

# The 2012-2015 Conservation of Listed Oracle Bones of the Institute of History and Philology, Academia Sinica

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*Bingbian 184 (R044679)*  
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## Brief History of the Oracle Bones Conservation Dilemma

Inscribed oracle bones (ca. 13<sup>th</sup>-11<sup>th</sup>-century B.C.E) are among the most important Anyang archaeological artifacts found during excavations that occurred during the 1930s and 1940s. More than 20,000 bone fragments were included among more than 100,000 artifacts that were discovered by early researchers from the Institute of History and Philology, Academia Sinica (ASIHP). Although these treasures shifted locations during World War II, the majority of the artifacts found during this period have been housed at the ASIHP, Taiwan since 1949. Unfortunately, in addition to sometimes being looted during wartime shipments, several of these fragile oracle bones were weakened either while being shifted or while being handled during research and restoration.

Turtle plastrons and shells as well as cattle scapula are two broad categories of divination oracle bones. According to the statistical studies of the hollows of oracles, *Bingbian* 184 (R044679), with more than 200 hollows (Fig. 1), is the largest turtle plastron from the Anyang archaeology excavation.<sup>❶</sup> It features polished, symmetrical rows of deep oval or shallow, nail-shaped hollows with vertical chisels on the inner sides of the bones. The surface hollows were burned with sticks to create the *Bu* 卜-shaped cracks during divination. During preparation stages and divination steps to make the bones thinner, hollows depth increased 0.1-0.2 cm, with the bone body undergoing severe temperature changes with a high temperature heat source, usually a burning stick.<sup>❷</sup> This divination process weakened the oracle bones, causing additional hollows and cracks that split into fragments. The divination process also affected the structure of the bones, making the conservation and preservation of these 3,000-year old



Fig.1: *Bingbian* 184 (R044679) features the highest numbers of hollows

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❶ Tso-Ping Tung, *Hsiao-t'un vol.2: Inscriptions part 1: Plates*. 2nd ed. (Taipei: Institute of History and Philology, Academia Sinica, 1994), p. 10.

❷ David Keighley, *Sources of Shang History: The Oracle-Bone Inscriptions of Bronze Age China* (Berkeley: University of California Press, 1978), pp. 12-27.

objects even more challenging. The way that the structure of the bones was undermined by the divination inscriptions that were carved and written on them is also a crucial issue.

Other methods to preserve the bones and the historical information they contain often unintentionally contributed to their decay and decline. For example, from the 1940s to the present, rubbings were taken to preserve and publish the inscriptions on the oracle bones. While these rubbings recorded the data on the surface of the bones, the process was sometimes damaging to their structural integrity. In addition, repairs and the consolidation of oracle bone fragments (often using glue, coatings, and consolidated plaster) had the unintended side effect of making them more fragile and harder to handle.

Archaeological context also affects the condition and conservation challenges of the oracle bones. There are several oracle bone pits from the Anyang archaeological excavation. HS20 was an ash pit which measured 4.5-5.0 meters in diameter from which six tortoise plastrons were piled on top of each other, as well as one tortoise shell.<sup>③</sup> R041003 and R041004 were excavated from HS20. Traces of R041003's red ink inscriptions on the front surface were transferred to the reverse side of R041004 as a print on the soil in the archaeological context.<sup>④</sup> It is a challenging issue both for researchers and conservators to preserve the print of partial inscriptions after several prior restorations.

YH127 (Fig. 2) is the most famous oracle bone pit of the Anyang archaeological excavations that were conducted during the 1930s. The whole "oracle bone pit" packed into an enormous wooden box, which was then transported from Xiaotun to Nanking. More than 17,000 fragments were pulled from this pit in Nanking.<sup>⑤</sup> The exact number of intact oracle bones excavated from this storage or "archive" pit is still a major research question. Researchers have been working on rejoining the oracle bone fragments from this site since the excavation started.

