

UNL Campus Archaeology: Building Digital Resources

EFFIE ATHANASSOPOULOS, SARA ANDERSON, CATHERINE ELLIOTT, COLE JUCKETTE, AMY NEUMANN, ERIK SCHULZ, University of Nebraska-Lincoln, NE, USA
KAMI AHRENS, University of Nebraska-Lincoln, NE, and Foxfire Museum and Heritage Center, GA, USA
AARON PATTEE, University of Heidelberg, Germany

UNL Campus Archaeology is a team project led by faculty, students, and alumni focused upon the analysis and reassessment of historic collections from excavations carried out on the University of Nebraska-Lincoln (UNL) campus, USA. The project is using 3D modeling techniques, non-rigid registrations of historical maps in GIS (Geographical Information Systems), and interactive online platforms to explore Lincoln's early urban development. The goal is to develop an interactive online portal for public outreach and education incorporating state of the art methods of recording cultural heritage. The case study for this presentation is a former domestic cistern that was excavated in 1997 during the expansion of the UNL Student Union. This diverse archaeological collection is in excellent condition, with a variety of artifacts, including glass bottles, faunal remains, and ceramics. The artifacts are representative of late nineteenth and early twentieth-century Lincoln homes before the area was redeveloped by the university. This archaeological collection offers insight into the social structure, domestic life, and trade patterns at the turn of the century. The project utilizes 3D models and photographs of artifacts, historical maps, and archival databases, disseminated through an intuitive and interactive online portal emphasizing public accessibility in *Scalar*, and the *Omeka*-based online repository for hosting the database information. *Scalar* is designed for a broad audience, consists of a non-linear narrative, and incorporates a wide variety of media and data formats, including 3D models. *Omeka* provides the *Dublin Core* standardized solution for digital databases, allowing visitors to explore the data more in-depth. The project serves as an online portal for public outreach and education, making archaeology an integral part of Lincoln's early history and the broader Great Plains region.

Key words:

Historical archaeology, digital heritage, digital databases, 3D modeling, historical maps, Nebraska, USA.

CHNT Reference:

Athanassopoulos et al. 2019. UNL Campus Archaeology: Building Digital Resources.

INTRODUCTION

The "UNL Campus Archaeology" project is a collaborative project led by faculty, graduate, and undergraduate students, focused on the analysis and reassessment of historic collections from excavations carried out on the University of Nebraska-Lincoln (UNL) campus in previous decades. Here we present a case study, an archaeological collection recovered from a cistern, filled with historic domestic debris. The cistern, located below the Student Union on the UNL City campus, was excavated in 1997 during the building's expansion. Unfortunately, the top half of the feature had been destroyed during the initial construction of the building. The UNL Anthropology field school had only two days to excavate and rescue the archaeological material before construction resumed.

The archaeological collection that was assembled is in excellent condition, including a great variety of artifacts, such as glass bottles, metal, faunal remains, personal items, and ceramics. The artifacts are representative of late nineteenth and early twentieth-century homes, before the area became part of the university, and offer insight into the social and domestic life of early Lincoln. The recovered material was initially processed by field school students

□

Authors addresses: Effie Athanassopoulos, Department of Anthropology, University of Nebraska-Lincoln, 816 Oldfather Hall, Lincoln, NE 68588-0368, USA, email: efa@unl.edu; Sara Anderson email: slanderson1031@gmail.com; Catherine Elliott email: celliott2432@gmail.com; Cole Juckette email: colejuckette@live.com; Amy Neumann email: amy.s.neumann@gmail.com; Erik Schulz email: erkschlz@yahoo.com; Kami Ahrens email: kahrens420@hotmail.com; Aaron Pattee email: aapattee30@gmail.com

in 1997. In the past two years, UNL faculty and students have been working with this assemblage to produce a complete catalogue, document diagnostic artifacts, undertake analysis, and create a digital resource to share with the UNL community, archaeologists, and the public. Thus, classroom based learning and collaboration has led to the development of a research project with several components:

1. Analysis of historic archaeological collections derived from excavations on the UNL Campus.
2. Undertaking historical research to obtain information about the households associated with the archaeological collections.
3. Application of 3D modeling procedures, laser-scanning and photogrammetry, to selected artifacts, which are representative of the material under study.
4. Application of GIS mapping techniques to integrate spatial data with historic maps and trace the development of early Lincoln.
5. Development of a digital exhibit that presents artifacts within their historical context.
6. Exploration of appropriate methods/digital tools in order to present historical and archaeological primary data in a digital format to a wide audience.

HISTORICAL BACKGROUND

Since the creation of the Nebraska Territory in 1854, the city of Omaha, built close to the Missouri River, on the eastern border of Nebraska, had been the territorial capital. When Nebraska was in the process of becoming a state, the legislature voted to move the capital south of the Platte River after much of the southern territory considered annexation to Kansas [Hays and Cox 1889:29]. The town of Lancaster was proposed as the state capital primarily for its central location, further west and south of the Platte River, where most of the territory's population lived [Zimmer 2005]. The town of Lancaster was an unconventional choice with a population of approximately 30 inhabitants drawn to this location by the salt flats and marshes. The development of a salt processing industry based upon the salt basins was expected to lead to rapid economic growth [Farrar and Gersib 1991].

Legislators who opposed moving the capital to Lancaster proposed that it should be renamed after the assassinated President with the expectation that constituents south of the Platte River, who had supported the Confederate cause during the Civil War, would find the name objectionable. Surprisingly, there was agreement on the name change and the selection was settled [Walton 2015]. Thus the frontier town of Lancaster was chosen as the new capital in 1867 upon Nebraska's admittance to the union, and its name changed to Lincoln, in honor of the late President Abraham Lincoln. To create a strong foundation for the capital, the legislature also located the state university, penitentiary, and insane asylum in Lincoln. The University of Nebraska was constructed and open for enrollment in 1869, drawing more people to move to and establish businesses in Lincoln. By 1870 the population had dramatically risen to 2,500, to 13,000 by 1880, and rose to 55,000 by 1890 [Zimmer 2005].

