Journal of Cuneiform Studies
Supplemental Series

Piotr Michalowski
Series Editor

Number 5
Sumerian Texts from Ancient Iraq:
From Ur III to 9/11

Sumerian Texts from Ancient Iraq

From Ur III to 9/11

Benjamin Studevent-Hickman

LOCKWOOD PRESS
(Published on behalf of the American Schools of Oriental Research)
2018

SUMERIAN TEXTS FROM ANCIENT IRAQ:
FROM UR III TO 9/11

Published by Lockwood Press on behalf of the American Schools of Oriental Research.

Library of Congress Control Number: 2018933761

ISBN: 978-1-937040-85-7

Printed in the United States of America on acid-free paper.

Contents

Preface

The present manuscript publishes 145 new cuneiform tablets from ancient Babylonia, from a time that scholars call the Ur III period (ca. 2110–2003 BCE)—the heyday of Sumerian civilization. Based on month names and other evidence, we know they are from a site near the ancient city of Nippur (modern Nuffar), the religious capital of Babylonia and an important political center for the kings of the Ur III dynasty. With a few possible exceptions, they appear to stem from the archive of a figure named Aradmu.

While tablets from the Aradmu archive have been published elsewhere, this volume more than doubles the number of available records from that collection and offers the first systematic study of its contents. Aradmu may be identified as a "head administrator" (Sumerian šabra), perhaps of the temple household of Ninurta, the city-god of Nippur. Based in part on his activities, which deal principally with agricultural tools and personnel, he was more likely a head agricultural administrator (Sumerian šabra gud). Aradmu, his father, and two of his brothers administered land in several fields, two of which are attested for the first time. Given Aradmu's further association with the temple household of Ninurta, these texts offer the first detailed information on the landed holdings and agricultural personnel of that institution in Ur III Nippur. Personnel and property of the temple of Inana also appear, as do those of the household of a deified king, namely Šu-Suen, penultimate ruler of the Ur III dynasty.

The find spot of the tablets is unknown. It is tempting to tie them to the site established by king Šu-Suen after his well-known campaign against the kingdom of Šimanum, which took him to Nineveh and other sites in the northern Tigris region. According to a later copy of his inscriptions, Šu-Suen built a site near Nippur for Enlil (the head of the Sumerian pantheon) and his wife, the goddess Ninlil, specifically to settle deportees from Šimanum.

The story of the tablets since leaving the ground has received considerable attention. They were confiscated by US Customs, in 2001; stored in the World Trade Center complex in Manhattan; damaged during the attacks of 9/11; repaired through funding from the US Department of State; and returned to Iraq. The repair work was done by the conservators Dennis and Jane Piechota, at their lab in Arlington, MA, and at the nearby Harvard Semitic Museum, in Cambridge. A revised version of the Piechotas' conservation report forms part of this volume.

The Aradmu records from the aforementioned lot of antiquities are published here in transliteration and translation. The difficulties of translating administrative records, owing to their highly abbreviated nature and other factors, are well known. Still, I found it worthwhile as a matter of user-friendliness to include translations, inadequate as they may be in places. Far too many publications of Mesopotamian administrative texts are completely useless to the larger academic community and the general public because they offer transliterations only. This is much to the detriment of Mesopotamian studies, which is in bad enough shape already. In my translations, I have tried to remain true to the Sumerian and to the genre, taking as few liberties as possible while making my sense of the text clear. Given the limited time I had with the tablets, the assorted photos of tablets that appear in the accompanying conservation report, and the fact that detailed photographs are available online, hand-copies of the tablets are not included, nor are drawings of the seals. Once fresh eyes look upon the photos of the tablets—even before then, no doubt—emendations to this manuscript can begin, especially where difficult lines of text are concerned.

Also published here is a response to my Freedom of Information Act request concerning the circumstances that led to the tablets' confiscation. It is, I think, the responsibility of scholars of the ancient world not only to publish the contents of the items that cross their desks but also to gather and make available as much information as possible about those items since they left the ground. If our responsibility is indeed to preserve historical information and, by doing so, to honor the memory of the ancients, then surely such details are as important as the data in the texts. This is a truism based solely on comprehensiveness of research, for that information, too, is history; it becomes all the more our task, it would seem, if those details have some impact on the destruction of the very knowledge we are trying to save.

I warmly dedicate this volume to the people of Iraq. While the data presented here may "belong" to all of us for our common stake in the ancient past, the objects from which those data stem are, at least in this case, Iraqi property. The data themselves, not to mention who publishes them, are of importance for not only Iraq's cultural heritage, but also its status in the international academic community. There is no question that the Aradmu records published here and known to exist elsewhere were looted in Iraq, exported illegally, and bound for a chain of sales that brought them to the United States and other countries. Here is not the place for an excursus on the legal and ethical issues involved with collecting and/or publishing unprovenanced antiquities, nor for a detailed presentation of my stance on those issues. Suffice it to say that, were it not for the fact that the Iraqis had been notified of these tablets and given final say in their publication, I would not have undertaken this project. This volume is, I hope, yet another testament to the extraordinary richness of Iraq's ancient past and a small step toward the responsible treatment of its unprovenanced material.

Benjamin Studevent-Hickman
Louisville, Kentucky
January 2018

Acknowledgements

Many people helped make this volume possible, but three deserve special thanks. The first is Dr. Amira Edan, Director General of Iraqi Museums, who generously gave me permission to publish the tablets. The second is Piotr Steinkeller, who alerted me about the texts and suggested I take on this project. He and I spent many hours together working with the tablets and discussing the issues they raised. He also read a draft of the completed manuscript and made many valuable suggestions and corrections. Lance Allred is the third. When he heard about this project, now several years ago, he told me that he had been working on a collection of tablets at Cornell University belonging to the same archive. He was thinking about presenting some preliminary remarks on that material at an upcoming conference devoted to Ur III studies. Seeing how far along I was with my project, and since I could not attend the conference myself for various reasons, he selflessly chose another topic to present. It was a testament to his generosity as both a scholar and friend. Where the history of our field is concerned, he deserves equal credit, if not more, for the identification and study of this archive.

Further thanks are due John Russell, for working with me to secure permission to publish the texts; Dennis and Jane Piechota, for their hospitality during my visits to Arlington and for contributing a revised version of their conservation report to this volume; Joseph Greene, Adam Aja, and Tim Letteney, for granting me access to the tablets while they were at the Harvard Semitic Museum; Xiaoli Ouyang, Seth Richardson, Elizabeth Stone, Jason Ur, and Aage Westenholz, for discussing specific issues raised by the texts; Piotr Michalowski, Walther Sallaberger, and an anonymous reviewer for reading a draft of the entire manuscript and offering wonderful feedback; attendees of my public talks about the archive, at the University of Little Rock and Harvard University, for their questions and suggestions; my colleagues at St. Francis School, especially Suzanne Bizot Gorman and Ralph Marshall, for their flexibility and support as I finished the manuscript; Robert Englund, for so expeditiously making the photos of the tablets available online; and Piotr Michalowski, for inviting me to publish this study in the Journal of Cuneiform Studies Supplemental Series.

Last, but certainly not least, I thank my wife, Ali, for her support throughout this project, and our sons, William and Olin, for providing many joyful distractions during its final stages—reminders of the important things in life. This would have been a much more difficult task without them.