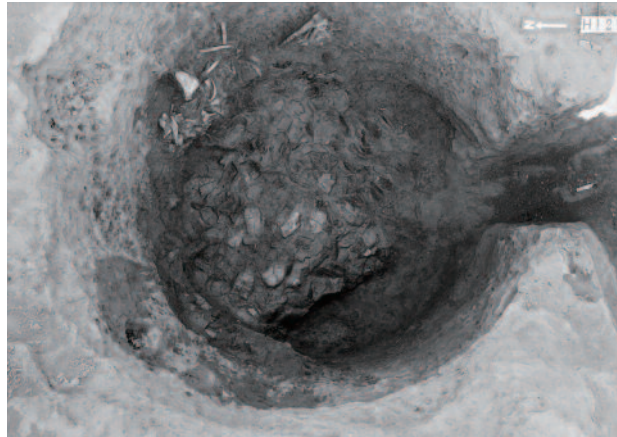


Fig.2: Xiaotun Oracle Bone Pit No.127 (YH127)

- ③ Tso-Ping Tung, "On the Seven Complete Inscribed Tortoise-shells from the Excavations at Hou-chia-chuang, Anyang." *Tien-Yeh-K'ao-Ku-Pao-Kao* no. 1 (Shanghai: The Commercial Press, Ltd, 1936), p. 96.
- ④ Wan-Li Chü, *Hsiao-t'un vol.2: Inscriptions Fascicle 1. Part2: Annotations of Inscriptions of Part 1* (Taipei: Institute of History and Philology, Academia Sinica, 1961), p. 491.
- ⑤ Tso-Ping Tung, 1994, p. 3.

Since 2000, all the oracle bones have been stored in a computer controlled and monitored system, which provides a  $20\pm 2^{\circ}\text{C}$  and RH50% to RH55% stable environment. The conservation project of listed artifacts was launched in 2010, and all listed oracle bones were part of the project. Dr. Johanna Muller was the post-doctoral conservation scientist. From 2010-2013, she conducted systematic surveys of the condition of 194 listed artifacts. Then she divided the condition into four levels: no danger (class I), no needed extra care (class II), needs care (class III) and needs care immediately (class IV). For listed oracle bones, Stéphanie Nisole, a freelance archaeological artifacts conservator from France, restored class III and IV listed oracle bones from 2013-2015.

Of the following six cases, Table 1 shows that turtle plastron (Table 1: R041003, R041004, R044679), turtle shell (Table 1: R041291), and bovid or another animal scapula (Table 1: R035888) were the most commonly used for inscriptions on oracle bones. Inscriptions on deer skulls (Table 1: R041038), ox skulls, and even human skulls were for recording events, not for divination. The species of animals the oracle bones were made from is still a question.

Table 1: Conservation Listed Oracle Bones in 2012-2015

| Image                                                                               | Registration no. | Item title                                     | Provenance                               |
|-------------------------------------------------------------------------------------|------------------|------------------------------------------------|------------------------------------------|
|  | R041003          | Engraved tortoise plastron                     | Houchiachuagnandi Oracle Bone Pit No. 20 |
|  | R041004          | Engraved tortoise plastron                     | Houchiachuagnandi Oracle Bone Pit No. 20 |
|  | R041291          | Tortoise shell with traces of cinnabar writing | Xiaotun Oracle Bone Pit No. 127          |
|  | R044679          | Engraved tortoise plastron                     | Xiaotun Oracle Bone Pit No. 127          |

|                                                                                   |         |                      |                    |
|-----------------------------------------------------------------------------------|---------|----------------------|--------------------|
|  | R035888 | Oracle bone          | Xiaotun Trench E16 |
|  | R041038 | Inscribed deer skull | Xiaotun Trench E10 |

## Conservation Problems and Issues

Some oracle bones from the list were in an extremely fragile state. Before deciding on intervention procedures, the first step was to determine if the fragility of the bones was due to alteration of the bone structure itself or because of well-intended but unintentionally harmful prior repairs. Most of the prior oracle bone restorations were performed using pre-synthetic conservation materials, including:

- Shellac
- Gypsum
- Japanese paper
- Wood mastic
- Cellulose nitrate (a transparent adhesive removable in acetone)

One of the main issues with the artifacts was the excess use of conservation materials. In the past, the intention was to consolidate the fragile bones; this had the unintended effect of adding unsupportable weight in the form of heavy plaster or wood mastic.