By the 1880s, Lincoln was a rapidly expanding hub of industry west of the Missouri River. This growth was due "not to extraordinary causes, but to the steady though rapid development of the country of which Lincoln has become the most convenient point to supply" [Hayes and Cox 1889:11]. Lincoln thrived upon manufacturing and purchasing goods within the city, growing the economy and expanding the middle class. Like many cities around the world, the economic depression of the 1890s resulted in the population declining to 37,000 by 1900, though the city has continued a pattern of steady growth ever since [Zimmer 2005]. According to the latest census information, Lincoln has a population of 280,369.

Due to its centrality, Lincoln became an important railway stop for both passenger and supply trains, bringing new citizens and imported goods to Lincoln— essential to the city's growth. Unique goods were manufactured en masse, imported, exported, and ultimately left behind as the city developed. How these average residents of historic Nebraska lived and thrived in this city, what objects they used in their day to day lives, and even what they chose to discard can all be found in the archaeological record. Excavations from various archaeological sites around the city provide a glimpse into artifacts utilized for the home and table within an urban middle class context in the early American Midwest.

THE ARCHAEOLOGICAL COLLECTION

The archaeological collection from the cistern is identified as site 25LC86 and consists of 443 numbered entries. It should be noted that in several cases the same number was assigned to multiple pieces that may belong to the same artifact, and in a few cases, one number was assigned to several bags of similar material, such as animal bones or metal fragments. Though the initial processing of the collection took place in 1997, a UNL Anthropology class, “Analysis of Archaeological Materials: Historic Material Culture,” taught by Effie Athanassopoulos, has undertaken the analysis and study of this collection over the last two years. Undergraduate and graduate students work collaboratively in groups to identify and reorganize the objects, create paper and electronic catalog records, take photographs and make 3D Laserscan and SfM (Structure from Motion) models of select artifacts, and begin the process of developing a digital database using the open source platform *Omeka*. One of the most important aspects of this project is to use existing collections as a learning tool. The collections offer the opportunity for students to learn about proper archaeological preservation and archiving in an interactive classroom setting leading to a multifaceted collaborative research project. Here, we report on ongoing work, placing particular emphasis on the building of a digital exhibit to share with the public. This project, born in the classroom, will bring wider attention to these archaeological resources which are an integral part of the history of nineteenth century Lincoln.

As mentioned previously, the material recovered from the cistern is a diverse and well-preserved collection dating from around 1870-1920. It consists of a large number of glass bottles, many of them medicinal; metal artifacts such as nails, padlocks, and eating utensils; faunal remains; personal items, such as pocket watches, fragments of pipes and combs; doll fragments, household goods, lamps, and a wide variety of ceramics. The ceramics include locally made utilitarian pottery, from a factory known as Lincoln Pottery Works [Schoen and Bleed 1993], and a wide range of table wares, including whitewares, transferwares, stoneware, and porcelain. We estimate that the minimum number of vessels in the collection (table wares and utilitarian shapes) exceeds 100.

Most of the ceramics were manufactured in the US and Europe including items with trademarks from thirteen international companies (Fig. 1). There are twenty eight vessels with identifiable trademarks, mostly undecorated whitewares. The majority of the trademarked pieces were produced in England and Ohio with a smaller percentage from manufactures in New Jersey and France. Several items are matching and must have been purchased in sets (four sets of whitewares, three sets of transfer-printed wares) (Fig. 2). The presence of multiple ceramic sets in this assemblage may indicate that several families/households discarded items in the cistern, once it became a refuse pit. Overall, on the basis of trademarks, the ceramics date to the period 1880-1907. This provides an estimated range for the period of occupation of the Lincoln neighborhood in which site 25LC86 is located. The ceramic assemblage, especially the high percentage of undecorated whiteware vessels, may also serve as an indicator of socioeconomic status. This Lincoln neighborhood, most likely, consisted of lower to middle class households. This inference is supported by ongoing research in the city directories which indicate that some of the houses in the vicinity of the cistern were rental properties which often had new occupants every year or two.

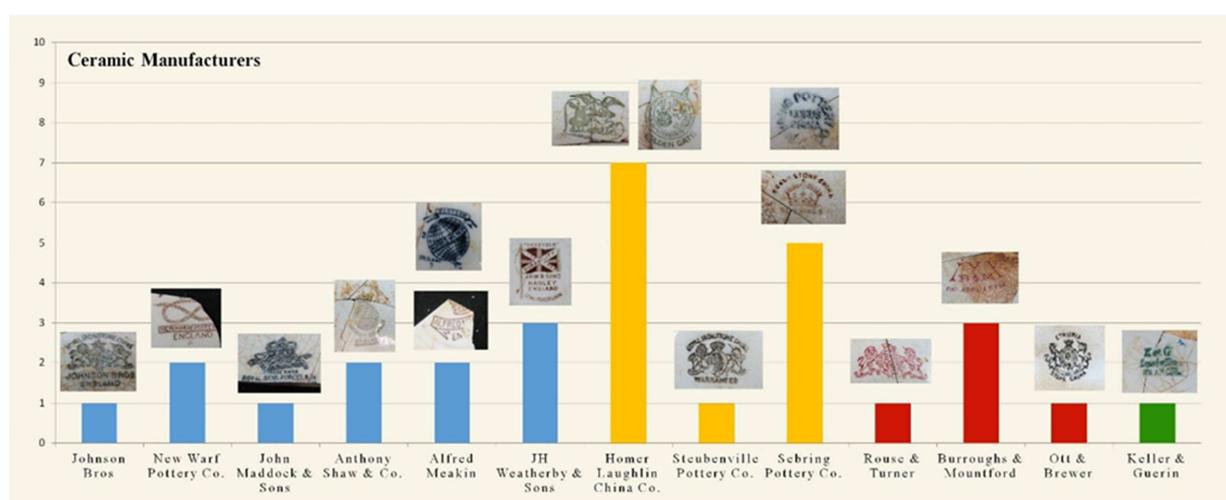


Fig. 1. Ceramic trademarks present in cistern assemblage.