Text 145 (IS3.ix.-): Sale of a Donkey

P499865

Obverse:
1. 1 ⸢anše⸣-nita mu-3
2. ⸢níg-šám⸣-bi 2 1/2 ⸢gín⸣ kug-babbar
3. ki é-a-ba-ni-ta
4. ⸢árad⸣-mu in-⸢sa$_{10}$⸣
5. ⸢lú⸣-^{d}nin-⸢šubur⸣
6. gàb-gi-im-⸢bi-im⸣
7. DIŠ lú-si$_{4}$ nu-bànda
8. DIŠ pàd-da
9. DIŠ puzur$_{4}$-é-a

Reverse:
10. DIŠ ur-^{d}suen dumu a-a-uru-mu

space

11. lú-inim-ma-bi-me
12. iti gan-gan-è
13. mu si-mu-ru-um^{ki} ba-hul

Seal:
1. lú-^{d}nin-šubur
2. dumu nimgir-sag-ge

Obverse:
1. 1 male donkey, three years old
2. its price: 2 1/2 shekels of silver
3. from Ea-bani
4. Aradmu bought.
5. Lu-Ninšubur
6. is the guarantor.
7. * Lu-si, chief plot manager
8. * Pada
9. * Puzur-Ea

Reverse:
10. * Ur-Suena son of Aya-urumu

space

11. they are the witnesses.
12. Month of Clouds Emerge,
13. Year that Simurum was destroyed.

Seal:
1. Lu-Ninšubur
2. son of Nimgir-sage.

Appendix A
The Conservation of the Tablets

Dennis and Jane Drake Piechota

In 2001, a smuggler attempted to bring into the United States a collection of illegally excavated artifacts from Iraq, including 6 cuneiform clay balls, 37 low-fired ceramic plaques, 5 low-fired ceramic figurines, 5 stone cylinder seals, 5 amulets, 1 ceramic press mold, 1 glass vial, and 302 catalogued cuneiform clay tablets. The objects were seized by US Customs, in Newark, NJ, then inventoried, sealed with customs tape in bubble-wrapped bundles, and placed in corrugated cartons for safekeeping. They were stored in Building Six of the World Trade Center, where they experienced serious water damage during the September 11, 2001 terrorist attack.

After the flooding, the original cartons, with their water-damaged artifacts, were stored outside Manhattan for approximately five years while the more pressing effects of the terrorist attack were dealt with. In 2006, the State Department was notified and Dr. John Russell, Special Coordinator for Iraqi Cultural Heritage, assessed the collection and saw that many of the unfired clay tablets were broken in place within their wrappings by rapid swelling and subsequent drying of the clay. He began the search for conservators who could preserve the collection.

From his colleague at Harvard University, Dr. James Armstrong, the then Assistant Curator of the Semitic Museum, Dr. Russell learned that the archaeological conservators Dennis and Jane Drake Piechota had been conserving the Semitic Museum's collection of over nine thousand cuneiform tablets since 1998. He contacted them, and they arranged to survey the collection to estimate its conservation needs. On June 28, 2007, Dennis and Jane Piechota joined Dr. Russell and James McAndrew, Senior Special Agent from Homeland Security, at the Fortress Storage facility in Long Island City, NY. They assessed the extent of damage to the artifacts, estimated the time and cost to conserve the collection, and, on August 3, Dennis and Jane Piechota presented their findings in a report to Dr. Russell entitled "Special Tablet Project: June 28, 2007 Assessment."

The assessment found that many of the cuneiform tablets showed fracturing from exposure to water and that all held high levels of soluble salts that were actively obliterating the cuneiform characters (figures 1A and 1B). There was also significant soiling both from the field and from the intentional application of obscuring mud by those working with the smuggler.

All conservation treatments first develop from a careful consideration of the condition of the artifacts in question. Second, the purpose for which the collection is maintained and the conditions of its future care are evaluated. The traditional practice of baking cuneiform tablets makes the clay more robust to environmental instability and facilitates the removal of soluble salts as well as extraneous surface accretions. It does so at the expense of its materiality, that is, the original character of the tablet as an unbaked clay object. A preferred approach is to begin a program of close monitoring of the salt-laden tablets while maintaining the collection under strictly controlled environmental conditions. Such a demanding program could not be assured in this case. Indeed, it is beyond the authority of a contract conservator to require continuously monitored environmental storage protocols. The unknown future conditions of curation coupled with the demonstrated presence of damaging soluble salts mandated aqueous desalination, a process that is not practical without baking. Baking followed by desalination has the benefit of preserving a collection as readable cuneiform documents regardless of future environmental conditions.

Given the above concerns the conservators recommended that the cuneiform tablets in this collection be baked, cleaned of extraneous accretions and soil, desalinated, and mended. The majority of the work would be performed at the Semitic Museum of Harvard University following the protocol established for the treatment of that museum's tablet collection. The other items in the lot were to be examined and treated separately from the tablets. Complete treatment documentation would be maintained for all objects, including before and after photography.

Figures 1A and 1B: (A) A portion of the collection is wrapped in their original seizure bubble wrap sealed with customs tape. (B) The wrapping of one bundle has been opened to show a cuneiform tablet broken in place due to water damage.

Before any further action was taken the collection was repatriated to the Iraqi government with Mr. Samir Sumaid'ie, the Ambassador of the Embassy of Iraq, acting as the agent of the government. The authors then developed a proposal for treatment entitled "Agreement among the Embassy of the Republic of Iraq, the U. S. Department of State and the Project Conservator Dennis Piechota for the Tablet Conservation Project." It was signed on October 8, 2008, and funded by the Department of State, Cultural Heritage Center, as contract requisition reference no. AQ 1072-7R7C31 and contract order no. SAQMMA07M0863.

On October 16, 2008, the collection was hand-carried by the conservators Dennis and Jane Drake Piechota from the Embassy of the Republic of Iraq, in Washington, DC, to the Object and Textile Conservation Laboratory in Arlington, MA, and placed in a locked and alarmed storage room. The Customs records associated with the collection had been lost, so the original inventory could only be reconstructed from numbers written on the wrapped-artifact bundles. Once in the laboratory, each bundle, which contained one or more cuneiform tablets and other artifacts, was opened, and each object was given a conservation tracking number and photographed with that number (figure 2).

Once each object was assigned a conservation tracking number, it was entered into an Excel spreadsheet to cross-reference it with both the list created by the State Department just prior to the project and the Customs inventory made during the seizure of the collection. Because of the loss of paperwork during the 9/11 attack, the Customs inventory was reconstructed from the numbers applied to the bundles and therefore formed an incomplete list (this was complicated further by the fact that some bundles were illegible or unlabeled). The tracking photos, too, were part of the registration process, preliminary to the conservation treatment photography. They allowed the conservation team to positively identify each artifact or group of artifacts during the first phase of treatment, which was to document the qualities and condition of each artifact. In addition, during later stages of treatment the photos served as a quick means of corroborating the identification of each object. In this way no fragments were lost or misplaced. This photo-documentation was important because many tablets are similar and no permanent number could be written on the tablet until after the baking phase of treatment. Each artifact was transferred to a small, archival, metal-edge storage tray, and the whole collection of 362 trays was then housed in fifteen metal-edge storage boxes.

Filemaker Pro version 10 database software was used to design a custom conservation-treatment database and data-entry worksheet containing fifty-four fields to describe the artifact condition, analyses, treatment decision, and treatment progress (figure 3). The database was refined over the course of the project to record each artifact's

Figure 2: Example of a cuneiform tablet as initially unwrapped from its original packing, immediately photographed and assigned a tracking number.

physical attributes, provenience, photographic history, condition, chemistry, and treatment. An artifact's work sheet and tracking photo remained with the artifact throughout the course of treatment. Measured characteristics of the tablets included dimensions, prebaking and postbaking weights, and prebaking and postbaking Munsell colors. Other data included the "before" and "after" photographic records with file names for each image; the overall state of the artifact as incomplete or complete, broken or not; and check boxes covering various common condition traits such as surface accretions, erosion, discoloration, the presence of trowel marks, and restoration fill. Treatment decisions and treatment progress were recorded with details of the baking process used, the desalination bath dates, whether surface consolidation was needed, and what resins were used for mending and consolidation. Using a Niton XL3t x-ray fluorescence analyzer, selected tablets were tested for the elemental chlorine to confirm the suspected presence of high amounts of soluble chloride salts in the tablet collection. The results were recorded on the treatment form under the analysis section.

