

## CHINESE CERAMIC QUADRUPEDS: CONSTRUCTION AND RESTORATION

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## 1 HISTORICAL BACKGROUND

The ancient Chinese prepared their royal dead to spend eternity in a style similar to that enjoyed in life. To this end sacrifices of servants, soldiers and animals were made, and their bodies — together with food, furniture and clothing — interred with their owner's. By the late Zhou dynasty (1027-256 BC) these were replaced by surrogates made of wood and clay [1]. An industry arose whereby sculptures (*ming qi*) of both necessities and luxuries were manufactured and sold specifically for burial. The most common earthenware *ming qi* were human figures, although replicas of houses, animals and scenes of entertainment were also popular. This burial practice continued into the Tang dynasty (618-907 AD) when it expanded to the middle class. So great were the numbers of tomb figures buried, and so vast was the amount of money spent to buy tomb articles during the early Tang period, that an imperial decree was issued limiting the number of figures according to the status of the individual [2]. However, this decree is known to have been widely disregarded [3]. Gradually the custom fell from favor, and although tomb figures continued to be made into the beginning of the Qing dynasty (1644), large-scale production subsided at the end of the Tang dynasty.

## 2 PROJECT SUMMARY

The objectives of the project were twofold: to study the fabrication process, and to examine old repairs of ceramic tomb figures. Horses and camels were chosen for this study because of the relative complexity of their manufacture and decoration compared to that of human figurines; furthermore, horses and camels have more extensive restorations than human figurines due to their fragile extremities which have rarely survived intact. Twenty-five animals which had been restored were examined. These included three Han (207 BC-220 AD) horses, four Sui (581-618 AD) camels, seventeen Tang horses and camels, and one modern horse. Most were examined with a binocular microscope and ultraviolet illumination. Some were X-radiographed\*, and one was xeroradiographed. Some had been dated by thermoluminescence, while others were sampled for dating prior to radiography.

Because tomb figures have been repaired in both the east and the west, a comparison of restoration methods was of interest. Horses and camels generally break in the same way — at the join lines at the top of the legs and at weak points in the legs such as ankles. The authors were interested to determine whether there was a difference in eastern and western approaches to repairing this common problem as there is, for example, in the restoration of lacquerware and scrolls.

## 3 MANUFACTURE

Mass production of the vast quantities of tomb figures was facilitated by the use of molds, although a few figures were hand-modeled or coiled on iron [5] or wooden [6] armatures. The molds were probably ceramic [7], although few have survived and none could be located for examination in the course of this study. Evidence of the use of wooden molds is reported to have been found on some Han house models at the Royal Ontario Museum

[8], but wood is unlikely to have been used for molds of the more sculptural animal figures. The following description of the molding of a hypothetical camel is based upon the examination of a number of horses and camels in American collections and the personal experience of the authors in clay molding.

The original clay mold was probably taken from a model or existing sculpture. This mold would have been made in a number of pieces so that it could be removed from any undercut areas. In the case of a large standing camel with a laden saddle, the mold pieces numbered as many as sixteen: two for each leg, two for the head, two for the body, one for each hump, and two for the monster masks decorating the saddle (Fig. 1 and Fig. 2).

