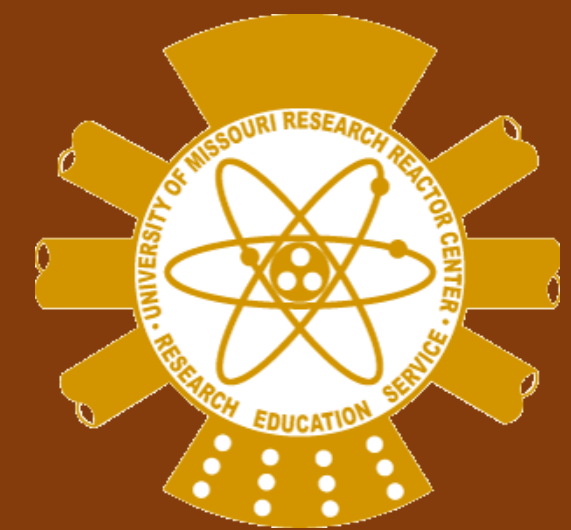




**SMU**  
Interdisciplinary Institute  
DEDMAN COLLEGE OF HUMANITIES & SCIENCES

# Evaluating the Authenticity of Curated Objects: Archaeometric Analysis of a “Brick from Ur”

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## Introduction & Background

Museums and other repositories often contain donated artifacts that lack adequate documentation of their provenience and life histories. Southern Methodist University’s Bridwell Library possesses a brick believed to be from the Great Ziggurat at Ur. It is one of many Near Eastern artifacts in the A.V. Lane Collection but is not mentioned in the acquisition documents. It may have been added as an afterthought to the well documented clay tablets and inscribed bricks. Dr. Alfred Valentine Lane donated his collection in 1917, and it was displayed from 1926-1946. More artifacts were added in 1941 and 1952. To assess the authenticity of poorly documented objects I employ archaeometric methods to determine its provenance and construction techniques. Results indicate it is not from Ur, but may result from rampant fraud that plagued the antiquities market in the early-twentieth century.



The Ziggurat of Ur reconstructed by Saddam Hussein  
([http://en.wikipedia.org/wiki/Image:Ancient\\_ziggurat\\_at\\_Ali\\_Air\\_Base\\_Iraq\\_2005.jpg](http://en.wikipedia.org/wiki/Image:Ancient_ziggurat_at_Ali_Air_Base_Iraq_2005.jpg))



The original exhibit on the A.V. Lane Collection  
(<https://sites.smu.edu/bridwell/specialcollections/avlane/avlanehome.htm>)

### The City of Ur

Ur was a Sumerian city-state and major urban center that was continuously occupied from 3,400 BCE – 500 BCE (Bahrani 2017).

### The Great Ziggurat of Ur

A ziggurat is a large stepped pyramid, and Ur’s served as a temple for the lunar god, Nanna, (Bahrani 2017) as part of a larger complex with administrative, economic, and ritual functions. Construction began during Ur-Nammu’s reign in the Third Dynasty and was completed during Shulgi’s reign in 2,100 BCE (Van de Mieroop 2016). British archaeologists excavated the ziggurat in the 1920s and 1930s (Wooley and Moorey 1982), and Saddam Hussein reconstructed parts of it in the 1980s.

### Where in the Ziggurat was Bridwell’s Brick? A Number of Hypotheses:

- ✗ Inner core built with mud brick layered with reed matting and mortar (Bahrani 2017)
- ✓ Eight-foot thick outer face made of baked brick set in bitumen mortar (Bahrani 2017)
- ✓ House of the god in heart of temple, made of “burnt brick” (Luckenbill 1927)
- ✓ Epic of Gilgamesh describes Uruk in the Early Dynastic Period from 2,900 BCE – 2,350 BCE and its baked brick walls (Foster 2001; Van de Mieroop 2016)

Therefore, if the brick from Bridwell Library is indeed from the Great Ziggurat at Ur, then it is likely from one of the outer facades, the heart of the temple, or a wall surrounding the temple complex because it has been fired.



Bridwell Library’s Brick from the A.V. Lane Collection, courtesy of  
Bridwell Library Special Collections and Rebecca Howdeshell, Digital  
Projects Librarian



Brick stamped with the name of Ur-Nammu  
([https://commons.wikimedia.org/wiki/File:A\\_brick\\_stamped\\_with\\_the\\_name\\_of\\_Ur-Nammu\\_of\\_Ur.jpg](https://commons.wikimedia.org/wiki/File:A_brick_stamped_with_the_name_of_Ur-Nammu_of_Ur.jpg))

## Methods

### Assessing Organic Content & Original Firing Temperature of the Brick:

Stepwise clay oxidation analysis paired with magnetic susceptibility and loss on ignition were used to examine whether the brick followed the trends of ancient Near Eastern brick-making with regards to firing behavior. Base measurements of magnetic susceptibility and mass were taken before the re-firing began. The color of the sample was also recorded according to the Munsell Soil Color System. The sample was fired in a muffle furnace at 100°C intervals from room temperature to 1000°C and held for 3 hours. In-between each interval, magnetic susceptibility, mass, and the Munsell color were recorded. Mass specific magnetic susceptibility was calculated, then graphed as a function of temperature. The derivative of this function was squared, and the point at which the magnetic susceptibility deviated from zero (the first positive or negative spike) indicated the maximum firing temperature (Goodwin and Hollenback 2016).