Before the tablets were treated, two Harvard University Assyriologists, Dr. Benjamin Studevent-Hickman and Dr. Piotr Steinkeller, Curator of the Semitic Museum, were asked to study them and record their data. They examined all the tablets in the collection and determined that many of them came from a single archive from somewhere near the city of Nippur (modern Nuffar) and dated to the Ur III period. Other tablets were found to date to the Old Babylonian period. Dr. James Armstrong examined the nontablet artifacts. They were found to date to the Uruk, Old Akkadian, Ur III, Old Babylonian, and Parthian periods. These scholars' observations were added to the provenience, period, and text fields of the treatment database.

IRAQ/USDS CUNEIFORM TABLET CONSERVATION PROJECT

HSM Receipt Date: 1/13/2009
Tracking Number: C.017
Artifact: Cuneiform Tablet
Material: unbaked clay
Period: Ur III
Provenience: Nippur
Text: Aradmu reference

L: ____ cm W: ____ cm Th: ____ cm
Initial Munsell: 10YR5/3 Post Munsell: ____
Initial Wt. 71.97 gm Post-bake Wt. ____ gm Post-trtmnt Wt. ____ gm

Photography BEFORE Treatment Date: ____ Initials: ____
☐ C.017.Ob.pre.jpg
☐ C.017.Rv.pre.jpg
☐ C.017.L.pre.jpg
☐ C.017.Rt.pre.jpg
☐ C.017.T.pre.jpg
☐ C.017.B.pre.jpg
T / L / Ob / Rt / Rv / B

Photography AFTER Treatment Date: ____ Initials: ____
☐ C.017.Ob.post.jpg
☐ C.017.Rv.post.jpg
☐ C.017.L.post.jpg
☐ C.017.Rt.post.jpg
☐ C.017.T.post.jpg
☐ C.017.B.post.jpg

Initial State: ☐ whole/unbroken ☐ whole/broken ☐ partial/unbroken ☐ partial/broken ☐ old break(s) ☐ fresh break(s) ☐ previous mend(s)

Initial Surface Condition: ☐ hard ☐ soft ☐ friable ☐ flaking ☐ soluble salts ☐ insoluble salt ☐ abrasions ☐ soil matrix ☐ excess adhesive ☐ soot blackened ☐ delaminating surface ☐ eroded surface ☐ surface fissures ☐ chipped ☐ stained

ANALYSES

TREATMENT DECISION
☐ Bake ☐ Unsuited for baking ☐ Desalinate ☐ No treatment ☐ Special needs (see below)
made by project conservators Dennis Piechota and Jane Drake Piechota

TREATMENT
☐ Baked in a Fisher Iso-Temp Forced Draft Programmable Oven using the 12 step (6 day, 7 hour) protocol described below

1-RAMP RATE I: 0.1°C/min. 2-SOAK I: 6 hr. at 60°C 3-RAMP RATE II: 0.1°C/min. 4-SOAK II: 6 hr. at 140°C 5-RAMP RATE III: 0.2°C/min. 6-SOAK III: 7 hr. at 375°C 7-RAMP RATE IV: 0.1°C/min. 8-SOAK IV: 12 hr. at 525°C 9-RAMP RATE V: 0.1°C/min. 10-SOAK V: 24 hr. at 595°C 11-RAMP RATE VI: - 0.3°C/min. 12-END at room temperature

Bake Bag No.: ____ Batch No.: ____ Bake Start: ____ Bake Finish: ____

☐ Desalinated for two weeks in constantly re-circulated and refiltered deionized water.
Desalination Start: ____ Desalination Finish: ____

☐ Mended with Acryloid B-72 adhesive dissolved in acetone ☐ Unmendable fragments saved

TREATMENT NOTES - SPECIAL NEEDS

HSM Conservation Assistant(s): ____ Treatment Completed: ____
Rev. 1/22/09

Figure 3: Sample of the Filemaker database conservation treatment form used for this project.

After this initial processing and study the artifacts were moved from the project conservators' laboratory in Arlington, MA to the Semitic Museum of Harvard University where a multiyear cuneiform tablet stabilization program was ongoing since 1999. In that program, to reduce costs, the conservators instructed graduate and undergraduate students at Harvard University in how to document, bake, clean, and mend the tablets of the Semitic Museum collections. The conservators along with the museum curators oversaw the students and maintained all necessary equipment.

In 2009 the museum's tablet program was temporarily suspended so that the tablets from this project could be processed using a similar system. During the course of this project, nine students were employed: Rebekah Junkermeier, Deena Ragavan, Bradley Spencer, Christine Thomas, Audrey Pitts, Josh Walton, Adam Anderson, Christopher Gilbert, and Jess Museck. Many of these students were studying Assyriology and could read cuneiform texts. Other personnel included the assistant curators of the museum who oversaw the day-to-day needs of the student workers, Dr. James Armstrong and Dr. Adam Aja. The assistant director of the Semitic Museum, Dr. Joseph Greene, was essential in developing the grant proposal and contracting with the conservators as well as filling in for the assistant curators.

Pretreatment photography was begun in January 2009. All conservation treatment photography was carried out using a Nikon D80 digital camera with a Nikon AF Micro-Nikkor 105mm VR macro lens mounted on a copy stand (figure 4).

Six views were taken of each tablet to record the condition of all surfaces and to make sure all signs were visible. The images were saved to disk as jpegs and labeled descriptively. For instance, the pretreatment image of the obverse of tablet Text 105 was labeled Text 105.Ob.pre.jpg., while a posttreatment image of the reverse of that tablet was labeled Text 105.Rv.post.jpg. Besides the obverse and reverse, images were taken of the left, right, top, and bottom edges of all tablets. Thin artifacts such as plaques had only two views recorded, obverse and reverse (figure 4).

The tablets in the collection were baked following a custom protocol developed for those tablets from lowland sites like that of Nippur of the Semitic Museum of Harvard University. The critical equipment for this project was a computer-controlled Thermo-Fisher Iso-Temp Model 750 Programmable Oven with Forced Draft. The purpose of the baking was to dehydroxylate the clays in the tablets to allow them to withstand immersion in water during the desalination phase and to give them long-term storage stability. Dehydroxylation is the application of heat to force the removal of bound water from within clay particles. It must be stressed that baking has significant liabilities: it is a nonreversible treatment that alters the appearance of the artifact. However, it is still the only practical method for stabilizing large collections of tablets whose cuneiform characters would be otherwise lost through salt damage.

As noted, this project was modeled after the successful cuneiform tablet treatment program ongoing at the Semitic Museum. In that work, the project conservators performed basic research starting in 1999 to determine