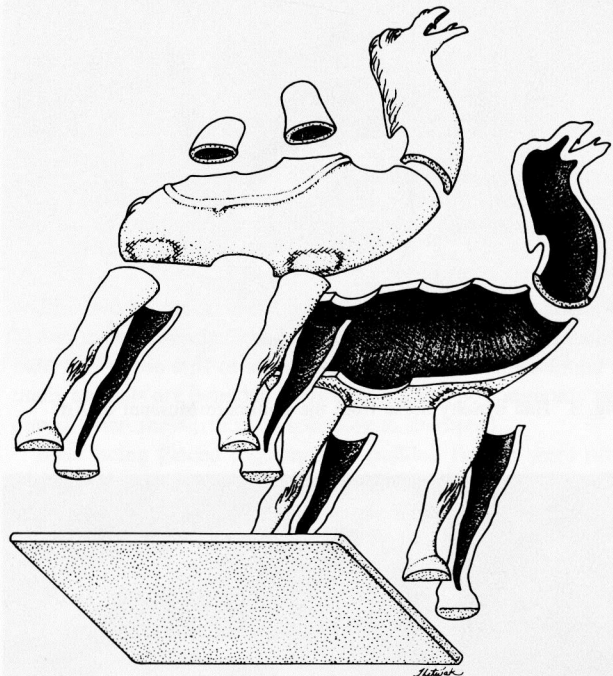


Fig. 1 A sketch of fourteen separately molded pieces plus the base which make up this hypothetical camel.

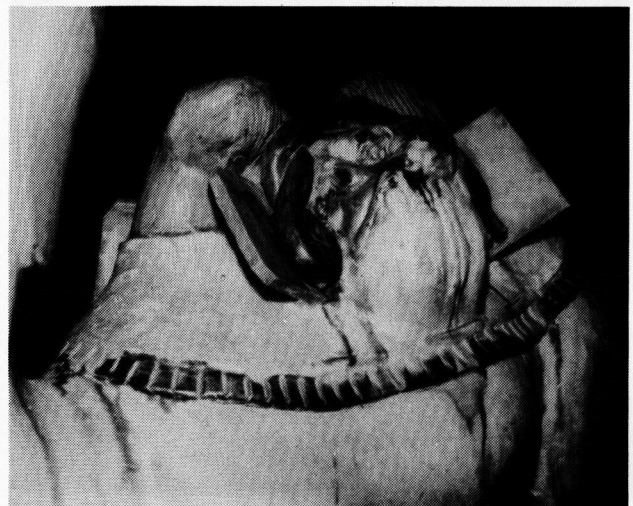


Fig. 2 Detail of a camel from the Buffalo Museum of Science showing separately molded and attached monster masks.

\* See [4] for copies of radiographs. The kilovoltage ranged from 100 to 200 with 5ma, depending on the size of animal and the presence of glaze. Time ranged from 2 to 5 minutes.

It is conjectured that after the mold was fired it was prepared for use by dampening or dusting with some type of parting compound to prevent the clay from sticking. Dry powdered clay is a likely choice; however, evidence of the use of mica, found on the surface of some Han tomb figures, has been reported [8]. Sheets of clay were pressed into the interior of each of the mold pieces. A single sheet of clay per mold piece seems to have been the norm; however, a Han horse at the Baltimore Museum of Art (1987.1) was made by partially overlapping two small sheets of clay in the body molds (Fig. 3 and Fig. 4). The act of pressing the clay sheet against the mold is apparent from the impression of the potter's fingerprints left in the clay. Latex impressions of the potter's knuckles and fingernails taken from the interior of

a camel at the Buffalo Museum of Science (C22839) revealed the use of fingers curled in a fist to push the clay into the mold (Fig. 5). In the case of the life-size horses of Qin Shi Huang, the interiors of the bodies have impressions left from using cloth-covered pounders to tamp the clay into the interstices of the mold [9]. While this method produced hollow bodies and heads, the legs of the animals examined were found to be both solid and hollow, which was unrelated to the size of the animal. Slender legs on smaller pieces are sometimes hollow as far down as the hock, such as the legs on a pair of Sui camels at the Metropolitan

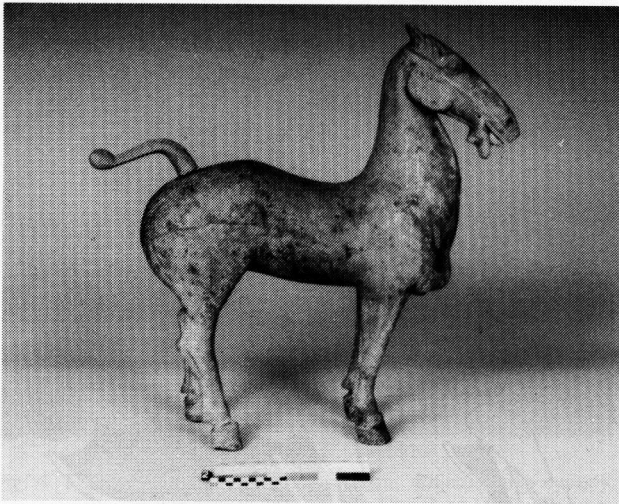


Fig. 3 Han dynasty horse from the Baltimore Museum of Art.