In addition, most of the bones kept residues of soil from the excavation site. Earlier conservators were likely concerned that extensive cleaning would damage the inscribed surfaces. However, over time, the weight of the plaster and the soil caused new breaks and cracks. In addition, early conservators had used synthetic adhesives to consolidate those gaps and cracks. Unfortunately, these bonding efforts introduced tension that damaged the edges of the fragments. In the end, the aging process of these adhesives (regular tube glues typically found in an office) damaged both the surface and the edges.

Removing prior restorations was the first concern. Cracks, breaks, and other weaknesses in the surfaces of the bones revealed that previous restorers had added layers of

strengthening or adhesive without removing previous fixes. The problems weren't fixed; they were just layered over, which caused them to become even more severe in many cases. The weight of the artifacts increased with every additional layer of filling material (mostly plaster), rendering them ever more fragile.



Adhesive on the surface



Removing adhesive from the surface



Soil from the archaeological site



Removing wood mastic



Removing Gypsum fillings



Multi-layers consolidated area

Fig.3: Variety of materials used for prior repairs

## Theoretical Approach

Although the bones were very fragile, it was essential to remove all earlier repairs prior to starting any new conservation treatment. Determining the type of material used in past restorations was the first challenge. As the most recent restorations used primarily synthetic adhesives, these were usually acetone removable (as long as bi-component adhesives like epoxy were not involved). On more delicate sections, Japanese paper was used to double the surface, sometimes with paper glue and sometimes with acrylic glue.

Other layers had been treated with plaster or wood mastic, neither of which are reversible in any solvent; the only solution was mechanical removal, using blades and mechanical drills (the latter for the heaviest areas). Beneath these layers was a primary adhesive of either shellac that was reversible in ethanol or organic glue that was reversible in water.

Because of the very delicate nature of the inscribed bones, any attempted restoration was possibly hazardous to the artifacts. But to meet the goal of regaining the original integrity of these unique historical items, difficult decisions had to be made. The bones were rapidly deteriorating under the weight of past restorations, and the only way to preserve these artifacts was to attempt to restore their integrity.

## Practical Approach

The six intervened cases studies conducted from 2012-2015 were divided into three groups according to their types and conservation issues as indicated below.

### Group I: R041003 & R041004

This group consisted of more than 200 broken, separate pieces rejoined with a transparent resin. The undersides were consolidated with gypsum plaster and mastic (hell brown). The gypsum formed an overlay for the mastic and soil layers. All previous repairs had partially deteriorated. In addition, lines of gypsum plaster had been added to consolidate the main cracks. These two objects were in several pieces and any prior repairs were extremely fragile and had certain remarkable characteristics: wide slits; movable parts on the main shards; the artifact itself had taken on a curved shape due to poor rejoining, its

surface coated with an unknown wax. The underside revealed a partially preserved epidermal surface free of inscriptions.

The restoration steps, including de-restoration, are indicated below.



R041003 front side, before



R041003 front side, after



R041003 underside, before



R041003 underside, after



R041004 front side, before



R041004 front side, after



R041004 underside, before



R041004 underside, after

## 1. Surface cleaning

The external surfaces were gently cleaned using ethanol on cotton. Tests were conducted on several different locations of the oracle bones, using a surgical blade to localize the original surface and the filling materials. There were three separate epidermal fillings:

- Plaster
- Wood Mastic
- Soil consolidated with some kind of adhesive.