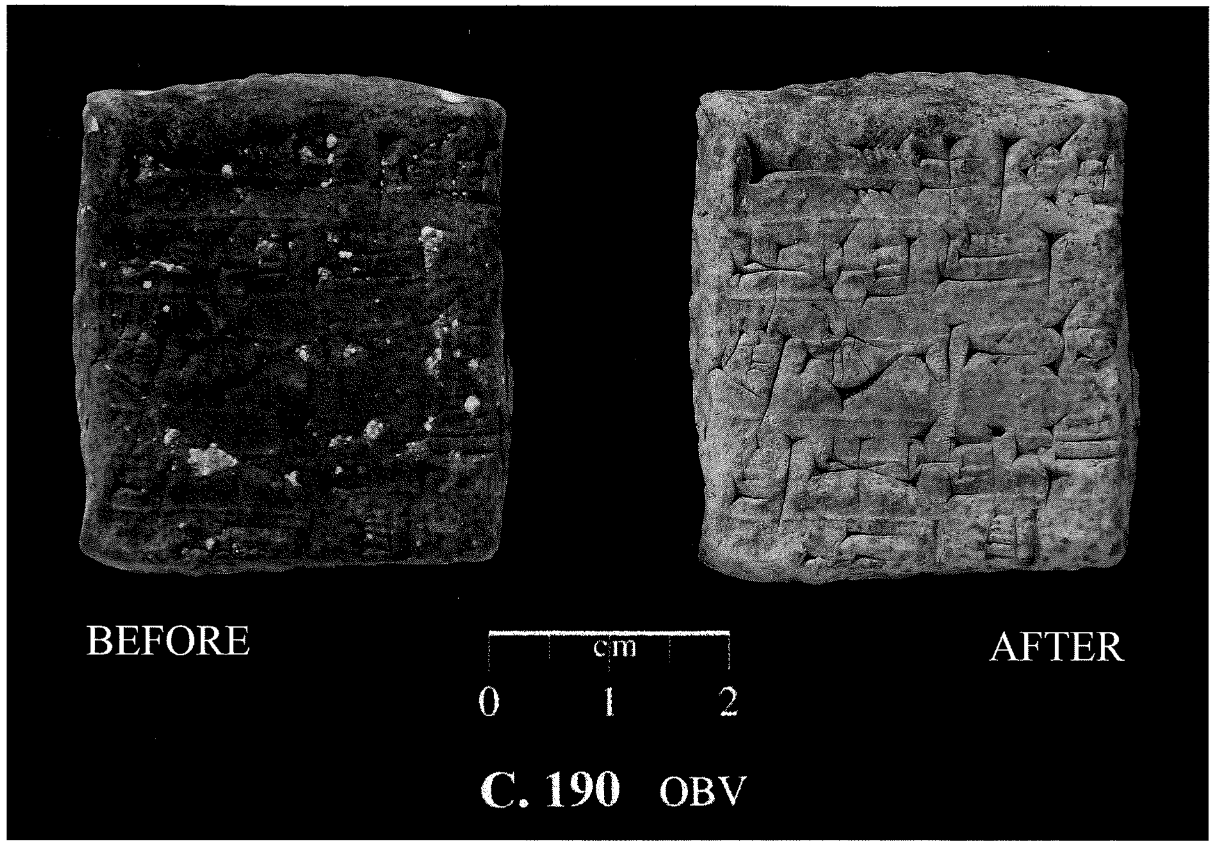


Figure 4: Two treatment images of the obverse of tablet C. 190. The left was taken before treatment and the right was taken after baking, desalination, and cleaning.

whether a baking program was an acceptable conservation procedure and, if so, to establish a new baking and desalination procedure that could be applied to the museum's tablet collection. This research included a review of past tablet conservation practices, the ethics of baking, high-temperature clay chemistry, the original scribal methods of clay-tablet formation, and the chemistry of the likely source clays and soil conditions during burial. This was followed by baking tests using unsigned tablet fragments from the museum's collections. While the research was not part of this project, it formed the basis for the methods used.

Baking has several other important though secondary benefits. It allows the easy removal of disfiguring and unethical restorations without causing damage to the underlying tablet surface. Firing to an appropriate temperature hardens the clay while leaving the surface soils soft and poorly adherent. Tests showed that most if not all clays baked to 500°C were dehydroxylated enough to withstand immersion in water without damage. But clay tablets baked a further 100°C to 600°C were also significantly hardened. In most cases they were hardened enough to allow mechanical cleaning with brushes of variable stiffness that could quickly and safely remove obscuring soils and accretions.

But baking can cause damage if done improperly. The rate of rise (the rate at which the oven temperature is increased during baking) must be reduced to the lowest possible rate to avoid stresses on the clay-tablet surfaces. Dehydroxylation causes clays to shrink. During baking, the surface clays are the first to dehydroxylate as the temperature is increased. The interior clays, which thus contain more water content, remain slightly swollen since they are dehydroxylated less completely. This difference causes stresses to develop between the wrapper clay, the thin

Figure 5: Cuneiform tablets wrapped in their stainless steel wire cloth bags associated with their treatment data records. Each bag sits on a short platform made of rigid stainless steel wire cloth ready to be baked in the oven.

clay layer that holds all of the information of the tablet, and the core clay, the flattened ball of clay that forms the bulk of the tablet. By slowing the rate of rise, one diminishes this dehydroxylation differential and relieves some of the stress on the wrapper clay.

Even with a slow rate of rise in oven temperature, dehydroxylation, which increases rapidly with rising temperature, will at higher temperatures take place too rapidly to be controlled. Long soaks, periods measured in hours where the oven temperature is held constant, are needed to allow the interior clays to "catch up" to the surface clays. During these holds, high temperature dehydroxylation will take place at a dramatically slower rate. For instance, during a 375°C soak, bound water, that would be rapidly lost at 425°C, is slowly released. So long soaks, especially at higher temperatures, are critical to leveling out the rate of dehydroxylation by bleeding off high temperature water loss and assuring that interior and exterior clays are equally dehydroxylated.

Typically clay tablets contain a wide variety of nonclay minerals. In fact, it is not uncommon for the clay to comprise only 30 percent of the tablet. The high-temperature chemistry of the nonclays is important to the baking protocol. Calcium carbonate, a common mineral introduced into tablets either from the clay source or the tablet burial environment, is perhaps the most important nonclay constituent. At temperatures above 600°C, calcium carbonate begins to decompose, a process called calcination. The mineral releases gaseous carbon dioxide and alters to calcium hydroxide, an unstable compound that is much more soluble in the high temperature water vapor being released during dehydroxylation. The calcium hydroxide migrates readily with these vapors to be deposited at the tablet surfaces and within any interior voids or laminations. Most important for long-term stability is that it can accumulate just below the tablet surface, along the interface of the wrapper and core. Over time, the unstable calcium hydroxide reabsorbs carbon dioxide from the air to reform the stable calcium carbonate. In the process, it swells and pushes outwardly on the surrounding clays, which can cause the slow loss of cuneiform characters.

While carefully monitored desalination will reduce the presence of calcium hydroxide on the tablet surface, a baking protocol that avoids the temperature range of calcination altogether is preferred. Recarbonation of the calcium hydroxide can occur in the desalination bath water, leading to the disfiguring precipitation of a hard-to-remove layer of calcium carbonate on the tablet surfaces. To avoid calcination, the peak oven temperature should be at or below 600°C since tests have shown that significant calcination can occur at 625°C. If tablets contain large amounts of carbonate surface accretions or internal nodules, soaking times at peak temperature should be limited to six hours. Tablets showing limited carbonates may be soaked for up to twenty-four hours at peak temperature to achieve maximum clay hardening.

Besides calcium carbonate, other minerals are present in clay tablets and can create a complex and highly reactive chemistry. Iron oxides, iron sulphides, and organic carbon are important in that they will often incompletely oxidize during baking at 600°C, giving an irregular surface coloration that reduces the legibility of the cuneiform characters. To avoid this, an oxidizing atmosphere must be maintained by using an oven that can maintain fresh,

fan-driven airflow throughout the protocol. To oxidize their undersides, the tablets must be lifted off the oven shelves using small, stainless steel wire cloth platforms to allow fresh airflow on all sides of the tablets. A selected bibliography representing the above areas of research is appended to this report.

To summarize, the hallmarks of the baking procedure are as follows:

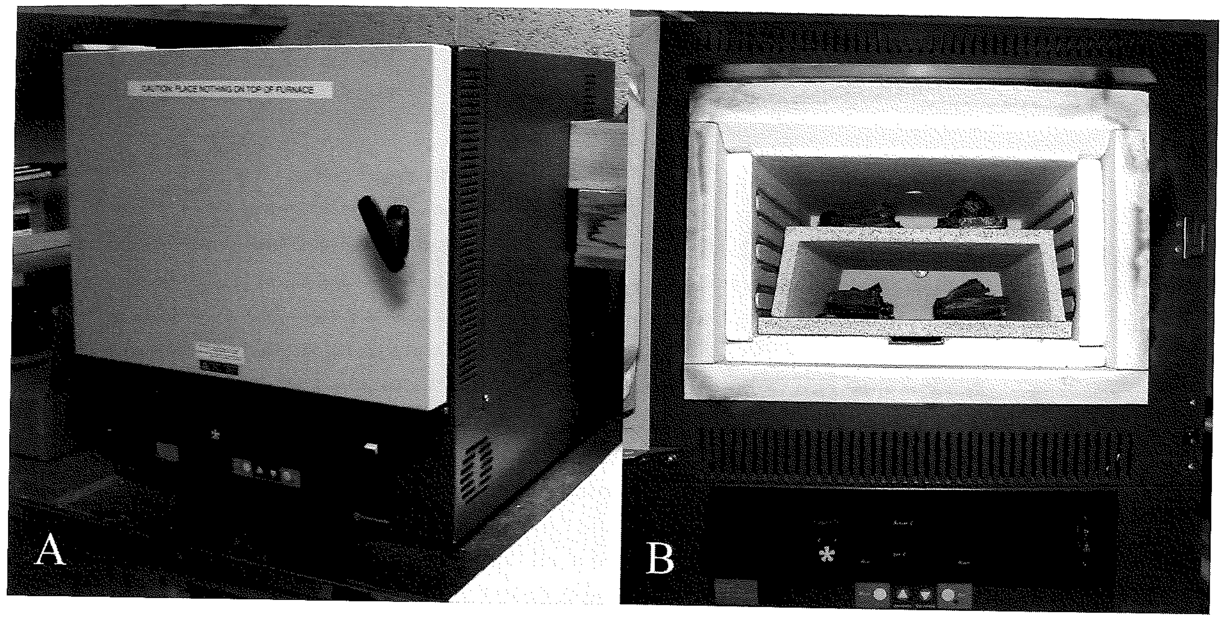
1. The lowest peak temperature possible is used during the bake to avoid collateral physico-chemical damage (e.g., the calcination of carbonates). In practice, this means a peak temperature of 595° to 600°C. After baking at this temperature all tablets can withstand immersion in water baths used for desalination.
2. The rate of tablet water loss due to dehydroxylation is kept as low and as constant as possible over the complete temperature range of the bake. This reduces the likelihood that soluble substances will be brought near the tablet surface during the bake. For this collection, the standard "ramp" rate (the rate at which the oven temperature is increased) was from +0.1°C/minute to +0.2°C/minute. Five holds or "soaks" at selected temperature levels were used to control the rate of dehydroxylation and to allow the reactive gasses generated by the baking process to dissipate before becoming concentrated within the tablet. By holding the temperature at 375°C for seven hours, for instance, reactions including dehydroxylation that occur rapidly at 400–500°C occur much more slowly and can be controlled.
3. A ventilated, oxidizing atmosphere is maintained at all times within the oven. This allows a consistently oxidized clay color to develop for improved legibility and permits reactive gasses to leave the oven space.
4. A completed baking cycle, including cooldown, takes no more than 168 hours or seven days. This allows the oven to be filled on the same day of every week, an important scheduling requirement for long-term projects.
5. Each tablet is placed in a bag made of 150 x 150 mesh stainless steel woven cloth labeled with a stainless steel disk embossed with an ID number. This assures that all fragments are kept within the stainless steel envelope and that the tracking information is maintained through the baking process (figure 5).

The twelve-step baking protocol as entered into the programmable oven computer:

1.	Ramp Rate I:	+0.1°C/min. to 60°C
2.	Soak I:	six hours at 60°C
3.	Ramp Rate II:	+0.1°C/min. to 140°C
4.	Soak II:	six hours at 140°C
5.	Ramp Rate III:	+0.2°C/min. to 375°C
6.	Soak III:	seven hours at 375°C
7.	Ramp Rate IV:	+0.1°C/min. to 525°C
8.	Soak IV:	twelve hours at 525°C
9.	Ramp Rate V:	+0.1°C/min. to 595°C
10.	Soak V:	six to twenty-four hours at 595°C
11.	Ramp Rate VI:	-0.3°C/min.
12.	End:	at room temperature

On February 12, 2009, an initial group of eight tablets was baked using the above protocol. This first group was inspected particularly closely for any damage that could have been caused by the baking process. For instance, the lengths of preexisting minute crack lines were compared before and after baking. Any tendencies for the outer wrapper clay of the tablet to separate from the tablet's core clay were noted and reexamined after baking. The surfaces were also closely examined for any "scumming" or build-up of surface salts due to the movement of moisture from the interior to the surface of the tablets. As with the Semitic Museum's Core Collection, it was found that no further physical damage was caused by the baking protocol, that the cuneiform characters were more legible, and that the formerly tenacious soil matrix could be more easily removed from the baked tablet surfaces.

One change was made after examining this first group of baked tablets. It was noted that the underside of some of the tablets (the side in contact with the oven shelf) was not oxidized as evenly or as completely as the exposed



Figures 6A and 6B: (A) Computer-controlled oven used for tablet baking. (B) With the door open on the right to show two shelves holding the tablets in their stainless steel wire cloth bags on the rigid stainless steel wire cloth platforms.

side. To prevent this, platforms composed of rigid stainless steel wire cloth were made to lift all subsequent tablets off the shelf surface about three-sixteenths of an inch to allow airflow underneath and more thorough oxidation (figures 6A and 6B).

In addition to the modern damage caused by the 9/11 terrorist attack, there was a great deal of previous haphazard repair work uncovered by the baking. All adhesives are burned off so that, when the tablets were removed from the oven, any mended tablets separated in place as loose fragments within their stainless steel bake-bags (figure 7).

This collection had many hidden mends intentionally obscured with mud, soil, or a mixture of resin with soil, to make them appear whole but dirty. Often unrelated ancient tablet fragments had been carved to fill the losses in tablets creating pastiches. On some tablets modern clay had been molded, pressed into the voids of ancient tablets, impressed with rude cuneiform-like markings and then partially obscured with soil. The full extent of these unethical practices only became apparent when the tablets were removed from the baking oven and cleaned. All fragments were saved but as they separated in the oven the smallest fragments of original tablets became difficult to distinguish from the pastiche fragments and from the obscuring soil. The sorting of the many tiny fragments lengthened the mending process considerably requiring a contract extension and a greater involvement by the consulting conservators.

The baked tablets were removed from the oven and immediately weighed to document their maximum weight-loss during baking. Because baked clay will regain some moisture in ambient conditions, they were weighed a third time months later to record their average moisture content. The prebake weight, immediate postbake weight, and posttreatment bake weight were recorded in the treatment database. The baked and weighed tablets were given a preliminary mechanical cleaning by dry brushing with varying sizes of hog bristle brushes. When necessary, sharpened bamboo skewers were also used to excavate the recesses of the cuneiform characters. The tablets were then placed in custom-made, open-weave panels for desalination. Each panel was designed to hold two tablets, one on each side. The panel and tablet pouches were made of polyester window screening through which the desalination water flows freely. The panels were fitted with a hanging rod so that the tablets in their pouches could be