Fig. 5 Positive impression of the front of the potter's fist used to press the clay sheet against the mold, taken from the interior of a Tang camel at the Buffalo Museum of Science.



Fig. 4 X-radiograph of the Han horse at the Baltimore Museum of Art showing the neck joint, fingermarks and the overlap of the two pieces of clay used to make up the side of the body.



Fig. 6 X-radiograph of the rear legs of a Sui dynasty camel at the Metropolitan Museum of Art, showing their unusual construction with a central core of clay or other material of similar density. These are thought not to be restorations because numerous breaks are continuous through the core material.

Museum of Art (13.220.67 A&B); while legs on large pieces are sometimes completely solid, as were those of the Baltimore Han horse. An unusual construction was found in the legs of a camel from the Sui dynasty in the collection of the Metropolitan Museum of Art (1974.289.4). X-radiography revealed that solid legs were constructed of a central cylinder of clay or other material of similar density around which the muscle and bone articulation was modeled or molded with added bits of clay (Fig. 6). These legs are exceedingly slender which may account for their unusual construction.

Next, the molded pieces were joined. The two halves of each discrete body part (the head, body, and each leg) were probably joined while still in their molds. This allowed the potter to manipulate the clay immediately from the inside without causing distortions to appear on the exterior. Furthermore, these seams have rarely failed, indicating that the clay was worked in a very pliable state, probably too pliable to have been able to support its own weight outside the mold. The head and body seams were made on a line longitudinally bisecting the figure (Fig. 7). Vertical leg seams were made most commonly down the front and backs of the legs, but a camel at the Virginia Museum of Fine Arts (51.12.2) has seams on the sides of its legs (Fig. 8). The clay was then allowed to dry until it could be handled and could support its own weight. After each body part was removed from its mold, the animal was assembled by way of a hole in the belly [9]. Evidence that the parts were removed from the mold before being assembled was found on the Baltimore Han horse which has two square impressions on the belly just in front of the rear legs (Fig. 9). These are probably impressions from supports used to prop the body so that the legs could be attached. If the parts had been still in the mold these props would not have been necessary. The surfaces were prepared by hatching the clay [10] and probably applying a thick slurry of clay to the areas to be joined, after which the surfaces would have been trimmed and smoothed.

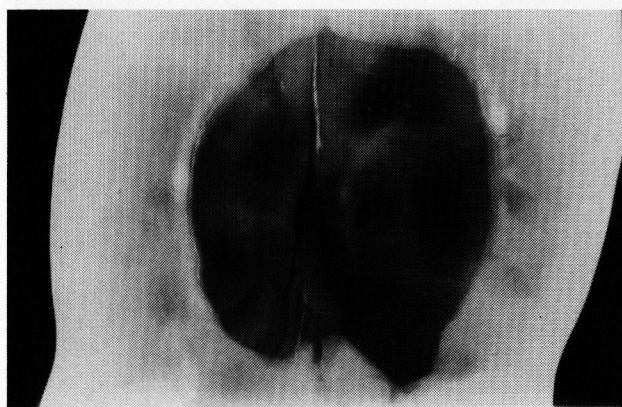


Fig. 7 X-radiograph shot through the back of a Tang dynasty horse from the Arthur M. Sackler Collection, showing the seam at the joint of the two body halves and the oval shape of the hole cut in the belly.