## **2. Plaster dismantling**

The plaster bonded with the bone too firmly and made the artifacts heavy, causing them to break into many parts. It was necessary to remove the old plaster using mechanical tools because there was no other way to take the plaster off. Cleaning tools with Proxxon micromort was used very carefully and final plaster dismantling was gently conducted with hand instruments and surgical blades.

## **3. Wood Mastic cleaning**

After establishing that the wood mastic was sensitive to water, a small amount of water was added to the mastic so that it could be scratched off using different hand tools.

## **4. Earth and adhesive consolidation materials cleaning**

This consolidation was likely a conservation treatment that was conducted just after archaeological excavation. The consolidation was achieved using shellac, and it consolidated both the surface and the earth remains. It was partially removed by using ethanol on cotton. A later intervention seems to have added another adhesive that was removed by using acetone.

## **5. Local consolidation and gap fillings**

After removing the old filling material, the artifacts became more fragile. It was necessary to add new fillings that were light and stable in order to consolidate the edges. We used Paraloid B44 in acetone, and Paraloid B44 mixed with glass microballoons 3M®. The fillings were colored using natural pigments. This consolidated the edges of the underside of the preserved engraved surface and the areas burned for divination.

## **6. Bonding**

The objects were in many pieces and tiny fragments. The gaps between the fragments were filled with Paraloid B72 and glass microballoons (3M®).

## **7. Surface retouching**

The gap fillings were retouched with watercolors.

## Group II: R041291 & R044679

Artifacts from Group 2 were rejoined in the wrong shape and some these areas had broken. A complete dismantling would be too hazardous for the plastrons. Removing part of the old adhesive that was thickly layered proved more manageable. It was also necessary to restore the turtle plastron back to its correct shape. Dismantling the two artifacts was not necessary.



R041291 front side, before



R041291 underside, before



R041291 front side, during



R041291 underside, during



R041291 front side, after



R041291 underside, after

## 1. Surface cleaning

The surfaces were covered with a sticky varnish that had trapped dust, leaving a brownish hue. Acetone was used during the cleaning process, as well as an acetone/ethanol solution. After using an enzymatic solution to clean the surfaces, the final cleaning was pure ethanol.

## 2. Bonding

The different pieces were re-bonded using Paraloid B72, because it seeps into the cracks for a better seal.

## 3. Local consolidation

After removing the old filling/adhesive material, the artifacts became more fragile. A light and stable adhesive was needed to consolidate the edges. We used Paraloid B44 in acetone, and Paraloid B44 mixed with glass microballoons 3M®. Natural pigments were added in the fillings to match the color. We also consolidated the edges of the preserved engraved surface underside and the areas burned for divination.

## 4. Wide gap fillings

The artifact R044679 was a gigantic one which had been rejoined from two separate parts, which caused major weaknesses. Reinforcing the middle joint was essential, and this



R044679 front side, before



R044679 front side, after



R044679 underside, before



R044679 underside, after

was executed using Japanese paper filling and Paraloid B72, which allowed us to build some reinforced bridges between the two parts of this artifact.

## 5. Surface retouching

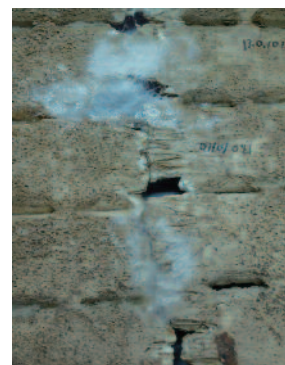
The fillings were retouched on both sides using acrylic colors and natural pigments in an acrylic emulsion. The artifact was cleaned with ethanol to make ensure that all excess color and filling material were removed from the surface.



Japanese paper bridges for filling



Using Japanese paper fibers



### Group III: R035888 & R041038

Group 3 consists of bones that were problematic because of their shape and their fragile surface consolidation.

The artifact R035888 is concave probably due to its burial environment; it had been rejoined with a transparent adhesive. The anterior side was discolored (green) likely due to corrosion of materials it was buried with.