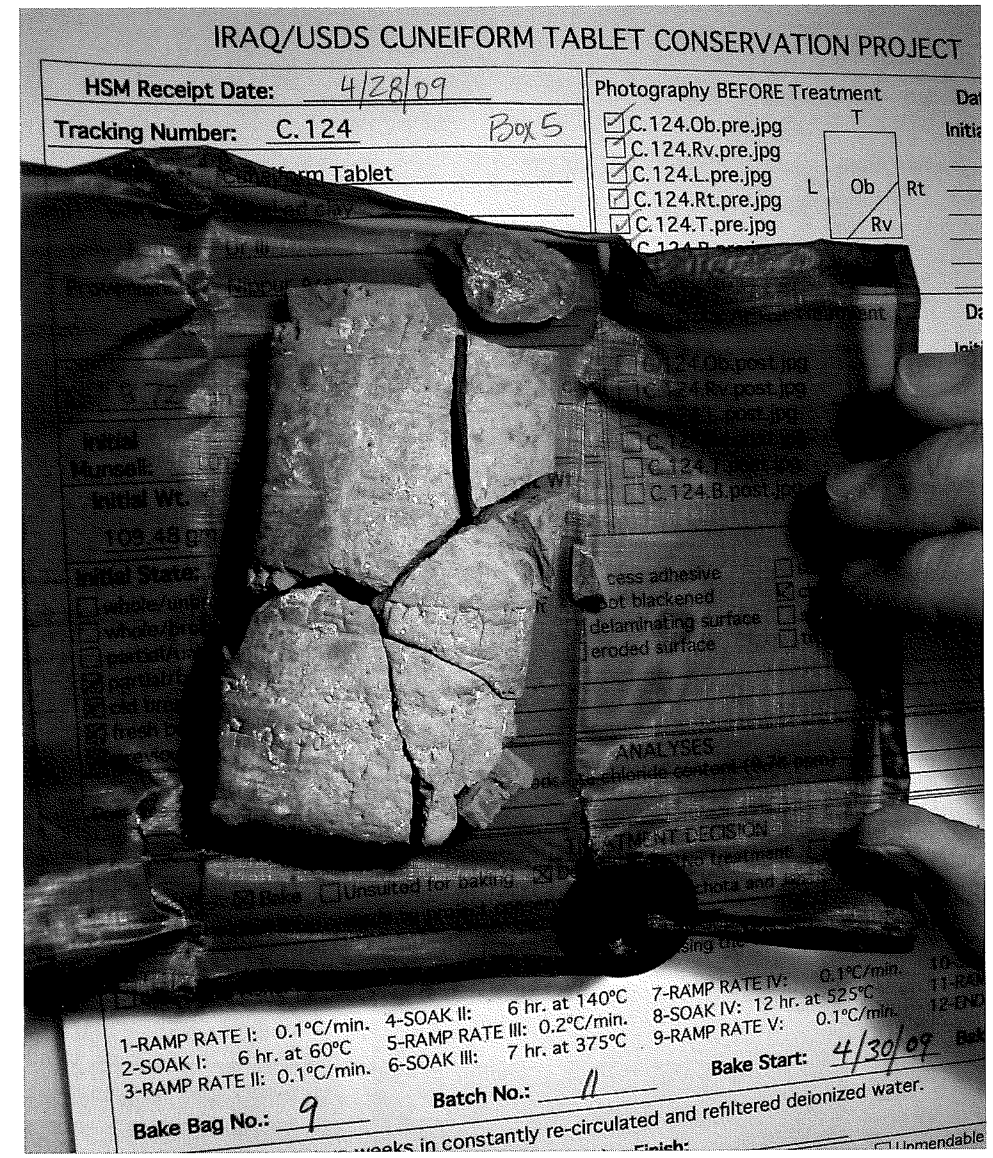


Figure 7: Cuneiform Tablet C.124 as it appeared immediately after baking. While no new damage is caused by baking, all previously mended fragments fall apart within the stainless steel wire cloth bag.

suspended above the bottom surface of the desalination tank. Each pouch was labeled with that tablet's tracking number (figure 8).

Each of two polyethylene tanks, measuring twelve inches wide by fifteen inches high by twenty inches long were filled with approximately twelve gallons of demineralized water. When fully loaded there were ten to twelve tablets in each tank so this provided a ratio of approximately one gallon of desalination water for each tablet. The tanks were connected to allow the desalination water to flow from one tank to the next and then back through a demineralizer. This closed loop of constantly demineralized water was monitored for conductivity to make certain that the water was always extremely low in soluble salts. The filtration pump speed was increased as needed to maintain near distilled quality water (i.e., twenty microsiemens) at all times regardless of the amount of salt migrating out of the tablets. In addition to the filtration pump, each tank was fitted with an internal circulation pump that kept the water within each tank constantly churning. This increases the rate of desalination by avoiding pockets of locally high salinity; it also reduces the likelihood that solubilized carbonates could redeposit on the

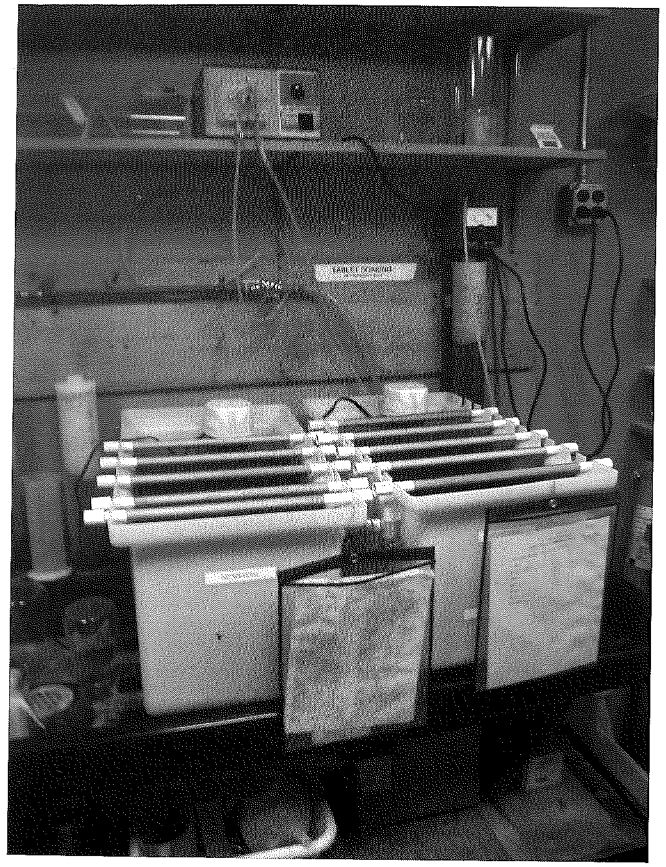


Figure 8: Two desalination tanks with internal circulation pumps, demineralizer, peristaltic filtration pump and screened-pouch panels with tablets.

tablet surfaces. Insoluble carbonate crusts have been known to deposit on the surfaces of freshly baked tablets when soaked in still water. As each weekly batch of baked tablets was removed from the oven, it would spend one week soaking in the first tank, followed by another week soaking in the second tank, for a total of two weeks of desalination. The steady one-week rotations through the oven and the two soaking tanks helped to maintain orderly and consistent processing during the critical phases of baking and desalination.

After two weeks of drying in their desalination panels the tablets were removed and all surfaces were recleaned in preparation for mending (figure 9).

They were mended using commercial Acryloid B-72 adhesive dissolved in acetone for large fragments and 20 percent Mowital polyvinyl butyral dissolved in ethyl alcohol for small fragments. The low viscosity of the latter adhesive allowed easier handling and tighter mends on the smallest fragments. Because of the large number of actual and false fragments the mending of the tablets was more difficult than expected. Students did all the basic mending and cleaning but for most of the project the conservators joined them weekly and took over the conservation work for all tablets with advanced or difficult needs (figure 10).

Because "fresh eyes" are needed to locate very small fragments, the mending was conducted by several workers each of whom may have spent several sessions with the tablet. Many tablets had spalled and eroded edges meaning that they had lost surface

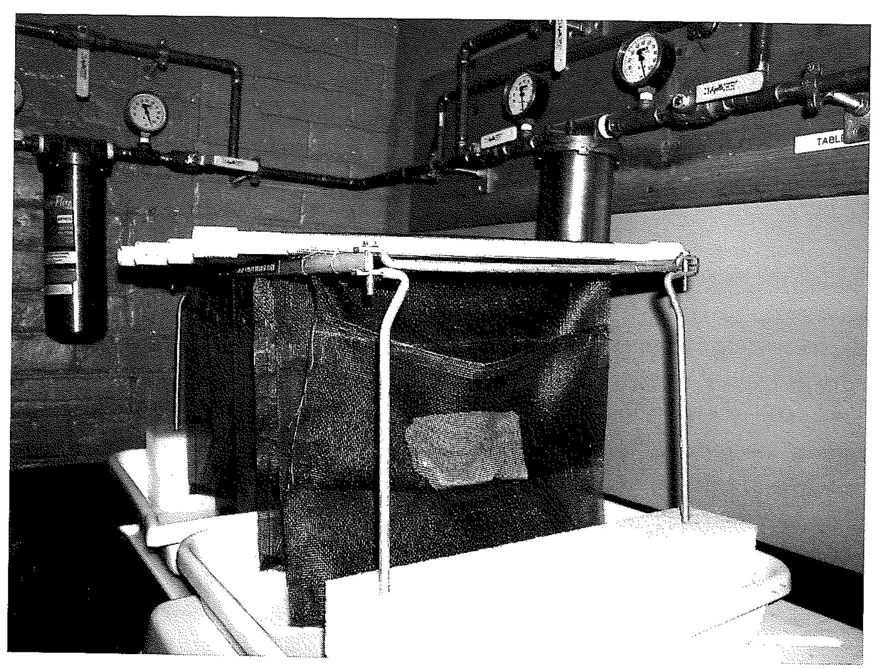


Figure 9: The desalinization pouches are removed from the water tanks with their tablets and allowed to dry for two weeks.