Fig. 2. Floral transfer printed mustache cup (a-side view, b-top view); hand-painted cup from France (c); transfer-printed lid of a chamber pot (d); set of three saucers from Burroughs & Mountford, New Jersey (e).

Glass artifacts are the most numerous category (200+ items) in the assemblage and include a large number of complete bottles. Of these, the majority are medicinal (100+ items), followed by liquor, food, glassware, toiletry, and other categories. Many of the medicinal bottles have embossed letters identifying the brand and company location (Fig. 3). The most popular medicine in the collection was Lydia E. Pinkham's vegetable compound advertised as a women's tonic with six bottles of various sizes. A notable find was the Warner's Safe Kidney and Liver Cure which dates to 1884-1887 and helped to refine the exact period of use for the cistern as a refuse pit. While the majority of the bottles were made in the US, Saxlehner's bitterquelle, a natural spring mineral water, was imported from Budapest, Hungary. Several embossed bottles came from local pharmacies, Roy's, Kostka's, and Cooper's, whose location in downtown Lincoln has been established through archival research. A GIS layer showing the location of Lincoln pharmacies during the years 1875-1920 is under development.

Chemical analysis of residues extracted from selected medicinal bottles has begun in collaboration with faculty and students from the Chemistry Department at UNL. The analysis, combined with historical advertisements, and research on local pharmacies provide a rich source of information about the medicinal products in this assemblage. Overall, the material record, along with textual sources, shows that by the turn of the century, the residents of Lincoln had a wide variety of choices available to them including ceramics of differing qualities and styles and a wide array of medicinal products. The Lincoln market offered products that were made locally, but also in other regions of the US and Europe. Thus, the cistern assemblage provides a glimpse at daily life in an early Lincoln neighborhood, prior to the expansion of the university in this area.

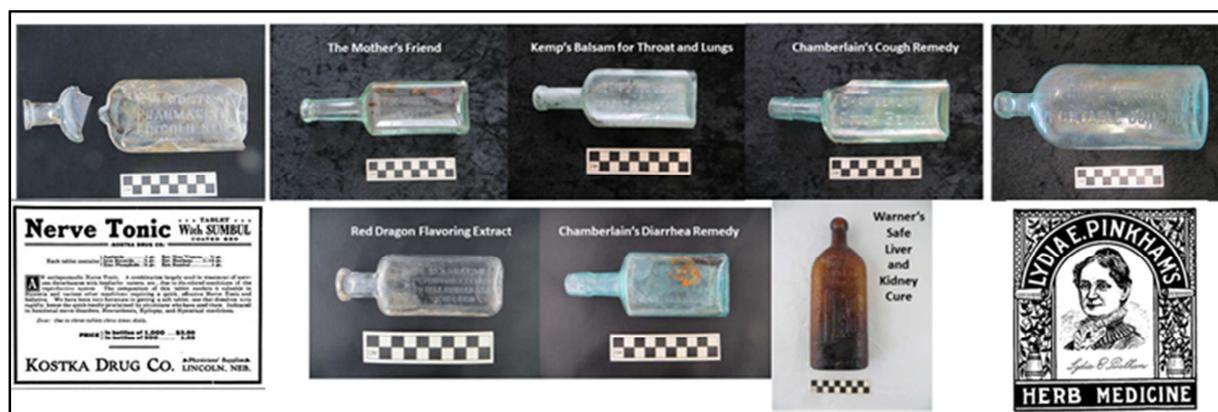


Fig. 3. Top row starting from left: B.O. Kostka Pharmacy, *The Mother's Friend*, *Kemp's Balsam for Throat and Lungs*, *Chamberlain's Cough Remedy*, *Lydia E. Pinkham's Vegetable Compound*; Bottom row: *Red Dragon Flavoring Extract*, *Chamberlain's Diarrhea Remedy*, *Warner's Safe Kidney and Liver Cure*.

SOLUTIONS

Why *Omeka*?

The first important task for our project was to develop a digital database that will serve multiple purposes. After consulting with the Center for Digital Research in the Humanities (CDRH) at UNL, we chose the open source platform *Omeka* for the online central database. *Omeka* is a web publishing platform designed for sharing digital collections and creating online exhibits. Factors important to the project which influenced our choice of *Omeka* were a user friendly interface and its capability to accommodate multiple users. It is easy to learn and allows for multiple users to be able to interact with the database [Marsh 2013].

Another important aspect of *Omeka* is that it is a relational database, storing the data into separate tables rather than a single storeroom [Clarke 2016]. This ongoing project will soon expand to include other historic collections, once the study of the cistern assemblage is complete. Combining all of the archaeological assemblages that we hope to explore in the near future, the growing database will contain several thousand artifacts, with many still to be examined and researched. We opted for using a relational database because of the large number of entries this project entails. Relational models of database management lend themselves to dense modes of archiving, making it the most conducive for this project. [Bissett 2015] *Omeka* also offers a variety of plugins for extra-database applications such as the Neatline plugin which combines maps and timelines into a GIS (Geographic Information Systems) platform [Foley and Murphy 2015].

Given the large volume of artifacts in each of the individual collections, standardization has become a key aspect of organization of the *Omeka* database (Fig. 4). Collectively, we created a list of vocabulary words that we can use to classify all of our artifacts. *Omeka* allows for tagging of objects and clear and consistent vocabulary terms are important for searching and examining these collections. These practices for standardization are also essential when it comes to creating metadata for archives. Based on a Dublin Core format, *Omeka* generates metadata fields that are standardized and simple to fill out. The 15 metadata elements offered by *Omeka* allow for flexibility as well as standardization. This archaeological collection requires a wide variety of author generated vocabulary, and the element classes used by Dublin Core allows us to provide details on specific aspects of each artifact, while still maintaining a universal standard [Greenberg et al. 2006].