The clay was probably still in a fairly pliable state when removed from the mold. The base, usually a rectangular slab, would have to have been attached in a semi-plastic state so that the hooves and base could be added. Ideally, the pieces being joined should have had about the same water content so that they would have continued to shrink at the same rate; differential shrinkage could have caused the joints to crack. In fact, cracks at joints caused by uneven shrinkage and poor trimming of joint surfaces have often left joints visible to the naked eye even in glazed areas. A good example of this are the legs and belly of a camel at the Baltimore Museum of Art (1956.148). Stamped

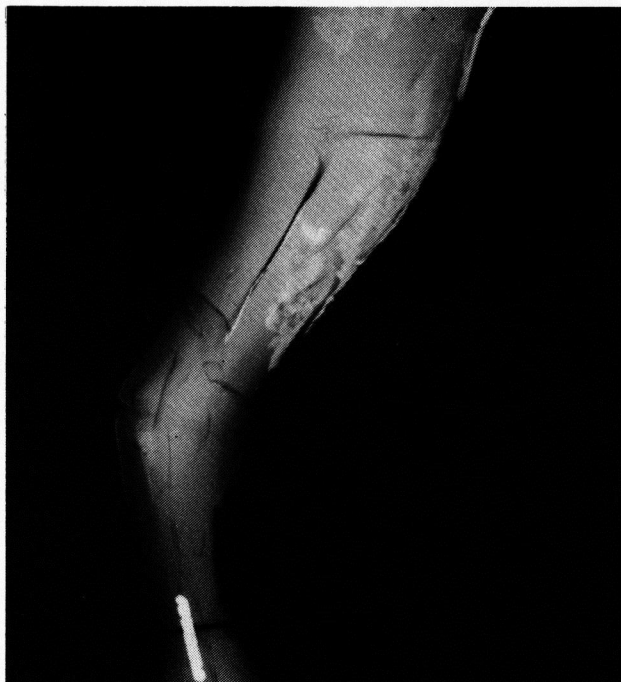


Fig. 8 X-radiograph of the leg of a Sui dynasty camel from the Virginia Museum of Fine Arts showing their unusual side joining and a drill bit dowel in the ankle. White patches on the thigh are remnants of lead glaze.

and incised decoration on the exterior was apparently also done before the clay reached the leather-hard state (Fig. 10). Leather-hard clay is too stiff to stamp; secondly, incised lines found on many animals are bounded by ridges of the type commonly produced when the surface of soft clay is disrupted.

After being pieced together, the molded figures were often given some individual details. The ears of all the horses examined, except for those of the modern reproduction, appeared to have been modeled free-hand and inserted through holes in the head (Fig. 11). Two camels in the collection at the Buffalo Museum of Science (C22839 and C22838), both of which are thought to be from the same tomb set, are excellent examples of how a basic form may be embellished by applied decoration. The camels appear identical in size and shape and may have been made in the same molds. One camel is very plain, however, with



Fig. 9 Detail of the Han horse from the Baltimore Museum of Art, with the arrow indicating one of the impressions visible in front of the rear leg.

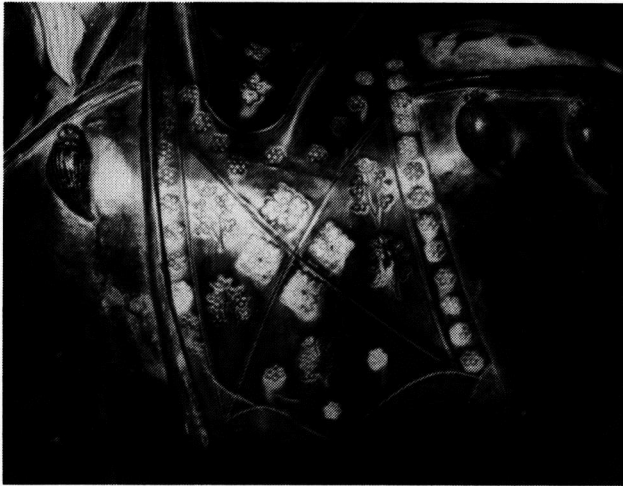


Fig. 10 Detail of the saddle blanket of a Tang horse at the Buffalo Museum of Science showing incised, stamped and applied decoration.

no saddle (Fig. 12). The other camel sports a loaded saddle decorated with monster masks; two coils of rope made of coils of clay and four boards made of slabs of clay were formed free-hand and added after the figure was molded (Fig. 2). Hatch marks and excess slurry are visible around attachment points. Other types of applied decoration commonly used include harness trappings, portions of saddles and short cropped manes on horses.