**The Brick’s Provenance:** The Archaeometric Laboratory at the University of Missouri Research Reactor preformed neutron activation analysis on the sample to measure thirty-three elements. Results were interpreted using GSRUN 8.0’s statistical analysis capabilities. Euclidean distances as well as elemental comparisons were made with the Missouri Research Reactor’s (MURR) and the Lawrence Berkeley National Laboratory’s (LBL) databases. These included ceramic and clay samples from archaeological sites in Iraq, Syria, Israel-Palestine, Jordan, and Lebanon to compare whether the elemental makeup of the brick resembles other clay artifacts from the region (Boulanger 2013).

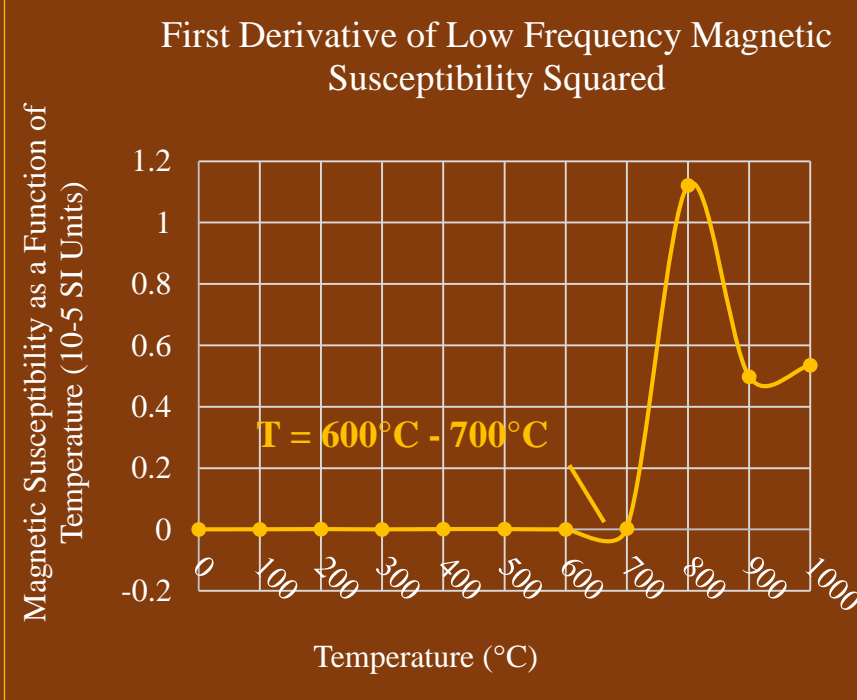


R. Arvid Nelsen, Bridwell Library Special Collections Rare Books and Manuscripts Librarian, sampled a piece that was already loose. See circle in images above. (Source: Bridwell Library Special Collections and Rebecca Howdeshell, Digital Projects Librarian)

## Results & Analysis

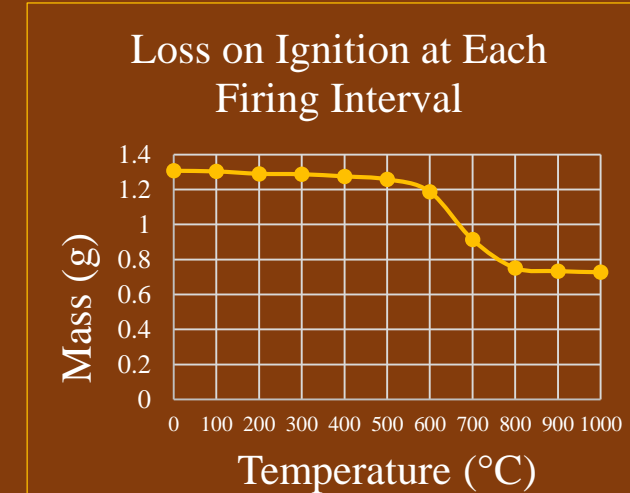
### Stepwise Clay Oxidation Analysis and Magnetic Susceptibility

Estimation of Firing Temperature Based on Color Change	
Temperature (°C)	Munsell Color
Baseline	light brown/pink
100	light brown/pink
200	light brown
300	light brown
400	light brown/reddish yellow
500	light brown
600	light brown/pink
<b>700</b>	<b>pink</b>
800	pink
900	pale yellow
1000	pale yellow



Stepwise clay oxidation analysis showed a distinct change after 700°C, and magnetic susceptibility data showed a dramatic shift between the intervals of 600°C and 700°C. This puts the most likely maximum temperature around 650°C.