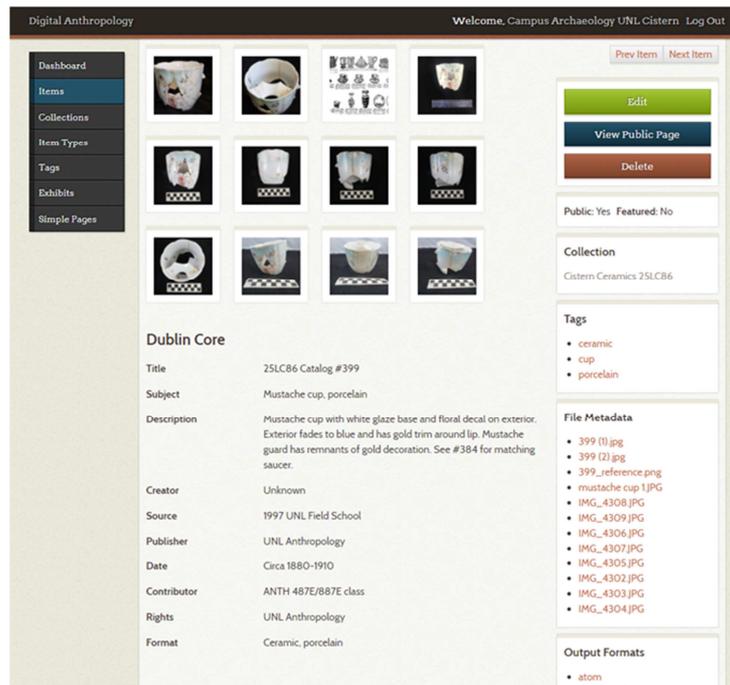


Fig. 4. Omeka database example: site 25LC86, porcelain cup, catalog #399.

Why *Scalar*?

Digital tools are lauded for democratizing accessibility to cultural heritage. However, online catalogs and comprehensive digitized collections remove the cultural material, such as an artifact, from its contextual framework and further separate it from its “essential materiality”—its connection to the original time and space of its first existence [Gardiner and Musto 2015:51]. We encountered this dilemma during the digitization process for the cistern assemblage and chose open source platforms that allow us to create an in-depth, curated exhibit that supplied the missing contextual information and guided the viewer through a detailed, yet engaging study of the past. This solution also allowed us to expand methods of representation and interpretation, and include media such as 3D models and geo-referenced historic maps.

While *Omeka* is a very good option for creating a digital archive, it was not the most conducive option for telling the story of the project and the significance of the collection to a non-academic audience. Extensive research on other open-source platforms led us to the selection of *Scalar*, created by the Alliance for Networking Visual Culture. *Scalar* was originally structured like a book, but with the option of arranging “pages” in a network format rather than a linear style (Fig. 5). This layout allows for user agency, enabling the viewer to select their own path of research rather than passively following a generic outline. Additionally, *Scalar* supports a diverse set of media, with the ability to link various pages to create multiple paths of dialogue and depth of analysis according to the person's interest, allowing us to incorporate as much material as we wanted [Ahrens 2017]. It is also ideal for collaborative projects, as multiple authors can be assigned to one “book” concurrently. The union of *Omeka* as the primary repository for artifact records, formatted for uploading artifact records and images, and *Scalar* as the mode of storytelling, is a more user-friendly approach for public outreach.



Fig. 5. Sample page of UNL Campus Archaeology Scalar website.

Maps

The integration of historic maps and images with modern maps provides a sense of place for archaeological sites and reveals further historical context. [Herzog 2017] In order to combine both paradigms of information ArcGIS was used to rescale and georeference historic maps to modern satellite maps and the GRS 1980 Transverse Mercator coordinate system. GRS 1980 was used because it is a global ellipsoid standard and it is the default system for GIS projects and training courses offered by the UNL Department of Anthropology. ArcGIS by ESRI was used because it is available at the University lab and the participants in this portion of the project have various amounts of training in its functions.

The method employed was georeferencing by adjusting transformation which is optimized for both global and local “least squares fitting” algorithms. The user applies control points to the target layer (the historic map) and the base layer of reference (ESRI default street map) after which the target layer is rectified to scale and fit the base layer (ESRI 2017). While this is a fairly simple process, it is time consuming, as more than 20 control points placed at street corners and lot lines were used for every historic map in order to improve accuracy. Despite this effort, some of the maps still display with a skew which is due to the modern streets and parcels being slightly altered in dimension over time and development in the city (Fig. 6).

The initial intended output was to provide evidence for which areas would have participated in dumping at the cistern site and where to begin researching the occupants of the houses on these plots. However, after beginning work with the maps, it was clear that the data collected and maps that were created could be used to identify other potential sites in the Lincoln area, as well as track the early development of the city. It is even possible that this data can be used to work alongside the city of Lincoln and local developers in order to investigate historic properties and identify new sites during renovations or following demolitions for new urban development. These observations showcase the practical nature of using historic maps in GIS, so that visualization can be enhanced for a comparative outcome that provides spatial context for physical places on and off of a map [Rumsey and Williams 2002].

Only three historic maps were selected from the Nebraska State Historical Society archive since they were the only maps of the Lincoln area that fit the time frame in question (1880-1900). These large format maps were based on surveys and information compiled in 1880, 1887, and 1893 for the city of Lincoln. The maps also establish the boundaries of the city itself at the appointed time and identify districts that were later acquired by the university, enabling us to chronologically track change in these neighborhoods.

The second source of historic maps were drawn by the Sanborn Fire Insurance Company and depict sections of the city in a detailed layout. The Sanborn maps are available through the Library of Congress and University Libraries.

Lincoln area maps are available for specific dates: 1884, 1886, 1891, 1903 and 1928. Five maps were selected from the collection dating to 1884, three from 1886, and nine from 1891. Each map provides symbology about the types of buildings present on each lot, in particular the purpose of the structure, any utility features, and the architectural materials used for the structure [Sanborn Map Company 1942]. The selected maps depict the area of interest, neighborhoods surrounding the university with a significant buffer to the south of the university grounds.