Incising was the most common method of figure embellishment of those animals examined, but stamping was also used. Delineation of a blanket surrounding the humps on a camel, eyelids, hair in the mane and forelock, and fur on a saddle blanket were all incised (Fig. 10). Clay or wooden stamps were used to create a repeating textile-like design on a saddle blanket of a horse in the collection of the Buffalo Museum of Science (C19242) (Fig. 10).

These added decorations seem to be more characteristic of the Tang period, whereas Han dynasty tomb figures appear to have been worked less after molding. Han craftsmen often attached other materials to the ceramic figures. Holes through the lower jaws of Han horses probably held bits of another material, perhaps bronze. Some Han horses were found with no legs; presumably these legs were made of organic material which has long since disappeared [11]. The Tang potter used fibers, probably horse hair, for the manes and tails of some horses. For

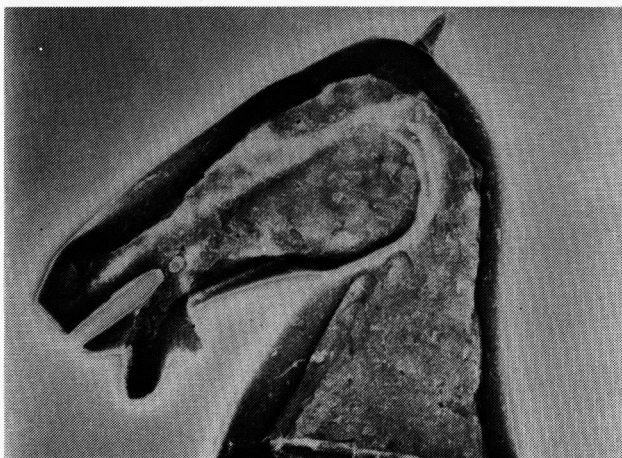


Fig. 11 Xeroradiograph of a Han horse at the Baltimore Museum of Art showing the ear penetration into the wall of the head which indicates that the ears were added to the head after it was molded.

instance, a horse in the Arthur M. Sackler collection (L 43.17.1) has a recessed area cut where the mane would have been attached. Mud caught in this recess still bears fiber impressions.

Unglazed figures were often painted after firing, and portions were sometimes gilded [12]. Han potters tended to use paint on unglazed figures rather than adding decorations in clay. Harnesses, saddle ornaments, and eye and mouth color were all executed in paint. The Tang potter also utilized paint, sometimes in combination with glaze. Two Sui dynasty camels at the Metropolitan Museum of Art (13.220.67 A&B) are glazed with straw-colored glaze and have traces of orange paint, apparently original, applied on top of the glaze to highlight nostrils and eyes.

The scope of this paper does not include a study of Chinese glazes, but a history of their use will be summarized [13]. Transparent green lead glazes began to be used during the Han dynasty. During the Sui period, glazed figures became more common; a straw-yellow colored glaze was popular. During the Tang dynasty the three-color glaze, *san cai* — a combination of green, brown and light yellow — came into fashion. However, some animals remained quite plain, glazed only with browns and yellows, and some unglazed figures were still produced. These glazes were usually applied to the exterior of the body excluding the base and were typically applied by brushing or pouring. A camel at the Metropolitan Museum of Art (13.220.67 A) has glaze on interior surfaces, probably indicating that the camel was glazed upside down.

