in turn, less lacquer use would mean a quicker drying process. But before we come to any conclusions, further research is needed on the subject, including the gathering of more examples.

Another special feature of the Fujiidera sculpture is the fact that all 1,041 arms are made of wood-core lacquer. The majority of the arms are made of paulownia wood, and the palms of the hands may have been made from a different wood type. The fingers are composed of copper wire, which was then wrapped in straw rope and built up with a lacquer containing sawdust into the required finger shape (fig. 5). Copper wire was generally used in hollow-core lacquer sculptures in order to effectively convey the detailed finger positioning and expression. The Ashura sculpture was similarly made. A wood framework was used inside the Ashura sculpture to prevent warping of the image due to shrinking. However, of particular note is the fact that different wood types were used for each of the sculpture's six arms and palms. It is thought that the wood type chosen for the palms allowed for easy insertion of the copper wire used in the fingers.

Conclusions

CT scanning has permitted a number of new discoveries about hollow-core lacquer methods in Japan. Research on the group of sculptures at Kōfukuji is continuing, primarily by the research team at the Kyushu National Museum. The next phase for the Fujiidera sculpture is to fully analyze the data acquired in the CT examination. It is my hope that this report on the current state of research on hollow-core lacquer sculpture in Japan will contribute to the advancement of research on this subject.

Reference

Tagawa, Shun'ei, Imazu Setsuo, Kusui Takashi, Yamazaki Takayuki, Yano Ken'ichirō, Sugiyama Junji, and Kotaki Chihiro. 2018. *Ashurazō no himitsu: Kōfukuji Chūkondō rakkei, kinen* 阿修羅像のひみつ: 興福寺中金堂落慶記念 [The secret of the Ashura statue: Celebrating reconstruction of the Central Golden Hall of Kōfukuji Temple]. Tokyo: Asahi Shinbun Shuppan.

Chinese Chronology, Warring States Period through the Republic of China

Warring States	475–221 BCE
Qin dynasty	221–206 BCE
Han dynasty	206 BCE–220 CE
Period of Division	220–589
Three Kingdoms period	220–280
Wei	220–265
Shu (or Shu–Han)	221–263
Wu	222–280
Jin dynasty	265–420
Western Jin dynasty	265–317
Eastern Jin dynasty	317–420
Northern and Southern dynasties	317–589
Southern Dynasties	317–589
Eastern Jin dynasty	317–420
Song (or Liu-Song) dynasty	420–479
Qi dynasty	479–502
Liang dynasty	502–557
Chen dynasty	557–589
Sixteen Kingdoms period	304–439
Northern Dynasties	386–581
Northern Wei dynasty	386–534
Eastern Wei dynasty	534–550
Western Wei dynasty	535–556
Northern Qi dynasty	550–577
Northern Zhou dynasty	557–581

Sui dynasty	581–618
Tang dynasty	618–907
Five Dynasties period	907–960
Liang dynasty	907–923
Tang dynasty	923–936
(Later) Jin dynasty	936–946
Han dynasty	947–950
Zhou dynasty	951–960
Ten Kingdoms period	907–979
Song dynasty	960–1279
Northern Song dynasty	960–1127
Southern Song dynasty	1127–1279
Xixia kingdom	982–1227
Liao dynasty	907–1125
Jin dynasty	1115–1234
Yuan dynasty	1279–1368
Ming dynasty	1368–1644
Qing dynasty	1644–1912
Republic of China	1912–1949