Fig. 6. Modern Lincoln street map with Sanborn maps overlay.

The cistern site (25LC86) sits on a parcel that had existed since 1887 but was not officially sub-listed as a part of parcel 25 until 1893. The parcel contains a block of buildings listed as “dwellings” by the Sanborn insurance company, and the cistern lies directly underneath the northeastern corner of lot 446 [Sanborn Map Company 1891]. This information assisted our team in identifying the address (446 N. 14th Street) and surrounding contexts of the cistern, along with other sites, and guided historical research on these and neighboring properties (Fig. 7). All data obtained from the historic maps was compiled in ArcGIS and built to show layers that expand by date in order to trace change over time. Because there are few maps available for the area of interest, change in this district and alterations after the initial development of the area is possible to document only during certain time intervals.



Fig. 7. Close up view of 14th and 'S' Streets showing the location of the cistern.

As mentioned previously, we are adding a GIS layer that shows the location of local pharmacies in the commercial district of Lincoln. Because of the large number of medicinal products consumed by the residents of 446 N. 14th Street, it is important to map the local pharmacies by year, their distance from each other, how long each pharmacy remained in operation, and observe changes during the period documented by the archaeological collection. In addition to Sanborn Insurance maps, other historical sources that we have utilized are Lincoln City Directories and historic photographs which aid in the reconstruction of the city both visually and spatially. Also, two bird's-eye-view maps of Lincoln from 1880 and 1889 were consulted (Fig. 8). This type of panoramic map was a popular cartographic form used to depict U.S. and Canadian cities and towns during the late nineteenth and early twentieth centuries. Known also as bird's-eye views, perspective maps, and aero views, panoramic maps are non-photographic representations of cities portrayed as if viewed from above at an oblique angle. Although not generally drawn to scale, they show street patterns, individual buildings, and major landscape features in perspective [Hébert and Dempsey 1984]. Overall, the different types of historic maps are extremely useful in identifying the building lots of relevance to this project and guide/facilitate the historical research in city directories and other archives.

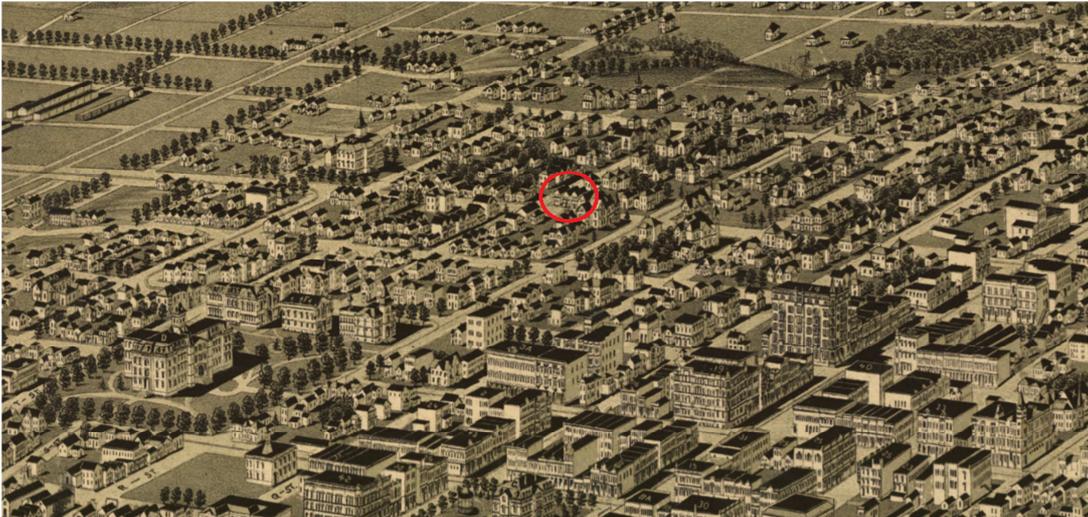


Fig. 8. Bird's Eye View, Lincoln, NE, 1889. The red circle shows the houses at the corner of 14th and 'S' Streets. Library of Congress.

3D modeling

This section discusses our efforts, successes, and challenges in applying 3D laserscanning and photogrammetric SfM procedures, to selected artifacts from the cistern collection. Due to the large size of the collection, it was clear that a rendering of each individual objects would not be practical. Instead, 3D models of select artifacts from representative categories (i.e. jugs, teapots, etc.) of the material were processed. Additionally, we focused upon artifacts that are made of materials that allow the application of 3D recording methods, such as unglazed ceramics, and metal objects. We also experimented with artifacts that have reflective surfaces, such as glazed ceramics and glass, with varying degrees of success, although these were largely unsuccessful [Sapirstein 2017]. Our experiments included unique items or objects with matte surfaces that modeled well in testing scenarios.

We employed two different methods in the 3D modeling process, laser scanning and SfM. Early experiments with a desktop laser scanner, the NextEngine 3D scanner, established the limitations of this method for scanning objects with transparent or reflective surfaces. The NextEngine uses parallel beam laser scanning, which involves the projection of laser stripes onto an object, then triangulation is used to calculate the distance of each point, generating a 3D point cloud [Lerma et al. 2010]. This method is faster compared to some others, as the four twin laser arrays allow multiple points to be scanned at once [Brown 2010; White 2015:41]. The scanner generates 3D point clouds and records RGB colored texture as well. It is equipped with twin 3.0 Megapixel CMOS image sensors for texture recording in color mode [Polo and Felicísimo 2012: 9047]. However, the textures are not high resolution, and far inferior to the texture qualities generated by image-based methods such as SfM. The NextEngine did produce highly accurate models (with a precision of 0.13–1.66 mm), from multiple views, in a fraction of the time required for photogrammetric processing, albeit without reliable textures [Polo & Felicísimo 2012]. The models required editing (trimming, aligning, fusing) and, depending on the complexity of the object, took between 1.5-2 hours to complete a final model (Fig. 9).