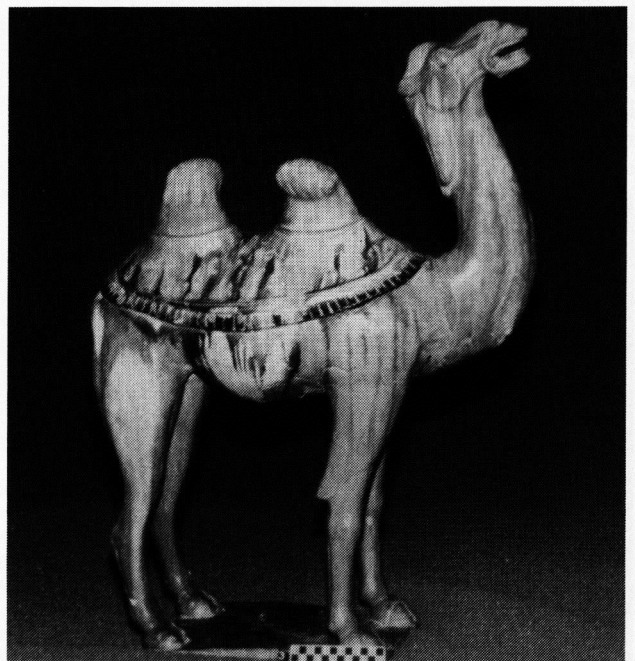


Fig. 12 A Tang camel at the Buffalo Museum of Science similar to the camel in Figure 2 but without saddle embellishment.

#### 4 TOMB FIGURES IN THE WEST

The history of the collection of tomb figures in the west began in the early twentieth century. In 1905, during construction of a railroad near Loyang, many Tang dynasty tombs were discovered [3]. Publication of an early Chinese collection increased the popularity of the figures [11], and by World War I a few figures had found their way into western collections. The bulk of tomb figures in the west left China in the 1920s, 1930s and latter part of the 1940s. This flow was again reduced to a trickle until the 1980s. Few if any of the figures in western collections were systematically excavated and, at least since the 1950s, it is likely that these figures left China without official government sanction [14].

The major centers for restoration of tomb figures leaving China in the past have been Hong Kong, Tokyo, New York and Paris. Today figures are often sent to Hong Kong where they are restored before being purchased by dealers or collectors [14].

Reproductions were reported to have been seen in China as early as 1912 [11] and are still manufactured there in factories and exported to the west. The figures made in the last few years are molded or slip cast, lead glazed and sometimes even mud coated (Fig. 13).

## 5 RESTORATION

All of the tomb figures examined, excluding the modern reproduction, had been broken and restored in the past. Appendages such as ears and tails were often missing or reconstructed. The most common breaks involved failures at attachment points of legs and heads. Multiple breaks were found most frequently in legs, both at the attachment points to the body and base and across the narrowest part of the leg just above the hock. The joint between the neck and the body gave way in nearly all of the animals. If humps, saddles or other decorative elements had been added to the figure, breaks often occurred at their points of attachment. Slab bases were also frequently broken. Generally the breaks occurred across the middle of the base and around the feet of the animals. Bodies were occasionally broken into many pieces. These breaks sometimes corresponded to thinner areas of clay just behind the front legs or just in front of the rear legs. In contrast, the seams thought to have been formed first, that is, those running down the center of the head and back and vertically bisecting the legs, rarely failed. These seams would have been made while the clay was more pliable; furthermore, smoothing and manipulation might have been accomplished using the mold itself as a support, as it is hypothesized that these parts were still in the molds. Both of these circumstances would have improved the strength of the seams.

X-radiography and xeroradiography were the most informative tools used, not only to reveal manufacturing techniques but also to examine breaks and repairs hidden by fills and overpaint. Interpreting radiographs of lead-glazed animals was complicated by the strong absorption of the X-rays in glaze-filled cracks or incised lines (Fig. 14).

Radiography also posed some questions. One leg of the Baltimore Han horse appeared, from the X-radiograph, to be made of clay similar to that of the body, based on density and porosity. However, the X-radiograph also disclosed a different

construction from the other three legs: four coils of clay protruded into the body cavity by which the leg had apparently been attached (Fig. 4). Was this an old repair, an original manufactured leg or a modern attachment? To help answer this question, xeroradiography was performed on the horse. The results revealed the leg to be of a similar density and porosity to the other three, but compositional analysis of the clay would be necessary to confirm this.