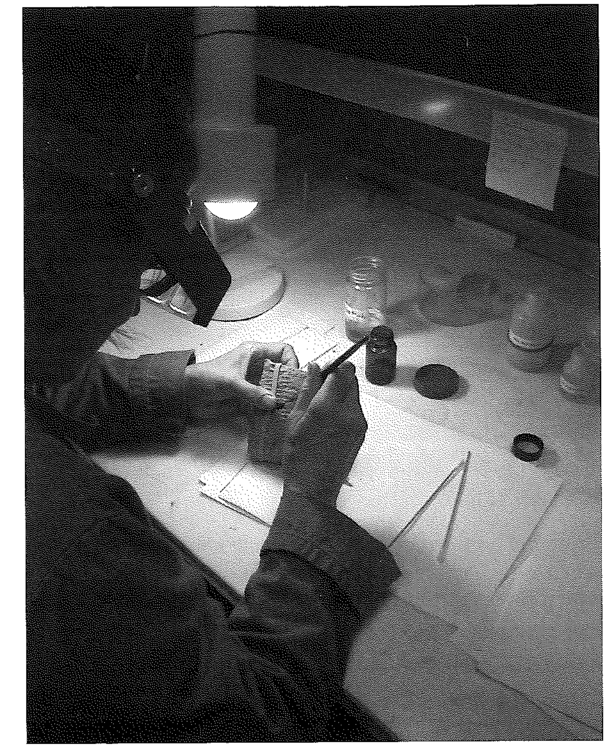


Figure 10: Conservator does final fine mending on a tablet.

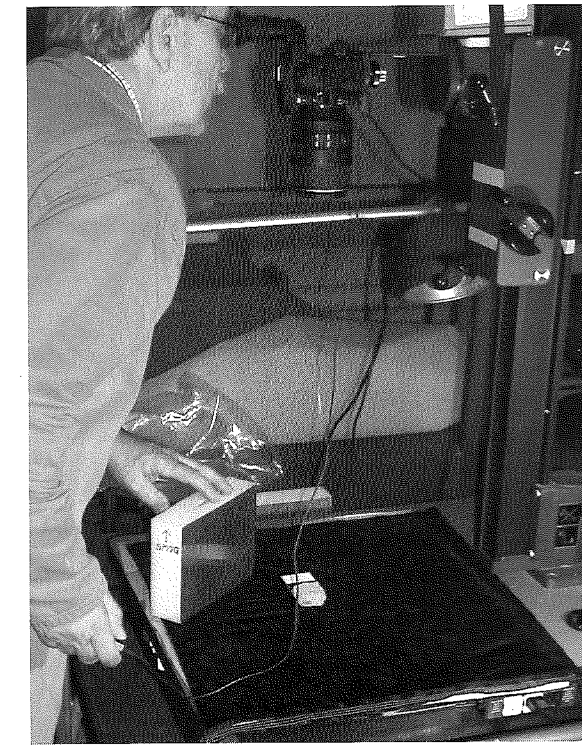


Figure 11: Conservator photographs tablet after treatment.

along their mating edges due to salt damage. These fragments did not conform to one another accurately and could not be positively seated in their correct positions. They were saved separately in bags labeled with the appropriate tracking number and stored along with the tablet in its box. Indeed, all unmended fragments were saved whether they had actually come from that tablet or had been improperly affixed to it as a pastiche.

Once student mending was complete the tablets were given a final inspection by the project conservators, who often performed additional fine cleaning and final small fragment mending. About 15 percent of the tablets were thought by the conservators to have surfaces that were soft enough to be easily abraded. They were consolidated by brush coating with Acrysol WS24 acrylic dispersion diluted in deionized water to 10 percent concentration and allowed to dry. After all mending and consolidation was complete, Dr. Studevent-Hickman returned to the collection to read the conserved tablets thoroughly and remarked that the treatment had greatly improved their legibility.

Besides the 302 catalogued cuneiform tablets and 6 cuneiform balls, the collection contained the other objects noted above. The ceramics were desalinated and cleaned in the same manner as the tablets. No treatment was required for the seals or the amulets. The glass vial was mended with Mowital polyvinyl butyral in ethyl alcohol. The post-treatment photography was completed for all artifacts (figure 11).

All data from each artifact worksheet were entered into the digital Filemaker database and saved in the searchable Filemaker format and as Adobe Acrobat files that could be opened by anyone without the Filemaker software. The 3900 "before" and "after" treatment images were burned onto three DVDs that also held the Filemaker treatment database and inventories. One set was sent to the Embassy of Iraq in Washington, DC and another set was sent to the Cultural Heritage Center of the US State Department.

The artifacts were custom-cavity packed for study, storage, and transport in fifteen Ethafoam 220 foam-filled, archival, metal-edge boxes measuring twenty inches long by twenty inches wide by three and one-half inches high. The foam cavities were lined with high-density polyethylene film to provide a nonabrasive surface (figure 12).

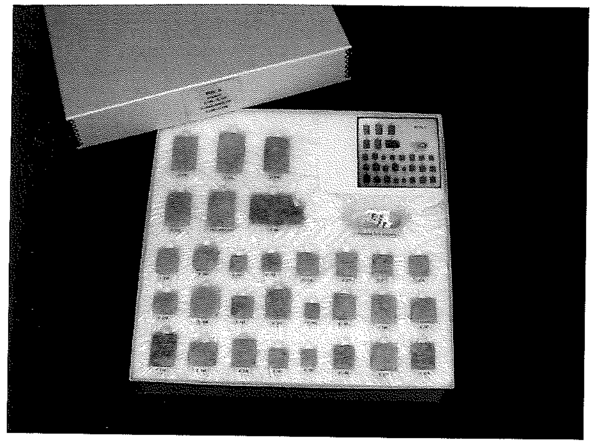


Figure 12: Cuneiform tablets encapsulated in Ethafoam for study, storage, and shipment.

Figure 13: The conserved collection is returned to the Iraqi Embassy. (Photo courtesy of Joseph Greene)

Three corrugated plastic boxes were custom built for hand-carry shipping with five metal-edge boxes loaded in each. On July 13, 2010 the conserved collection was hand-carried by the conservators to the Embassy of the Republic of Iraq in Washington, DC. Staff of the contracting parties were present for the return of the collection including Mr. Wael Al-Robaaie, Mr. Mohammed Al-Fityan and Ms. Baidaa Abdulkareem from the embassy, Dr. Joseph Greene and Dr. James Armstrong from the Semitic Museum and Ms. Vivianna Cowl and Dr. Amy Gansell from the State Department, Cultural Heritage Center (figure 13).

Acknowledgements

The authors wish to thank all who helped to make this project a success, from the Semitic Museum the students Rebekah Junkermeier, Deena Ragavan, Bradley Spencer, Christine Thomas, Audrey Pitts, Josh Walton, Adam Anderson, Christopher Gilbert and Jess Museck, the Director, Dr. Lawrence Stager, the present and former Assistant Curators, Dr. Adam Ada, and Dr. James Armstrong, the Assistant Director, Dr. Joseph Greene, and the Assyriologists, Dr. Piotr Steinkeller and Dr. Benjamin Studevent-Hickman; from the Embassy of the Republic of Iraq the Ambassador Samir Sumaida'ie, the Second Secretary, Mr. Wael Al-Robaaie, the Second Secretary, Mr. Mohammed Al-Fityan, and the Attaché, Ms. Baidaa Abdulkareem; from Homeland Security, Senior Special Agent James McAndrew; and from the State Department, Cultural Heritage Center, Dr. John Russell, Dr. Amy Gansell, and Ms. Vivianna Cowl.