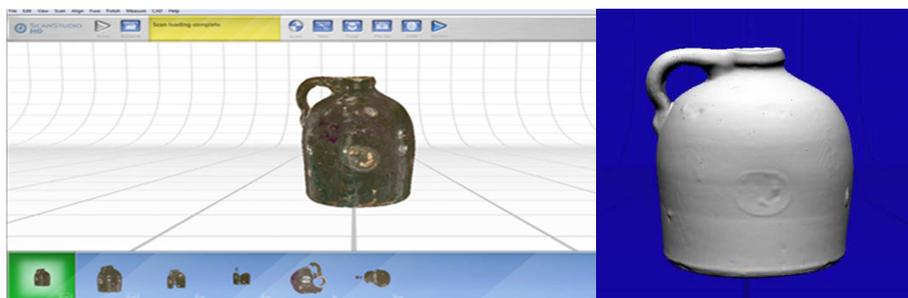


Fig. 9. 3D model with NextEngine laser scanner.

In order to improve texture, we turned to SfM Modeling using *Agisoft Photoscan Pro*. Preliminary tests made it clear that SfM offered the highest quality models and the most versatility for compatible objects [Sapirstein 2017]. Due to the nature of photogrammetry, objects with glossy or highly reflective surfaces were extremely difficult to capture. When glare is captured and then transmitted into modeling software it prevents large areas of the objects surface from being accurately displayed, which results in the software failing to reconstruct object geometry with precision. In order to reduce glare, special techniques were used to produce a low-light or ambient light setting for each object to be photographed. These settings led to successful modeling of several locally produced ceramics, primarily utilitarian vessels covered with a dark brown glaze. Using the same light setting, we were able to model some of the whitewares from the collection as well. In order to achieve success in capturing 3D data on glossy objects, the lowest possible light setting was used to minimize glare. The cameras had to be calibrated for low light photography by adjusting the ISO sensitivity slightly higher, widening the aperture, and lengthening the exposure time. It was also helpful to adjust for a higher exposure compensation in these settings. After continued experimentation we found that keeping the target in a steady position and moving the camera around it was better at reducing overall glare and increasing the surface that could be captured. In order to do this more efficiently, we engineered and built a wooden stand where the object was positioned, while the camera was placed on a platform that moved around the stand at a fixed focal length. This set-up enabled us to take clear and high quality images (Fig. 10).

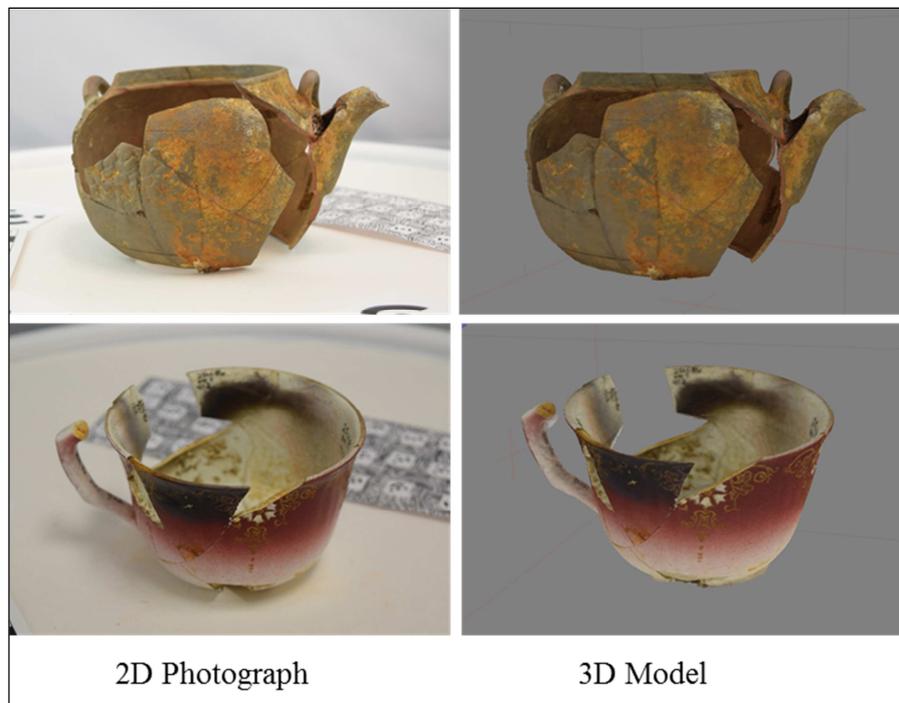


Fig. 10. Comparison of 2D photograph and 3D photogrammetric model.

The next step was for the images to be uploaded into the *Agisoft Photoscan Pro* software, and processed using a workflow that we designed. The photographs were placed within a project folder and alignment began, leading to the creation of a dense cloud, built of hundreds of thousands of individual points that lie along the visible surface of the object. When the dense cloud was completed, the points were connected into a mesh, which transformed the cloud of points into data that constitute a solid object. At this stage, an image based texture can be applied over the solid shape to give it photorealistic qualities (Fig. 11). In the final stage of processing the model was “decimated” in order to reduce the number of shapes or “faces” that make up the surface geometry, thus reducing the file size of the project, a necessary step in order to upload the model to 3D hosting sites. Our project has used the Sketchfab hosting site to display the 3D models. Despite multiple attempts using a myriad of different light settings, translucent glass could not be successfully captured/modeled. This was most likely due to the inability for motion capture to filter out

or recognize surfaces that have light passing through them or visible geometry behind the intended surface for capture. There was limited success with dark-colored glass objects.



Fig. 11. Four stages of photogrammetric model generation.