In most cases, the geographical origin of repairs could be determined through an examination of old records and photographs or from information provided by museums or dealers. Fragments of newspapers from France and Japan incorporated into the repairs of two different camels, and a label printed in Chinese with traditional characters found on a piece of metal used as a dowel inside a third, indicated the origin of these repairs. The restorations identified as having been completed in Japan, China, Hong Kong, New York, Washington and Paris could not be differentiated by technique. Whether restored in the east or the west, the basic materials and techniques were similar.

Materials used to repair animals varied as seen both in our examples and in the literature. Dowels were often used in necks and legs. These included metal screws, sheet metal (Fig. 14), drill bits (Fig. 8), slender wooden dowels, wire mesh, and a 5cm-diameter log with bark. Staples are commonly made of iron, nickel silver, copper and bronze [15]. Metal dowels and staples were used in both a camel repaired in China (MMA 10.221.31) (Fig. 14) and in a camel repaired in New York (VMFA 51.12.2).

Glues ranged from natural to synthetic: shellac [16], animal glue and rosin\*; epoxy, acrylics and nitrocellulose [10]; rubber-based adhesives, vinyl alcohols and vinyl acetates [15]; and mulberry tree juice, wheat paste combined with lime, and rice and egg mixtures [17]. Shellac, the most common adhesive found in our study, was used to adhere pieces on a camel repaired in France\* and a camel repaired in China.



Fig. 13 Factory in Xian, China, showing fabrication of reproductions of tomb figures.



Fig. 14 X-radiograph of the head of a Tang dynasty camel at the Metropolitan Museum of Art, showing the neck repaired with a rolled sheet of metal, nails and staples, and the pooling of lead glaze in the incised lines of the camel's blanket.

\*Infrared analysis performed by Walter Hopwood, CAL, Smithsonian Institution.

Fill materials for replacement parts and gaps included: plaster of Paris, plaster combined with resins and pigments, clay mixed with adhesives, whiting mixed with binders, polyester resin, gutta percha, and epoxy putty [13]. Fills were found to be reinforced with paper, cloth and wire mesh. Replacement legs taken from other animals of the same period are noted in the literature [17]. Although none was positively identified in this study, it is possible that replacement parts were fabricated in clay and fired onto animals at a temperature lower than the original firing temperature [18]. Another possibility is that they were reconstructed in clay, fired and then attached. Plaster, the most common fill material found both in the literature and in this study, was used in animals repaired in the east and the west.

Overpaint was common to all of the restorations examined. Again, a variety of materials was used: oil paints, pigments in shellac, acrylics and others. The most prevalent method of hiding repaired areas was to smear mud over the animal both inside and out. All of the figures examined for this study had some quantity of mud on them.

## 6 CONCLUSION

In the past both eastern and western restorers approached the problem of repairing ceramic animals with similar methods and materials. In fact, western restorers of the past seem to have had more in common with their eastern counterparts than they do with modern museum conservators in terms of the materials used. The most favored repair materials in the past have been shellac, plaster and metal dowels. With the advent of synthetic adhesives the modern conservator in both the east and west has gained access to materials with greatly improved strength and reversibility. Furthermore, they do not stain as does shellac [14]. Staples are no longer necessary, and dowels only in extreme cases.

The materials used by past restorers seem somewhat randomly chosen, especially those used for dowels. The incorporation of cans, wood, drill bits, nails and screws give the impression that the restorer used whatever was on hand. This contrasts sharply with the extremely methodical approach to eastern scroll and lacquerware restoration. Perhaps this is because restoration methods of scrolls and lacquerware stem from the manufacturing techniques for these objects. In the case of restoration of ceramic quadrupeds this does not seem to be true, except in the infrequent instances of refiring.

The most interesting result of this study proved to be an expanded understanding of the construction method used for Chinese ceramic quadrupeds. For example, variation in the construction of legs was revealed by X-radiography. The discovery of the potter's fist impression on the interior of two camels shed new light on the pressing of clay into the molds. Finally, an increased knowledge of construction methods contributed to a

better understanding of structural weaknesses.

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