R035888 front side, before



R035888 underside, before



R035888 front side, during



R035888 underside, during



R035888 front side, after



R035888 underside, after

## 1. Surface cleaning

The external surface was gently cleaned using ethanol on cotton. The previous restoration improved the strength and the physical structure of the object. Tests were made in different places by using different solvents to find the best way to dismantle the artifact. Acetone appeared to be the most efficient.

## **2. Adhesive cleaning**

Acetone on cotton was used to dismantle the oracle bones. The artifact was then placed in a plastic bag to maintain a vaporous solvent. After dismantling the object, we cleaned the edges, carefully using acetone on a brush. We removed prior restoration materials from the surface partially using acetone on cotton. It was necessary to use blades to be more efficient. We managed to reach the original surface.

## **3. Bonding**

The object was in 12 separate pieces and with some small fragments. Paraloid B44 was sufficient to rejoin.

## **4. Gap filling**

Paraloid B44 and glass microballoons (3M®) were used to fill gaps between the fragments. Natural pigments were added to color fill the material directly.

## **5. Surface retouching**

The gap fillings were retouched using watercolors.

## **6. Last surface cleaning**

The artifact was cleaned with ethanol to remove all remaining color and filling material from the surface.

## **7. Recommendations for conservation**

The artifact is now in a better state and structurally strong. It is nevertheless a very delicate piece that needs to be handled carefully. The conservation conditions must be stable.

The artifact R041038 was brownish and shiny because of an old consolidation agent. Derestoration was performed first, which was followed by surface cleaning.

## **1. Surface state**

Shellac was on all of the deer skull surfaces, explaining its brown hue. Consolidated treatment was probably conducted just after the archeological excavation.



R041038 front side, before



R041038 front side, after

## 2. Shellac cleaning

The shellac was partially removed using ethanol on cotton. Cleaning with ethanol on cotton was not very effective, so we had to cover the artifact with tissues soaked with ethanol and leave in a plastic bag to maintain a vaporous solvent. After melting the shellac, we carefully cleaned the surface edges using different tools to reach the original surface. A great deal of clay and consolidated concrete had covered the artifact and obscured its original integrity.

## 3. Bonding

The back part of the object was broken into two main pieces with some small fragments. The fragments had been joined in the wrong position. We dismantled the bonding and rejoined it, using Paraloid B44/72.

## 4. Gap filling

The gaps between the fragments were filled using Paraloid B44 and glass microballoons (3M®). Natural pigments were added to directly color the filling material.

## 5. Surface retouching

The gap fillings were retouched using watercolors.

## 6. Light consolidation

A light solution of Paraloid B72 (5% in acetone) was applied to the weakest areas of the surface.

## Conclusions

The six listed oracle bones are in a better state and structurally stronger after the intervention. Their shapes are corrected and they are safer to handle. Nevertheless, these are fragile pieces that must be carefully managed. All the conservation materials for oracle bones intervention are stable, removable and known for their optimized aging process. Bone structure is always susceptible to humidity variation. However, the conservation conditions for oracle bones have been stable for the past several years.

In addition to the restoration of these amazing artifacts, the Institute also gained a professional oracle bone conservator who was trained during this conservation project. This will allow the Institute to foster communication between future conservators and ASIHP, which will facilitate future interventions.

It should also be noted that the multiple layers of conservation materials on the surface of the oracle bones served as a time capsule of the Institute's preservation history. Past restorers tried to find the best available "modern" materials for the artifacts. For example, Liang Siyong, the first generation archaeologist, introduced discarded photographic film (Cellulose Nitrate) and Acetone solvent into IHP as an Oracle Bone adhesive.<sup>⑥</sup> New interventions conducted between 2012 and 2015 followed these conservation ethics, which were based on the "less is more" principle, including reversible and minimum interventions. It is hoped that by following these ideas, this latest conservation will last for at least 100 years.

⑥ 張秉權，《甲骨文與甲骨學》（臺北：國立編譯館，1988），頁 106。

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