We have invested considerable effort in 3D modeling procedures, because 3D models offer significant advantages; they provide a superior record of artifacts, compared to 2D products, since they closely approximate the experience of the original [Olson and Placchetti 2015: 21]. In our view, 3D technology can aid interpretation, as well as publication of archaeological data. The application of 3D models allow for interpretative studies on a larger scale, bridging the gap between the researcher and the artifact when the two are not in close proximity. Not only do 3D models open the door for large scale research and collaboration, but their open availability allows for a regional understanding to develop between researchers [Scopigno et al. 2011]. They provide a way to access these materials and promote their existence digitally. Furthermore, the act of creating a 3D model is a step towards digital preservation; a 3D model can potentially serve as an enduring record of an artifact. In order for these models to contribute in the effort to preserve the past, we must methodologically create procedures to ensure their consistency and accuracy. While, digitized 3D models may not ever be able to completely replace the value of working with the actual artifact, having 3D proxies will ensure that their contextual and informational significance will endure, with continued effort to update and store these virtual models [Remondino 2011]. Finally, 3D technology is opening up new forms of interaction, with digital extensions of museum exhibitions through augmented reality, a technology that we plan to explore in the near future.

PUBLIC EDUCATION & FUTURE WORK

This project has provided and continues to provide the University of Nebraska-Lincoln students with hands-on learning, to engage with archaeological collections and digital applications. Archaeology does not have to take place in a distant locale with exotic and foreign people and materials. It is, in fact, just as necessary to research and understand our communities “back-yard” as it is to learn about remote cultures. Not only does this project serve this purpose and provide students with an opportunity to learn about early Lincoln, but it encourages collaborative student-based learning. It provides students with a way to learn not just from our instructor but also one another. Systematically inventorying artifacts, learning the protocols for housing artifact assemblages, researching and analyzing the various artifact categories, collaborating to upload and abide by the Dublin Core metadata standards, learning 3D modeling methods and creating models, are some of the efforts undertaken by undergraduate and graduate students alike. Thus, the UNL Campus Archaeology project is not only providing knowledge and public engagement but it is facilitating student initiative and collaboration through each and every stage.

As stewards of cultural heritage, we have a responsibility to the Lincoln community to share the archaeological collection from the UNL campus and the history that surrounds them. In order to fulfill this duty, our team has built a presence on social media (Facebook). Given that Facebook is one of the most popular platforms, it is a first step that we have taken in order to share our ongoing work. With continued growth, followers are able to not only interact with our group but with one another as they are kept up-to-date with current research. Also, we have future plans to create a physical exhibit to be displayed in a UNL-affiliated facility. Both the main university library, Love

Library, and the Center for Great Plains Studies have exhibition space that would be ideal for a small display of the cistern artifacts. This exhibit would be an extension of the digital exhibit and might include pieces that were not represented as digital models. A physical exhibit would provide the local community the opportunity to experience part of their history in person. Additionally, this element of the project will inform the general public about historic archaeology and important sites within the city of Lincoln, hopefully dispelling common misconceptions that archaeology is only focused on prehistoric sites. The exhibit would include background information on historic archaeology in Lincoln, the excavation of each site, and a historic sketch of Lincoln at the turn of the century. Interpretative labels would accompany the artifacts selected for display, touching on the topics covered in the digital exhibit. Though the amount of additional media that can be provided in a physical exhibit is more limited than its digital counterpart, visitors can be directed towards the latter, if they are interested to learn more about the collection.

Another tool that we are planning to explore is Augmented Reality, a technology with many novel applications in the cultural heritage sector that brings exhibits and artifacts to life in new ways. With the help of these technologies, visitors can see extra digital content on top of the view of the actual objects, using a mobile device. For example, Augment, an augmented reality application, allows 3D models to be presented in real time. Using customized tags, users can simply scan the label and pull up a version of the 3D model on their mobile device or tablet, while the background remains a real time image of their surroundings.

For both our digital and proposed physical exhibits, augmented reality can be used to supplement the experience by allowing distance learners and in-person visitors to engage and interact with artifacts. For visitors to the physical exhibit, augmented reality will be especially beneficial for merging the digital and physical in an enticing manner. Additionally, augmented reality will give viewers the chance to examine an artifact in detail, rather than viewing it through a glass case. Finally, the benefit of augmented reality versus a simple host for 3D models is that artifacts can be placed in contexts more familiar to the viewer. Rather than a simulated digital environment, users can experience and understand how the artifact related to its historic, real-world environment. Historic photographs of Lincoln in the late 1800s-early 1900s will be combined with augmented reality in order to create a virtual experience. A visitor will be able to scan a Quick Response (QR) code, and have an old photograph appear over the current area. This will provide the core for an application that will become available to residents or visitors to explore Lincoln's history in the form of a virtual tour. The application will incorporate the GIS layers and combine them with historic photos to highlight the development of historic Lincoln. This latter element, the historic context, is perhaps most important, as in exhibitions, the direct connection between the essence of culture—human society—and artifacts is lost. Applications like Augment begin to restore this connection and provide a more immersive experience that bridges reality and digital reconstruction.

We hope that these complementary approaches to artifact presentation and interpretation will provide a thorough historical account that will enrich the understanding of the history of Lincoln, Nebraska, will make archaeology an integral part of Lincoln's early history and contribute to preservation efforts of local heritage.

ACKNOWLEDGEMENTS

We are grateful to Professor Peter Bleed for his tireless efforts to document the history of early Lincoln through the preservation and study of its material remains. His persistence to excavate areas of historic Lincoln that underwent development is the reason that we have extensive collections to study and share with the community. We are also grateful to the Nebraska State Museum for protecting these resources and making our work possible. We would like to thank the UNL Department of Anthropology for the opportunity to develop a class that focuses upon classroom based research and learning.