Selected Bibliography for Appendix A

Al-Naqshbandi, Ali. "The Iraq Museum Laboratory." *Studies in Conservation* 18 (1973): 36–42.

Al-Rawi, A., M. Jackson, and F. Hole. "Mineralogy of Some Arid and Semi-arid Land Soils of Iraq." *Soil Science* 107 (1969): 480–86.

Bateman, C. A. *The Treatment of Cuneiform Tablets in the British Museum, Colt Archaeological Institute.* Rome: ICCROM Unpublished Report, 1962. ICCROM Shelf Location A1 11/2.

Bateman, C. A., V. E. Crawford, G. F. Dales, and L. J. Majakewski;. *Preservation and Reproduction of Clay Tablets and the Conservation of Wall Paintings.* London: Quaritch, 1966.

Bauluz, B., M. J. Mayayo, A. Yuste, C. Fernandez-Nieto, and J. M. Gonzalez Lopez. "TEM Study of Mineral Transformations in Fired Carbonated Clays: Relevance to Brick Making." *Clay Minerals* 39 (2004): 333–44.

Buringh, P. "Living Conditions in the Lower Mesopotamian Plain in Ancient Times." *Sumer* 13 (1957): 30–46.

———. *Soils and Soil Conditions in Iraq.* Baghdad: Ministry of Agriculture, 1960.

Burtch, H. P. "Photographing Cuneiform Tablets." *Technical Studies in the Field of Fine Arts* 6 (1937–1938): 24–25.

Dales, G. F. *Plane-surface Reproductions of Cuneiform Documents.* Rome: ICCROM Unpublished Report, 1962. ICCROM Shelf Location A1 11/3.

Delougaz, Pinhas. Pages 39–57 in *The Treatment of Clay Tablets in the Field.* SAOC 7. Chicago: University of Chicago Press, 1933.

Dunham, A. C. "Developments in Industrial Mineralogy: I. The Mineralogy of Brick-making." *Proceedings of the Yorkshire Geological Society* 49 (1992): 95–104.

———. "Developments in Industrial Mineralogy: II. Archaeological Mineralogy." *Proceedings of the Yorkshire Geological Society* 49 (1992): 105–15.

Dunham, A. C., A. S. McKnight, and I. Warren. "Mineral Assemblages Formed in Oxford Clay Fired under Different Time-temperature Conditions with Reference to Brick Manufacture." *Proceedings of the Yorkshire Geological Society* 53 (2001): 221–30.

Ford, William Frederick. *The Effect of Heat on Ceramics.* London: Maclaren, 1967.

Franken, H. J. "Some Remarks on the Technology of Clay Tablets." *Lettre d'Information Archéologie Orientale* 3 (1981): 53–54.

Grimshaw, Rex W., and Alfred Broadhead Searle. *The Chemistry and Physics of Clays and Allied Ceramic Materials.* New York: Wiley-Interscience, 1971.

Guinan, Ann, Gary Oller, and Dorothy Ormsby. "Nippur Rebaked: The Conservation of Cuneiform Tablets." *Expedition* 18 (1976): 42–47.

Heller-Kallai, Lisa, and Irena Miloslavski. "Reactions between Clay Volatiles and Calcite Reinvestigated." *Clays and Clay Minerals* 40 (1992): 522–30.

Joshi, R. C., Gopal Achari, D. Horsfield, and T. S. Nagaraj. "Effect of Heat Treatment on Strength of Clays." *Journal of Geotechnical Engineering* 120 (1994): 1080–88.

Mackenzie, R. C., and A. A. Rahman. "Interaction of Kaolinite with Calcite on Heating: I. Instrumental and Procedural Factors for One Kaolinite in Air and Nitrogen." *Thermochimica Acta* 121 (1987): 51–69.

Mackenzie, R. C., A. A. Rahman, and H. M. Moir. "Interaction of Kaolinite with Calcite on Heating. II. Mixtures with One Kaolinite with Carbon Dioxide." *Thermochimica Acta* 124 (1988): 119–27.

Malek, Z., V. Balek, D. Garfinkel-Shweky, and S. Yariv. "The Study of the Dehydration and Dehydroxylation of Smectites by Emanation Thermal Analysis." *Journal of Thermal Analysis* 48 (1997): 83–92.

Matson, F. R. "The Brickmakers of Babylon." Pages 61–75 in *Ceramics and Civilization I: Ancient Technology to Modern Science.* Edited by William D. Kingery and Esther Lense. Columbus, OH: American Ceramic Society, 1984.

Organ, Robert M. "The Conservation of Cuneiform Tablets." *BMQ* 23 (1961): 52–58.

Packard, E. "The Cleaning of a Babylonian Tablet." *Technical Studies in the Field of Fine Arts* 8 (1939–1940): 90–97.

Parkinson, A. Eric. "The Preservation of Cuneiform Tablets by Heating in a High Temperature." *Museum News* 27 (1950): 6–8.

Parsons, A. J., S. D. J. Inglethorpe, D. J. Morgan, and A. C. Dunham. "Evolved Gas Analysis (EGA) of Brick Clays." *Journal of Thermal Analysis* 48 (1997): 49–62.

Rathgen, Friedrich. *The Preservation of Antiquities.* Cambridge: Cambridge University Press, 1905.

Reade, J. E. "The Manufacture, Evaluation and Conservation of Clay Tablets Inscribed in Cuneiform: Traditional Problems and Solutions." *Iraq* 79 (2017): 163–202.

Redfern, S. A. T. "The Kinetics of Dehydroxylation of Kaolinite." *Clay Minerals* 22 (1987): 447–56.

Riccardi, M., B. Messiga, and P. Duminuco. "An Approach to the Dynamics of Clay Firing." *Applied Clay Science* 15 (1999): 393–409.

Rice, Prudence M. *Pottery Analysis: A Sourcebook.* Chicago: University of Chicago, 1987.

Roth, Kendra. E., C. Mei-An Tsu. "Conservation of Unfired Earth Artifacts on Archaeological Sites." *Field Notes: Practical Guides for Archaeological Conservation and Site Preservation* 14 (2002): 1–6.

Thickett, David, and Sophie Brookes. *Investigation of White Bloom Formed on Cuneiform Tablets during Conservation.* Report 1998/10 Conservation Research Group. London: British Museum. 1998.

Thickett, David, and Marianne Odlyha. "The Contribution of Thermoanalytical Techniques to the Conservation Treatment of Cuneiform Tablets in the British Museum." *Thermochimica Acta* 365 (2000): 167–75.

———. "Playing with Fire: Characterization of Clay Types Used to Fabricate Clay Tablets and Their Thermal Behavior during Firing-based Conservation Treatments." Pages 809–13 in *12th Triennial Meeting: Lyon, 29 August–3 September 1999; Preprints.* Edited by Janet Bridgland. London: James & James, 1999.

Thickett, David, Marianne Odlyha, and Denise Ling. "An Improved Firing Treatment for Cuneiform Tablets." *Studies in Conservation* 47 (2002): 1–11.

Tsu, C. Mei-An. "Developing a Firing Program for Cuneiform Tablets in the Field." *Kaman-Kalehöyük* 13 (2004): 193–966.
Unruh, Julie. "A Revised Endpoint for Ceramics Desalination at the Archaeological Site of Gordion." *Studies in Conservation* 46 (2001): 81–92.
Velde, Bruce, and Isabelle Druc. *Archaeological Ceramic Materials: Origin and Utilization*. Berlin: Springer, 1999.

Corresponding Author:

Dennis Piechota
Conservator
Fiske Center for Archaeological Research
Department of Anthropology
University of Massachusetts at Boston
Boston, MA 02125
dennis.piechota@umb.edu

Appendix B
Final Response for Freedom of Information Act Request concerning the Tablets
(Case Number 2012FOIA10452)