### Loss on Ignition



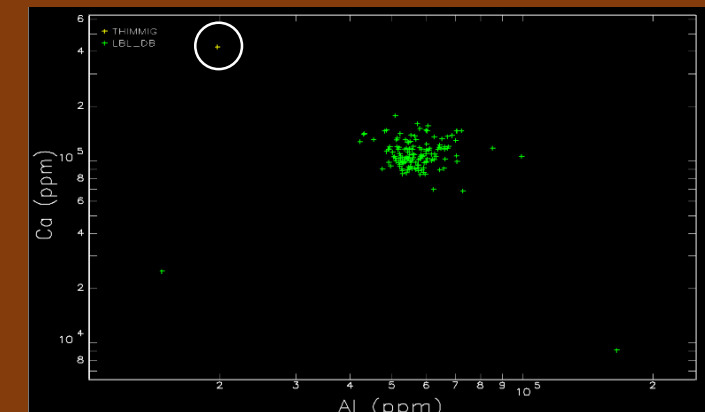
Front of sample after fired to 700°C

Loss on Ignition	
Start Mass	1.3074 g
End Mass	0.728 g
Mass LOI	0.5794 g
% of Mass LOI	44.317%

The greatest mass change took place after 600°C, which supports the hypothesis that the brick was purposely fired at a low temperature to maintain the organic temper’s tensile properties. In all, it lost 44.3% of its total mass.

### Neutron Activation Analysis

Euclidean				
ID	Distance	Country	Site Name	Artifact Type
NUZ0013	0.0774	Iraq	Nuzu	Tablet
NUZ0014	0.0790	Iraq	Nuzu	Tablet
NUZ0004	0.0793	Iraq	Nuzu	Tablet
NUZ0017	0.0794	Iraq	Nuzu	Unknown
SAM0120	0.0794	Iraq	Samarra	Pottery



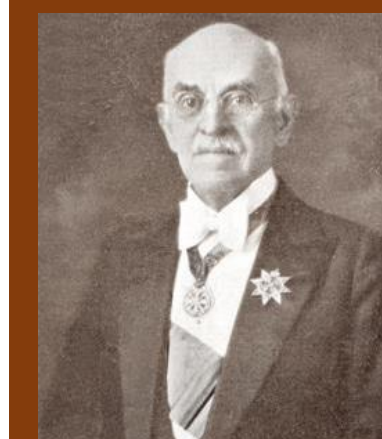
The upper left table shows Euclidean distances between the brick and Iraqi LBL samples. Measures less than 0.02 are considered related. Unfortunately, the brick is not statistically similar to any clay samples from modern Iraq.

The scatterplot above and to the right shows major elements Al (x-axis) and Ca (y-axis). The circled point is the brick, and it is an extreme outlier. If the brick was from the same area, it would be in the cluster.

Database	Euclidean Distance	Country	Site	Artifact Type	Time Period
MURR West Asia	0.019	Palestine	Kh. El-Maqatir	Fired clay lining kiln	Byzantine
MURR Full	0.0205	Palestine	Kh el Maqatir	Fired clay lining kiln	Byzantine
LBL Full	0.0252	Israel	Tell Magadim	Philistine Pottery	Early Bronze Age
LBL Middle East	0.0268	Israel	Tell Megadim	Philistine Pottery	Early Bronze Age
LBL Full	0.0285	Israel	Tell Magadim	Philistine Pottery	Early Bronze Age

The table above shows Euclidean distances between the brick and over 75,000 samples from different databases. It is most similar to artifacts from the Levant dating to the Byzantine Era and not the first millennia BCE

## Discussion & Conclusion



Dr. A.V. Lane  
(<https://sites.smu.edu/bridwell/specialcollections/avlane/avlane.htm>)

Bridwell Library’s brick’s firing profile is consistent with others from ancient Mesopotamian ziggurats. The brick was fired to a temperature less than 650°C, perhaps to maintain the tensile strength organic temper provided.

Neutron activation analysis indicates that the elemental makeup of the brick is statistically different from clays found in ancient Iraq. It is instead, most similar to clays from Palestine. This does not mean the object is from the Levant, only that the major and trace amounts of elements in the brick resemble that of clays from this area.

SMU’s brick is not a strong match to any of the 75,000 clays in the databases. **It is likely not from Ur or from any building in the ancient Near East dating to 3,400 BCE - 500 BCE.**

Dating the brick is the only archaeometric method that would confirm whether the object was produced during the time of Ur’s occupation.