REFERENCES

- Kami Ahrens. 2017. *Dressing the Part: Clothing and Gender Identity on the Frontier*. MA Thesis, Department of Anthropology, University of Nebraska-Lincoln.
- Thaddeus G. Bissett. 2015. The Development and Use of Digital Spatial and Relational Databases: Analysis of Depression Era Archaeological Collections from the Lower Tennessee Valley of Western Tennessee. *Collections: A Journal for Museum and Archives Professionals* 11 (4), 305-324.
- Jeffrey Brown. 2010. Innovation at home – Inside a 3-D desktop scanner. *Electronic Engineering Times*, 27

- September, 48–49. Available at http://www.eetimes.com/document.asp?doc_id=1281318.
- John R. Clarke. 2016. 3D Model, Linked Database, and Born-Digital E-Book: An Ideal Approach to Archaeological Research and Publication. In Sander Münster, Mieke Pfarr-Harfst, Piotr Kuroczyński, Marinos Ioannides, eds. *3D Research Challenges in Cultural Heritage II. Lecture Notes in Computer Science*, vol 10025. Springer, Cham.
- ESRI. 2017. <http://desktop.arcgis.com/en/arcmap/10.3/manage-data/raster-and-images/fundamentals-for-georeferencing-a-raster-dataset.htm>
- John Farrar and Richard Gersib. 1991. Nebraska Salt Marshes. *NEBRASKAland Magazine* 69:6.
- Ronan Foley and Rachel Murphy. 2015. Visualizing a Spatial Archive: GIS, Digital Humanities, and Relational Space. *Breac: A Digital Journal of Irish Studies*, 2015 (Oct.). ISSN 2372-2231 Available at <https://breac.nd.edu/articles/visualizing-a-spatial-archive-gis-digital-humanities-and-relational-space/>
- Eileen Gardiner and Ronald G. Musto. 2015. *The Digital Humanities: A Primer for Students and Scholars*. Cambridge: Cambridge University Press.
- Jane Greenberg, Maria Christina Pattuelli, Bijan Parsia, and W. Davenport Robertson. 2006. Author-generated Dublin Core metadata for web resources: a baseline study in an organization. *Journal of Digital Information*, 2(2). Available at <https://journals.tdl.org/jodi/index.php/jodi/article/view/42/45>
- Arthur Baldey Hayes, and Samuel D. Cox. 1889. *History of the City of Lincoln, Nebraska*. Lincoln, NE: State Journal Co.
- John R. Hébert, and Patrick E. Dempsey. 1984. *Panoramic Maps of Cities in the United States and Canada: a checklist of maps in the collections of the Library of Congress, Geography and Map Division*. Washington DC: Library of Congress, 2nd edition.
- Irmela Herzog. 2017. Reconstructing Pre-Industrial Long Distance Roads in a Hilly Region in Germany, Based on Historical and Archaeological Data. *Studies in Digital Heritage* 1 (2), 642-660. DOI: 10.14434/sdh.v1i2.23283
- Jose Luis Lerma, Santiago Navarro, Miriam Cabrelles, and Valentin Villaverde. 2010. Terrestrial laser scanning and close range photogrammetry for 3D archaeological documentation: the Upper Palaeolithic Cave of Parpalló as a case study. *Journal of Archaeological Science*, 37(3), 499-507. DOI: <https://doi.org/10.1016/j.jas.2009.10.011>
- Allison C. Marsh. 2013. Omeka in the classroom: The challenges of teaching material culture in a digital world. *Literary and Linguistic Computing*, 28(2), 279-282. DOI: <https://doi.org/10.1093/llic/fqs068>
- Brandon R. Olson and Ryan A. Placchetti. 2015. A Discussion of the Analytical Benefits of Image Based Modeling in Archaeology. In Brandon R. Olson and William R. Caraher, eds. *Visions of Substance: 3D Imaging in Mediterranean Archaeology*. The Digital Press @ The University of North Dakota, 17-26.
- María-Eugenia Polo and Ángel M. Felicísimo. 2012. Analysis of Uncertainty and Repeatability of a Low-Cost 3D Laser Scanner. *Sensors* 12, 9046–9054. DOI: <http://dx.doi.org/10.3390/s120709046>
- Fabio Remondino. 2011. Heritage Recording and 3D Modeling with Photogrammetry and 3D Scanning. *Remote Sensing* 3, no. 6, 1104–38. DOI: <https://doi.org/10.3390/rs3061104>
- David Rumsey and Meredith Williams. 2002. Historical maps in GIS. Available at <https://www.davidrumsey.com/gis/ch01.pdf>
- Sanborn Map Company. 1942. *Description and utilization of the Sanborn map*. New York.
- Philip Sapirstein. 2017. A high-precision photogrammetric recording system for small artifacts. *Journal of Cultural Heritage*, 2017. DOI: <https://doi.org/10.1016/j.culher.2017.10.011>.
- Christopher M. Schoen and Peter Bleed. 1993. The Archaeology of the Lincoln Pottery Works. *Central Plains Archaeology*, vol. 3 (1), 1-240.
- Roberto Scopigno, Marco Callieri, Paolo Cignoni, Massimiliano Corsini, Matteo Dellepiane, Federico Ponchio, and Guido Ranzuglia. 2011. *3D Models for Cultural Heritage: Beyond Plain Visualization*, vol. 44, 48-55. DOI: <https://doi.org/10.1109/MC.2011.196>.
- Don Walton. 2015. Sesquicentennial tale: When it was Lancaster vs. Omaha. *Lincoln Journal Star*, July 27.
- Suzanna White. 2015. Virtual Archaeology – The NextEngine Desktop Laser Scanner. *Archaeology International* 18, 41-44. DOI: <http://dx.doi.org/10.5334/ai.1804>
- Edward Zimmer. 2005. Lincoln--Lancaster County. Virtual Nebraska. Available at <http://www.casde.unl.edu/history/counties/lancaster/lincoln/>

Imprint:

Proceedings of the 22nd International Conference on Cultural Heritage and New Technologies 2017.

CHNT 22, 2017 (Vienna 2019). <http://www.chnt.at/proceedings-chnt-22/>

ISBN 978-3-200-06160-6

Editor/Publisher: Museen der Stadt Wien – Stadtarchäologie

Editorial Team: Wolfgang Börner, Susanne Uhlirz

The editor's office is not responsible for the linguistic correctness of the manuscripts.

Authors are responsible for the contents and copyrights of the illustrations/photographs.